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TIGER RANGE STATE REPORT – LAO PEOPLE'S DEMOCRATIC REPUBLIC

The attached document has been submitted by the Lao People's Democratic Republic in compliance with Decision 14.65 (*Asian big cats*). *

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TRENDS IN TIGER DISTRIBUTION AND POPULATIONS IN LAO PDR

EXECUTIVE SUMMARY

Over 93% of tiger habitat has been lost globally in the last 100 years. Tigers today, with uncertainty in their population numbers, exist in small isolated and fragmented patches of forest across 14 range countries. At present, those small and isolated tiger populations that survive are continuing to decline due to hunting for tiger body parts, depletion of prey, and persecution by angry farmers.

Despite this decline, Lao PDR still contains extensive habitat in several tiger conservation landscapes that could potentially harbor viable tiger populations, but the status of the tiger population in almost all of these landscapes remains known. The paucity of information may be due to the fact that tigers have received little conservation attention in the past due to a lack of national capacity and financial support. However, the existing data from field surveys during 1990s, recent research and monitoring in a few national protected areas and anecdotal reports from others indicate that wild tigers do still occur in Lao PDR, but at very low numbers.

Tigers are adaptable to a wide range of habitat and can live wherever there is sufficient prey. So, despite the low abundance of tigers in the country at the present time, there are enormous opportunities to make the recovery and conservation of wild tiger populations possible in the Lao PDR. This is because, i) the current human population is relatively low (22 people/km^2) compared to neighboring tiger range countries, ii) there are 21 established national protected areas that may serve as core source populations for tigers in the existing landscapes, and iii) of particular importance, there are national policies that promote biodiversity conservation and sustainable development in place, as well as the dissemination of national laws addressing wildlife protection. Given these opportunities and the potential for tiger populations to rebound, tiger recovery is possible in many parts of Laos as long as we can maintain and increase habitat and prey, and protect tigers from illegal poaching.

The primary objective of these background notes is to assist participants in the preparation of the National Tiger Action Plan by providing basic information about tigers including tiger behavior and ecology, current tiger population status, threats to tigers and areas significant to tiger conservation in Laos. In addition, it describes the role of tigers in biodiversity conservation and human livelihoods, the opportunities and constraints for tiger conservation, and recommended actions to consider for implementation to achieve the goal of tiger conservation in Lao PDR.

1. TRENDS IN TIGER DISTRIBUTION AND POPULATIONS IN LAO PDR

1.1 Past records (to 2005)

1.1.1 Sources of data and methods for past records

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

1988-1993. Salter 1993[21] analyzed village questionnaire data on wildlife distribution gathered between 1988-1993.

1932-1998. Duckworth and Hedges 1998[22] assessed the status of tigers in Laos by reviewing five sources of data, which included published papers from 1932 to 1998, wildlife survey reports, reports of other surveys, media articles and personal communication.

1991-1998. Duckworth, Khounboline and Salter 1999[23].provided a baseline on the status of tigers in Laos by summarizing data compiled from field surveys for large mammals for periods exceeding a week during 1991-1998 in 32 different areas of the country.

2003-2004. Johnson, Vongkhamheng et al., 2006[13] used camera traps set in five 100 km^2 sampling blocks across NEPL NPA from 2003 to 2004. Each 100 km^2 sampling block divided into 25 4-km^2 grid cells, in which a pair of cameras was placed to photograph both sides of individual tigers in optimal locations. Cameras were

mounted on trees at 45 cm and set to operate for 24 hours per day and left in the forest for over 30 days. The software program "CAPTURE" was used to generate tiger density estimate as tigers could be identified to individual tigers by their distinct stripes. As prey could not be identified to individuals by their markings, index of prey abundance was used, i.e. number of photos per 100 camera trap days (CTD). CTD was calculated from the time the camera was mounted until the date of the final photo for a total effort of 3,588 total CTD.

1995-2005. Dinerstein et al. 2006[6] delineated tiger conservation landscapes based on tiger records from 1995-2005, current forest cover, and human influence.

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

1988-1993. Salter[21] reported tigers present in 87% of interviews (n=328) spread across 18 NPAs of Laos.

1932-1998. Duckworth and Hedges[22] mapped 64 tiger records spread over the country, of which only 21 were confirmed records based on sightings or remains of tigers. Based on tiger data and habitat availability they suggested only five areas that showed particular potential for harboring viable tiger populations. These areas were:

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

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

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

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

2003-2004. The camera trap surveys in NEPL NPA [13] found that the NPA supported a small viable tiger population with an estimated density of 0.2 to 0.7 tigers per 100 km^2 and a population estimate ranging from a minimum of 7 to as many as 23 tigers in the sampled area. An index of prey abundance ranged from 0.08 independent photos (IP) per 100 CTD for gaur, 0.25 IP per 100 CTD for sambar, 0.27 IP per 100 CTD for serow, 0.40 IP per 100 CTD for wild pig, and 2.77 IP per 100 CTD for muntjacs.

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

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

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

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

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

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

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

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

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

Class 3 and Potential Landscapes[(3)] (see maps Appendices 2, 3 and 4)

(TCL#33) Areas within and adjoining Hin Nam Nor NPA

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

(TCL#36) Areas within and adjoining the Nam Ha and Nam Kan NPAs

- Areas within and adjoining Nam Phoun and Phou Phanang NPAs
- Areas within Phou Den Din NPA
- Areas within and adjoining Xe Bangnouan and Phou Xiengthong NPAs

1.2 Current records (2005-present)

1.2.1 Sources of data for current records

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

i) Results of field research projects and,

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

- tiger signs/sightings with a detailed description of the evidence, location and date,
- tiger human conflict with a description of the human killing or type of livestock killed, description of the evidence for each case, and date,
- threats to tigers including direct killