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GIBBONS AS LANDSCAPE SPECIES: STRATEGIC PLANNING FOR PRIMATE CONSERVATION IN LAO PDR.

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SUMMARY

Bolikhamxay Province in Lao PDR (hereafter Laos) contains the largest block of high quality dry evergreen forest remaining in Indochina in the 1570 km^2 Nam Kading National Protected Area (NKNPA). The Integrated Ecosystem and Wildlife Management Project (IEWMP) used the Wildlife Conservation Society's 'Landscape Species Approach' to bring together government, communities and NGO stakeholders to select seven landscape species for the province, which included the northern white-cheeked gibbon (*Nomascus leucogenys*). Government staff worked with the IEWMP to create maps identifying areas of management priority for the gibbons, which took into account the most suitable habitat and the location and relative importance of human-caused threats. The resulting maps were used to build a conceptual model, which identified a population target for the species as well as management interventions for reducing direct and indirect threats to the species to reach the target.

A monitoring program using line transects was implemented in the NKNPA to measure gibbon population change over time to assess the effectiveness of management interventions and to adapt actions accordingly. This paper presents baseline results of the modeling, management interventions and line transect monitoring for gibbons in the Nam Kading National Protected Area.

INTRODUCTION

Planning for conservation requires the consideration of the complex interplay between different social, ecological, and biological factors, and trying to prioritize inevitably limited resources to obtain the greatest conservation benefit. At times this must also be done with limited information and must take into account the heterogeneous and changing nature of large landscapes. The 'Landscape Species Approach' is a strategic planning process that guides wildlife management within large landscapes of human influence. The approach engages multiple stakeholders and uses GIS, modeling, monitoring, and evaluation of "landscape species" to measure success (Sanderson *et al.*, 2002). This paper outlines the application and results of this approach in the landscape of Bolikhamxay Province in central Laos and reports on the monitoring baseline for one "landscape species" - the northern white-cheeked gibbon (*Nomascus leucogenys*).

MATERIAL AND METHODS

Study Area

The Nam Kading landscape (Fig. 1) is part of the larger Northern Annamites eco-region (Wikramanayake & Dinerstein, 2002), which is renowned for the recent discovery of several unique endemic species of global conservation significance (Duckworth *et al.*, 1999). The Nam Kading landscape boundaries are the same as those of the 'Tiger Conservation Landscape' (Wildlife Conservation Society *et al.*, 2006), which contains five national

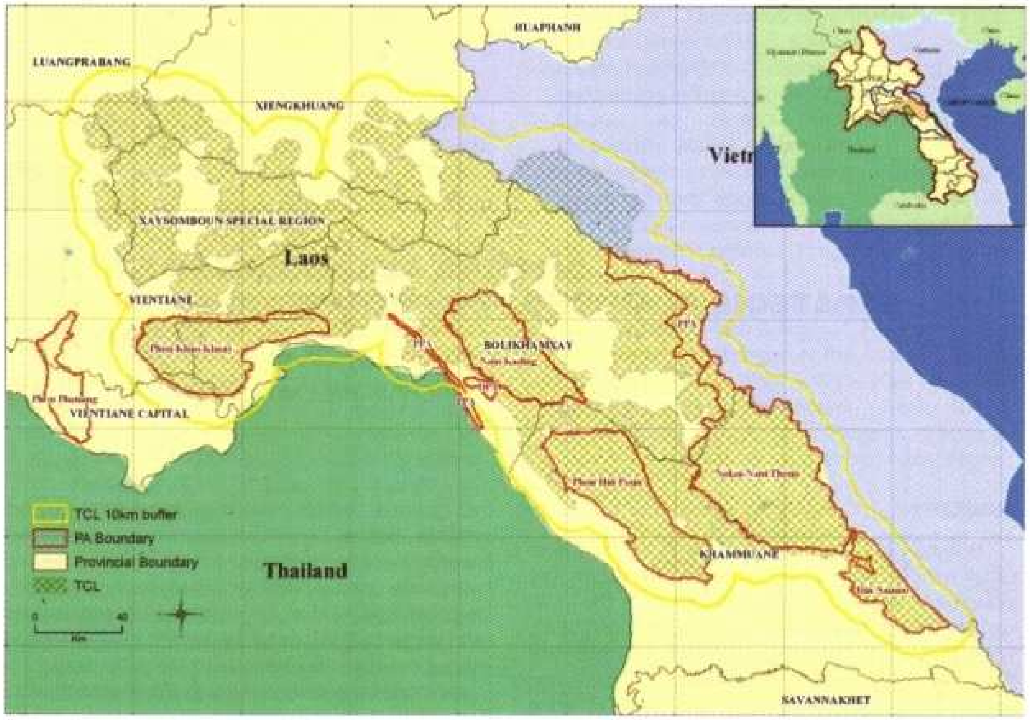

Fig. 1. The Nam Kading Landscape.

protected areas as well as three provincial protected areas. The landscape also covers six provinces, Luang Prabang, Bolikhamxay, Khammouane, Vientiane Capital, Vientiane Province and Xieng Khuang. The focus of this paper is on the Nam Kading NPA (NKNPA) in Bolikhamxay Province.

The NKNPA is 169,000 ha entirely within Bolikhamxay Province. It is a mix of upper and lower mixed deciduous forest with a primary forest cover of 85% (Forest Inventory and Planning Division, 2001). There are 24 villages within 5 km in the NKNPA and 3 enclave villages which have a total population of around 13,802 people (National Statistics Centre, 2005). This is lower than other protected areas in Laos. The area is very rugged which has afforded it better protection from habitat loss and illegal hunting than other protected areas in Laos.

In 2005, the Wildlife Conservation Society (WCS) along with the Provincial Agriculture and Forestry office of Bolikhamxay (PAFO) received funding from the Global Environment Facility (GEF) and the MacArthur Foundation to implement the Integrated Ecosystem and Wildlife Management Project (IEWMP), a five year project to build national capacity to effectively manage the globally significant biodiversity of Bolikhamxay Province.

Methods

During the first year of implementation, the IEWMP used a conceptual model approach to set a conservation goal and broadly assess threats (Wilkie, 2004). The process involved the following steps: a) Developing a vision state for the NKNPA, b) design a conservation objective (e.g. Margolius & Salafsky, 1998) c) state the direct threats d) state the indirect threats. The indirect threats were identified as factors contributing to the direct threats, e) design interventions (management activities) to reduce the threats. From this point the project employed the living landscape process to plan conservation within the larger landscape. The steps taken by the IEWMP are:

Step 1: Landscape species selection

Step 2: Spatial modeling of habitat and threats and production of conservation landscapes

Step 3: Designing approaches and measures of success

Step 4: Implement actions and measure effectiveness

Step 5: Review progress and revise approach.

These form an adaptive management framework outlined in Fig. 2. The methods and results from implementing each step in the NKNPA were as follows:

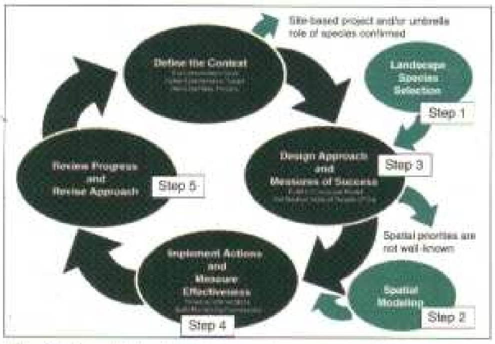

Fig. 2. The 'Living Landscapes' process.

Step 1: Landscape species selection

Landscape species (LS) have five characteristics:

- they range over large areas
- use a variety of habitat types
- are especially vulnerable to threats in the landscape (such as over harvest or habitat loss)
- are socio-economically important
- have a strong ecological function in the natural ecosystem (e.g. seed disperser, top predator) (Coppolillo & Gomez, 2004).

Candidate species presented must have at least one of the five criteria. Based on the above criteria a set of 21 candidate species was made (Table 1). This list was sent to eleven taxa experts in preparation for selecting 'Landscape Species' for the Nam Kading landscape. Each expert was asked to contribute information on the characteristics of each species as related to the five criteria outlined above.

Following this process a three day workshop was held in March 2006. The workshop was attended by district and provincial government agencies, village headmen and WCS staff with the aim of assessing the candidate species list. These stakeholders were consulted on the selection of the species, the assessed threats and susceptibility to threats, species utilized habitats and management zones where the species occurred. During the workshop the IEWMP used 'Landscape Species Selection' software Version 2.1. (Wilkie, 2004; Strindberg, 2006). Further details about how this process was

Table 1. Initial list of candidate species for selection as 'Living Landscape' species.

1	Great hornbill	*Buceros bicornis*
2	Wreathed hornbill	*Rhyticeros undulatus*
3	Lesser fish eagle	*Ichthyophaga humilis*
4	River lapwing	*Vanellus duvaucelii*
5	Big-headed turtle	*Platysternon megacephalum*
6	Water monitor	*Varanus salvator*
7	Oriental small-clawed otter	*Aonyx cinerea*
8	Eurasian otter	*Lutra lutra*
9	Stump-tailed macaque	*Macaca arctoides*
10	Francois' langur	*Trachypithecus francoisi*
11	Northern white-cheeked gibbon	*Nomascus leucogenys*
12	Bear	*Ursus* sp.
13	Clouded leopard	*Neofelis nebulosa*
14	Tiger	*Panthera tigris*
15	Asian elephant	*Elephas maximus*
16	Sambar	*Cervus unicolor*
17	Gaur	*Bos gaurus*
18	Wild boar	*Sus scrofa*
19	Serow	*Naemorhedus sumatraensis*
20	Pakhe	*Bagarius bagarius*
21	Pakheung	*Hemibagrus wyckoides*

carried out can be found in the 'Landscape Species Selection Report for the NKNPA' (Strindberg, 2006).

Results

The process resulted in a final list of six 'Landscape Species': Asian elephant (*Elephas maximus*), tiger (*Panthera tigris*), southern serow (*Naemorhedus sumatraensis*), Eurasian wild pig (*Sus scrofa*), northern white-cheeked gibbon (*Nomascus leucogenys*), and great hornbill (*Buceros bicornis*) (Strindberg, 2006).

Step 2: Spatial modeling of habitat and threats

Methods

Following the first meeting, modeling for each of the species was conducted.

It was intended to:

- show where the important human-caused threats are occurring and how strongly they impact the species (called 'Threats Landscapes'), and
- use the Biological and Threats Landscapes to create 'Conservation Landscapes' (Didier, 2006). The Conservation Landscapes for Bolikhamxay Province identify the areas of the landscape that are a management priority for the species (Bryja, 2006, Rasaphone & Johnson, 2007).

As little was known on northern white-cheeked gibbons in the wild, a literature review of closely related species was completed to assess likely important spatial and lifecycle requirements. This was used to guide modeling and selection of GIS proxies.

GIS proxies were chosen and modeled based on inputs in Table 2 to produce biological landscapes, based on information collected during the first stakeholder meeting. A second stakeholder meeting was held in November 2006, eight months after the first, to allow stakeholders to assess the habitat and threat modeling (Bryja, 2006). Below are the biological, threats and conservation landscapes for the northern white-cheeked gibbon as generated in the modeling.

Results

Biological landscape for the northern white-cheeked gibbon (Fig. 3).

The biological landscape was defined by gibbon preference for a habitat with a high density of tree cover, a minimum core area (as discussed below) and an elevation below 2000 m asl. The GIS proxies used included vegetation type and elevation models. For vegetation, a score of 1-100 was given to represent suitability based on the literature review (Table 2).

Since gibbons have very limited dispersal capabilities and do not cross open spaces that are wider than 10 m, major roads and rivers were treated as barriers to their movement. It was assumed that gibbons could cross smaller rivers and unpaved roads as long as there was a high density of tree cover. For the minimum core area, we considered a minimum viable number of groups/families to be six

Table 2. GIS proxies for gibbon 'Landscapes' (Bryja, 2006).

Land cover		gibbon
Urban		0
Agriculture		0
Regeneration forest		50
Secondary forest		30
Forest plantation		0
Savannah		0
Scrub		0
Grassland		0
Mixed broad-leaved		80
Coniferous forest		0
Lower dry evergreen		
	low density	90
	high density	100
Upper dry evergreen		
	low density	90
	high density	100
Lower mixed deciduous		
	low density	70
	high density	80
Upper mixed deciduous		
	low density	70
	high density	80
Dry dipterocarp		0
Bamboo		0
Riparian		100
Swamp		0
Water		0
Rock		0

Fig. 3. Biological landscape for northern white cheeked gibbons *(Nomascus leucogenys)*(darker green represents higher quality habitat) (Bryja, 2006).

groups for a patch of habitat (without distinction of quality) to be considered suitable. Core area needed per group was estimated to be 30 ha, hence a patch of minimum size 6 x 30 ha = 180 ha is needed for a viable population.

'Threat Landscape' for the northern white-cheeked gibbons

Hunting (Fig. 4)

To assess hunting pressure, access to the area and population pressure were modeled. A model buffering travel routes (rivers and roads) and a costs surface were developed. A cost surface represents the difficulty of movement over the landscape and takes into account terrain and access routes. The effects of population pressure were modeled by adapting existing programs used in WCS Congo to the Southeast Asian situation (AML Arc Info) (Bryja, 2006).

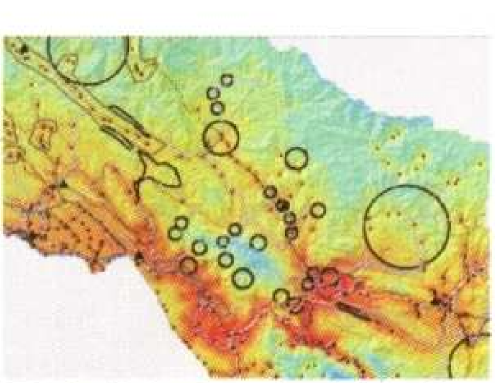

Fig. 4. Combined travel cost and population modeling to assess hunting threat within the landscape for northern white-cheeked gibbons (*Nomascus leucogenys*) (red areas represent high hunting pressure, circles represent known areas of trade and/or hunting) (Bryja, 2006).

Logging (Fig. 5)

Logging was identified as one of the most important threats to gibbons. To create the layer that represents the risk of logging, we used information about the presence of plantation forests and logging activities provided by government officials. We also modified the layer by identifying additional areas, which might be under a higher risk of logging activities within the province. We based our assumption about the logging threat on the forest type, slope and proximity to roads.

'Conservation Landscape' for the northern white-cheeked gibbon (Fig. 6)

The threat and the biological landscapes were then merged to form the conservation landscape. The conservation landscape provided a visual representation of both the threats and habitat for each of the LS in the landscape and can be used to prioritize actions within the landscape.

Step 3: Design approaches and measures of success

3.1 Build a conceptual model
Methods

A single general root-cause-analysis diagram, termed a conceptual model (Wilkie, 2004), for the NKNPA was developed by the IEWMP with district staff in November 2005 (Vannalath & Hedemark, 2005). Following landscape species selection and production of 'Conservation Landscapes', detailed conceptual models for each of the six LS that represent the Nam Kading landscape (Johnson & Vannalath, 2006) were made. The team that was assembled to develop the conceptual models included district government officers from all districts surrounding the NKNPA, the NKNPA Manager and Deputy Manager, IEWMP site staff and volunteers, and WCS staff working with the IEWMP project.

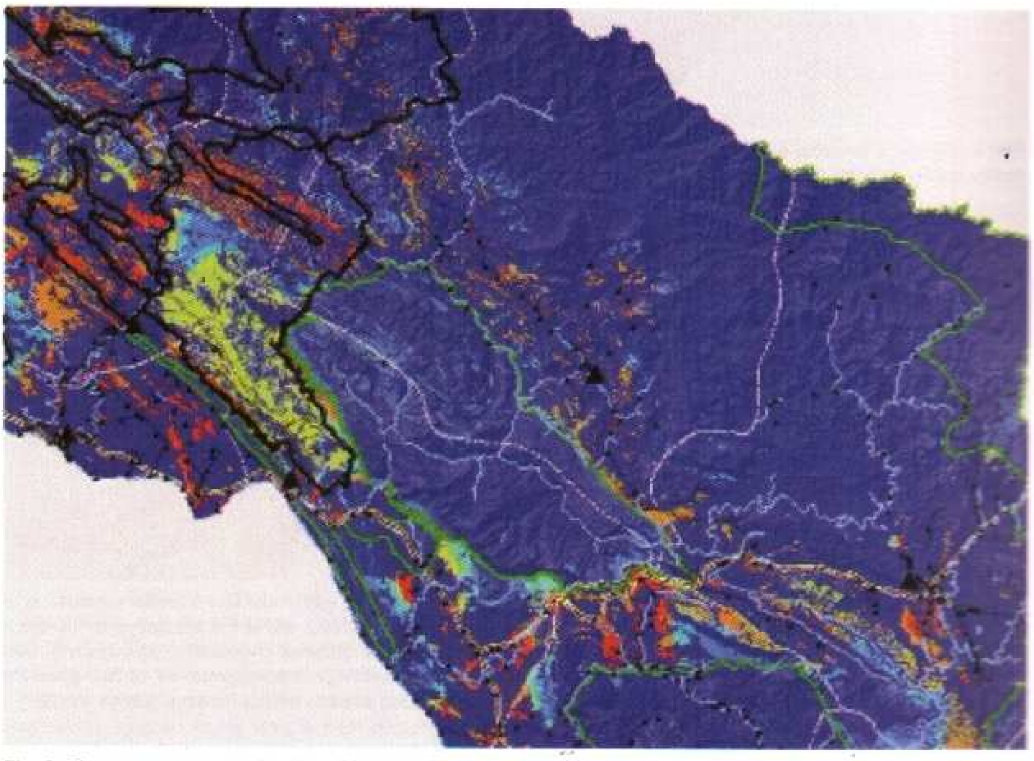

Fig. 5. The map represents the risk of logging. The areas marked with black graphics show the area of plantation forest where selective logging is happening.

The methods used to develop the conceptual models were:

- Review the 'Conservation Landscape' and the basic biology of the species.
- Based on the 'Conservation Landscape' and the biology of the species, state the conservation objective. Participants aimed to construct SMART objectives that were S: Specific, M: Measurable, A: Achievable, R: Realistic, and T: Time-bound (Margolius & Salafsky, 1998).
- State the direct threats. We used data that resulted from the Landscape Species selection and habitat modeling activities as above (Bryja, 2006; Strindberg, 2006) to define the direct threats.
- State the indirect threats. The indirect threats were identified as factors contributing to the direct threats. To keep the exercise focused on ways to reduce the most direct threats, we specifically defined the indirect threats as - who was carrying out the actions that were leading to the direct threat, how and for what reason.
- Design interventions (management activities) to reduce the threats.

Results

After reviewing the gibbon 'Conservation Landscape' (Fig. 6), we concluded that most of the NPA still provides high quality evergreen forest habitat for gibbon, but that the majority of the area is threatened by hunting (red and orange areas overlaid with blue circles that indicate high levels of hunting). Habitat loss as a result of logging is also a threat along the western boundary of the NPA. The conservation landscape shows that only the very core of the NPA now provides high quality habitat where the level of threat is low (green area).

In our review of gibbon biology, we discussed gibbon reproduction, dispersal, and population viability. In general, gibbons live in pairs and have one offspring approximately every two years (Leighton, 1987). The juvenile stays with the parents for approximately eight years before it must disperse to find its own territory in which to survive. Gibbons

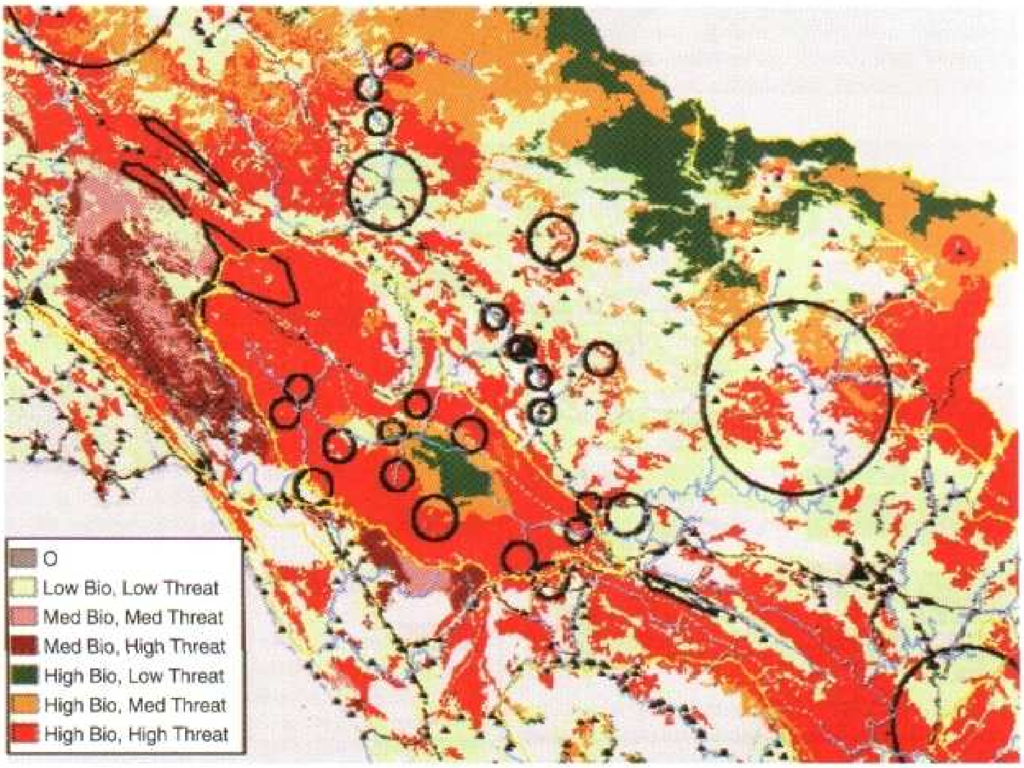

Fig. 6. Conservation landscape for northern white-cheeked gibbons (*Nomascus leucogenys*).

are unlikely to cross forest gaps that are greater than 10-20 m and are unable to cross large rivers.

Based on the literature, we estimated that the evergreen forest in Nam Kading could possibly contain three family groups/km^2 with an average group size of four individuals (Leighton, 1987; Geissmann *et al.*, 2000). For long-term population viability, references indicated that 125 groups is a minimum and the ideal population size would be at least 1250 groups (Bleisch & Jiang, 2000). To achieve the latter would require 416 km^2 of ideal habitat. Based on our 'Conservation Landscape', we estimated that 80-90% of the NKD (total area of 1690 km^2) may be suitable for gibbons. Theoretically, it would be possible to harbor up to 4500 groups, or around 18,000 individuals, in the NPA in the absence of all threats.

Based on the above review of gibbon biology the workshop participants settled on the following objective:

"A 10% increase in population of northern white-cheeked gibbons will be achieved within five years of the baseline survey within the NKD NPA."

Following the review of the 'Conservation Landscape' and gibbon biology, the participants discussed what could be done where, and by when, to expand gibbon populations in the NPA and together developed a conceptual model outlining the conservation goal, direct and indirect threats and conservation interventions. The interventions are outlined in the conceptual model for white-cheeked gibbons (Fig. 7).

3.2 Develop a monitoring strategy to measure success

Methods

Prior to beginning the project no quantitative surveys of any wildlife within the NKNPA had been done. In order to inform and design a robust and effective monitoring strategy we conducted an encounter rate survey for the LS in early 2007 (Vanderhelm & Johnson, 2007). Teams conducted surveys in eight locations around the park (Fig. 8). In each of the survey zones teams looked for signs of each of the six LS species. Signs included prints, vocalizations, and sightings. Teams walked at a rate of around 1 km per hour from sunrise to 12 pm every day recording signs of target species. For each sign a GPS point was taken. Track logs from the GPS provided rough estimates of the distance traveled and thus encounter rates for detecting each of the species was calculated (Vanderhelm & Johnson, 2007).

From 233 km of transects walked, gibbon encounters (vocalizations or sightings) were around

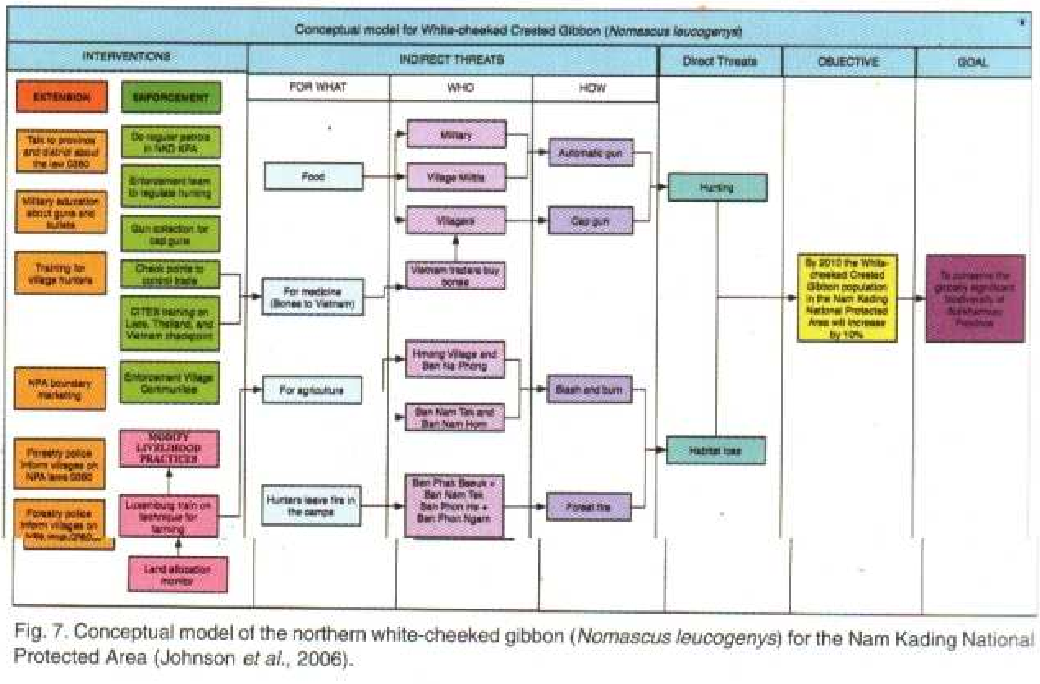

Fig. 7. Conceptual model of the northern white-cheeked gibbon (*Nomascus leucogenys*) for the Nam Kading National Protected Area (Johnson *et al.*, 2006).

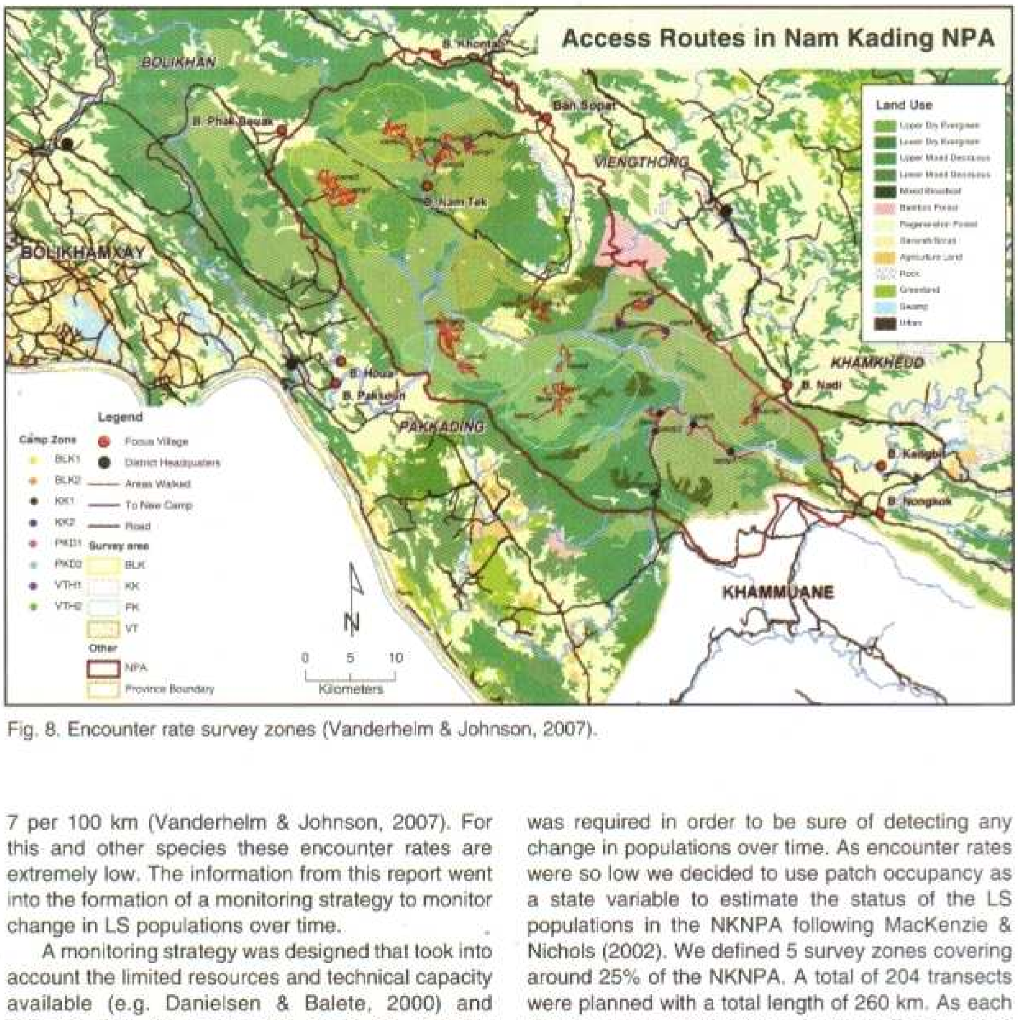

Fig. 8. Encounter rate survey zones (Vanderhelm & Johnson, 2007).

7 per 100 km (Vanderhelm & Johnson, 2007). For this and other species these encounter rates are extremely low. The information from this report went into the formation of a monitoring strategy to monitor change in LS populations over time.

A monitoring strategy was designed that took into account the limited resources and technical capacity available (e.g. Danielsen & Balete, 2000) and ensured that the monitoring could be correctly carried out and continued by the IEWMP in the long-term. We also considered that the strategy must be able to collect sufficient and appropriate data to detect relevant changes in the LS (Danielsen & Jensen, 2005).

Results

Line transect methods were chosen to monitor gibbon populations in the NKNPA. These methods, although not optimal for gibbons, were chosen to capture other LS during each survey. By conducting a simple power analysis following Gerrodette (1987), we determined a total transect length of ~260 km was required in order to be sure of detecting any change in populations over time. As encounter rates were so low we decided to use patch occupancy as a state variable to estimate the status of the LS populations in the NKNPA following MacKenzie & Nichols (2002). We defined 5 survey zones covering around 25% of the NKNPA. A total of 204 transects were planned with a total length of 260 km. As each transect is traversed 4 times the total effort is ~1040 km. Transects were placed 1 km apart and are up to 2 km long (Fig. 9). Transects were walked repeatedly on four consecutive mornings between sunrise and midday and signs of LS species were collected.

Step 4: Implement actions and measure effectiveness

4.1 Implement conservation actions
Methods

Conservation actions were developed following those outlined in the conceptual models. The actions described in Fig. 7 fall broadly into 3 work units:

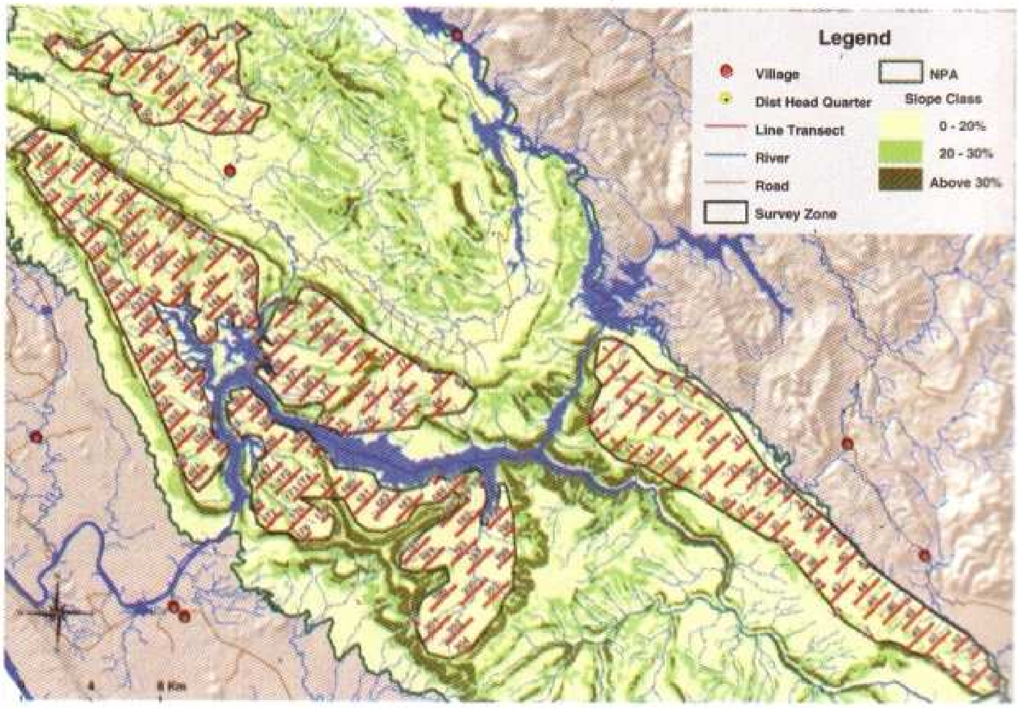

Fig. 9. Sampling design for transects for the Nam Kading National Protected Area (Strindberg & Johnson, 2007).

awareness raising, law enforcement and village development activities. Over the past 4 years activities have been guided by the conceptual models built for each species. Teams were formed, trained and activities implemented on the ground. Each work unit used an adaptive management framework (Margolius & Salafsky, 1998) to review and improve activities.

Results

The awareness raising team has developed key conservation messages based on the conceptual model (Fig. 7) and up until November 2008 has implemented these in three of the four districts surrounding the NKNPA. The activities implemented involved: teacher training, village visits, military camp visits, short radio spots, posters, plays, competitions, market visits and bus station visits. Each activity was assessed against objectives using a pre and post test design. Activities are described by Vannalath & Hedemark (2006).

Enforcement work started in earnest in March 2007 with the completion of an enforcement strategy for the NKNPA (Hallam & Lynam, 2007). The enforcement strategy used the conservation landscapes and additional local knowledge from districts to design strategies to protect the populations of LS within the NKNPA, prevent trade along major trade routes and stop the sale of LS in local markets. From 2007 to 2008, 36 staff members were involved in active implementation of these key activities in and around the NKNPA.

Village development work has been done in order to encourage positive conservation behavior. The IEWMP works in eight target villages with a total population of 3500 people. This is around 25% of the total population within 5 km of the NPA. An initial 'Participatory Rural Appraisal' (PRA) (Chambers, 1994) was done. From this interventions and activities were designed with the objective of alleviating poverty while encouraging positive conservation behavior. Examples of activities included: non-timber forest product (NTFP) management planning and market links, formation of fish conservation and frog conservation zones, forming village patrolling teams, and village revolving funds linked to positive conservation behavior.

In addition to these broad activities the IEWMP also established and officially recognized boundary for the NKNPA and a total protected zone (TPZ) within the NKNPA. Villages were intimately involved in deciding on and negotiating the location of both the boundary posts and the TPZ sign locations. In each village area abutting the NKNPA concrete boundary posts were erected and TPZ signs established attached. This was followed up by raising awareness on the benefits of the TPZ. This action has clarified village land areas and allows easier enforcement of NKNPA rules.

4.2 Measure effectiveness

Methods

The monitoring strategy was implemented in line with the steps described in Step 3.

While walking line transects, data were collected on presence or absence of gibbons, using sounds or sightings. In addition, standard distance sampling measurements were made during sighting only. Each transect was traversed four times to increase the detection probability for occupancy surveying. Transect results were exported from the Excel database and analyzed using PRESENCE software (Hines, 2006). We ran several models to assess best fit (a lower AIC represents a better model fit) and concluded that the 'Single Season Heterogeneity Model' was the most suitable (Royle & Nichols, 2003).

We then ran this model to obtain occupancy results in the survey area. We also calculated the coefficient of variation (CV) for the occupancy estimate to assess the reliability of the estimates. This is the estimate of standard error (SE) of the occupancy divided by occupancy estimate. For species such as gibbons that have a high amount of spatial heterogeneity in the estimate, low CV's can be difficult to achieve. Thus for gibbons in this survey we decided that a CV of 30% or lower was acceptable.

Results

In total only 405 km of the anticipated 1040 km were surveyed. This was due to the incredibly rugged nature of the NKNPA and an early onset of the wet season in May 2008. At this point we have established the first quantitative baseline of wildlife populations within the NKNPA.

In total 105 of 204 transects representing 405 km of transect were completed. The results represent only 37% of the planned 1040 km survey effort. Twenty-eight gibbon detections were recorded along the 405 km of line transects walked. This included 25 independent detections of gibbon vocalizations and three sightings of gibbons (gibbons were also detected outside transects). These results were used in occupancy analysis provided they were within 500 m (the patch size) of the transect and between sunrise and 12 pm as stated in the protocol (Table 3).

Gibbons were detected (sightings and vocalizations) on 18% of transects walked (n=105; naïve estimate of occupancy in Table 4). Based on these detections, the estimated occupancy for gibbons s 30% (SE=8 CV=28%). Individual detection probability (20%) was relatively good, and the SE relatively low (6) with an acceptable CV of 30%. This means that the occupancy estimate of 30% is a fair representation of the true occupancy.

Step 5: Review progress and revise approach

The overwhelming advantage of the 'Living Landscape' process is that it has provided a planning strategy firmly based on biological knowledge that provides a clear vision of both where and when to implement conservation actions. It has ensured efficiency in conservation actions where resources are scarce. It has also promoted management participation in a tangible product through several stakeholder workshops. The 'Conservation Landscapes' are a key tool that are used regularly in planning and are easily explained to non expert audiences.

The 'Living Landscapes' process has also contributed practical tools for long term planning, and these have been incorporated into the first management plan for the NKNPA. Various difficulties

Table 3. Table of detections of northern white-cheeked gibbons (*Nomascus leucogenys*) (sightings or vocalizations) in Nam Kading National Protected Area, 2008-2009.

Record type	on transect			off transect			Grand Total
	seen	heard	Total	seen	heard	Total	
Number of gibbon	3	25	28	0	8	8	36

Table 4. Occupancy table for northern white-cheeked gibbons (*Nomascus leucogenys*) in Nam Kading National Protected Area.

Species	A Naïve	B λ (Std. error)	C r (Std. error)	D Psi (Std. error)	E N	CI
Gibbon	18	36(12)	20(6)	30(8)	47.6	15.8 - 77.6

A Naïve estimate of occupancy; does not incorporate detection probability (p)
B Abundance index of gibbon cluster per transect
C Individual detection probability of gibbon
D Estimated probability of transect occupied by gibbons
E Abundance index of gibbon clusters

were encountered during the process. At times, the process, development of methods, and key terms has proved confusing. This is especially the case when trying to translate the concepts and technical words into local language. In addition the time taken was much longer than initially expected. The process of selecting species and landscape modeling along with development of the monitoring strategy took approximately 18 months. The total cost of the process was around US$40,000. However once established the process can easily be updated within the adaptive management cycle (Fig. 2)

The monitoring results for gibbons support the 'Conservation Landscape' developed as part of the 'Living Landscape' process. Populations of gibbons within the NKNPA are low based on interpretation of the occupancy results but there is potential for recovery with reduction in threat and in consideration of good habitat already within the NKNPA. Repeat surveys will discover if the interventions are having the required effect. However, the monitoring protocol also proved over-ambitious for the time and topography of the NKNPA resulting in incomplete survey effort. As the management of the NKNPA matures the living landscape process will continue to provide a solid basis for continuing management.

CÁC LOÀI VƯỢN ĐƯỢC XEM NHƯ LÀ LOÀI CẢNH QUAN: CHIẾN LƯỢC HOẠCH ĐỊNH CHO CÔNG TÁC BẢO TỒN LINH TRƯỞNG Ở CHDCND LÀO

TÓM TẮT

Tỉnh Bolikhamxay của nước CHDCND Lào chiếm diện tích lớn nhất của những cánh rừng thường xanh có độ khô ráo cao còn lại ở Đông Dương có tổng diện tích 1.570km^2 của Khu Bảo tồn Quốc gia Nam Kading. Dự án quản lý hệ động thực vật thiên nhiên lồng ghép với hệ sinh thái (IEWMP) sử dụng phương pháp tiếp cận các loài cảnh quan của Quỹ Bảo tồn Động Thực vật hoang dã đã tiến hành cùng hợp tác với các cơ quan Chính phủ, các tổ chức cộng đồng và các tổ chức phi chính phủ liên quan để chọn ra bảy loài cảnh quan cho tỉnh, trong đó có loài vượn đen má trắng (*Nomascus leucogenys*). Cán bộ nhà nước làm việc với dự án IEWMP để lập ra những bản đồ xác định các vùng quản lý ưu tiên cho loài vượn, trong đó bao gồm sinh cảnh, địa điểm phù hợp nhất cũng như tác động từ các mối đe dọa do con người gây ra cho loài. Những bản đồ được sử dụng để xây dựng một mô hình mang tính khái niệm xác định mục tiêu cho mật độ quần thể loài cũng như các can thiệp lên công tác quản lý làm giảm các mối đe dọa trực tiếp hay gián tiếp đến loài để đạt được mục tiêu đề ra. Một chương trình giám sát sử dụng phương pháp giám sát tuyến được tiến hành thực hiện trong Khu bảo tồn Quốc gia Nam Kading (NKNPA) nhằm đo đếm mật độ quần thể vượn thay đổi qua thời gian và đánh giá tính hiệu quả các can thiệp lên công tác quản lý, đồng thời làm quen với các hoạt động một cách phù hợp. Tài liệu này giới thiệu các kết quả cơ bản về cách thức lập mô hình, các can thiệp quản lý và giám sát tuyến cho loài vượn tại Khu bảo tồn Quốc gia Nam Kading.

REFERENCES

Bleisch, W. & Jiang, X.L. (2000): Action plan for conservation of gibbons of the Wuliang mountains, Kunming, China., Sino-Dutch Forest Conservation and Community Development Project, Kunming.

Bryja, G. (2006): Building Conservation Landscapes for the Bolikhamxay province (with focus on the Nam Kading NPA).Wildlife Conservation Society, Vientiane (Report).

Coppolillo, P. & Gomez, H. (2004): Selection criteria for suites of landscape species as a basis for site-based conservation. Biological Conservation 115(3), 419-430.

Chambers, R. (1994): Participatory Rural Appraisal (PRA): Analysis of Experience. World Development 22(9), 1253-1268.

Danielsen, F. & Balete, D.S. (2000): A simple system for monitoring biodiversity in protected areas of a developing country. 9(12), 1671-1705.

Danielsen, F. & Jensen, A.E. (2005): Does monitoring matter? A quantitative assessment of management decisions from locally-based monitoring of protected areas. Biodiversity and Conservation 14(11), 2633-2652.

Didier, K. (2006): Living Landscapes Program—Building Biological and Threats Landscapes. Technical Manual No 6. Living Landscapes Program, Wildlife Conservation Society, New York.

Duckworth, J.W., Salter, R.E. & Khounboline, K. (compilers) (1999): Wildlife in Lao PDR: 1999 Status Report; pp. 275. IUCN-The World Conservation Union / Wildlife Conservation Society / Centre for Protected Areas and Watershed Management. Samsaen Printing, Bangkok.

Forest inventory and Planning Division (2001): Landcover of Lao PDR. Department of Forestry, Vientiane.

Geissmann, T., Nguyeen Xuan Dang, Lormee, N. & Momberg, F. (2000): Vietnam Primate Conservation Review 2000. Part 1: Gibbons. Fauna & Flora International – Indochina Programme, Hanoi.

Gerrodette, T. (1987): A power analysis for detecting trends. Ecology 68, 1364–1372

Hallam, C. & Lynam, A.J. (2007): Guidelines for a Wildlife Protection Strategy for the Nam Kading NPA: Summary of workshop findings 1 – 2 April, 2007. Vientiane Lao PDR, Provincial Agriculture and Forestry Office, Bolikhamxay and WCS Lao PDR Program. (Unpubl.).

Hines, J.E. (2006): Presence 2 - Software to estimate patch occupancy and related parameters. Laural, MD, USA, USGS-PWRC.

IEWMP (2006): Report on Living landscapes species selection. March 2006, WCS/PAFO Bolikhamxay Province.

Johnson, A. & Vannalath, S. (2006): Using conservation landscapes to build conceptual models for the Nam Kading National Protected Area Landscape. Vientiane. (Unpubl.).

Leighton, D.R. (1987): Gibbons: territoriality and monogamy. In: Smuts, B.B., Cheney, D.L., Seyfarth, R.M., Wrangham,R.W. & Struhsaker, T.T (eds.): Primate Societies; pp. 135–145. University of Chicago, Chicago.

Mackenzie, D.I. & Nichols, J.D. (2002): Estimating site occupancy when detection probabilities are less than one. Ecology 83, 2248-2255.

Margolius, R. & Salafsky, N. (1998): Measures of Success. Centre for Resource Economics, Washington DC.

National Statistics Centre (2005): Population and housing census year 2005. Vientiane.

Rasphone, A., & Johnson, A. (2007): Technical Report on Building Species Conservation Landscape for Central Laos (Mainly around Nam Kading National Protected Area, Bolikhamxai). Vientiane. Wildlife Conservation Society. (Unpubl.).

Royle, J.A. & Nichols, J.D. (2003): Estimating Abundance from Repeated Presence-Absence Data or Point Counts. Ecology 83(3), 777-790.

Sanderson, E.W. & Redford, K.H. (2002): A conceptual model for conservation planning based on landscape species requirements. Landscape and Urban Planning 58, 41-56.

Strindberg, S. (2006): Landscape Species Selection for the Nam Kading Landscape. Lao PDR. Vientiane. Wildlife Conservation Society. (Unpubl.).

Strindberg, S. & Johnson, A. (2007): Recommendations for Monitoring Landscape Species in the Nam Kading National Protected Area. Vientiane, Lao PDR. Wildlife Conservation Society and the Integrated Ecosystem and Wildlife Management Project (IEWMP). (Unpubl.).

Vannalath, S. & Hedemark, M. (2005): Conceptual model for the Nam Kading NPA, Vientiane Lao PDR. Bolikhamxay Provincial Agriculture and Forestry Office and Wildlife Conservation Society. (Unpubl.).

Vanderhelm, F. & Johnson, A. (2007): Baseline investigation into the status of wildlife in the Nam

Kading National Protected Area. Bolikhamxay Provincial Agricultural and Forestry Office and Wildlife Conservation Society. (Unpubl.).

Wildlife Conservation Society, Worldwide Fund for Nature & Smithsonian Institution (2006): Tiger conservation landscape: classification and prioritization.

Wilkie, D.S. (2004): Technical Manual No.2: Conceptual Models. Living Landscapes Technical Manuals. Living Landscapes Program. Wildlife Conservation Society, New York.

Wikramanayake, E. & Dinerstein, E. (2002): Terrestrial ecoregions of the Indo-Pacific: A Conservation Assessment. Island Press, Washington DC.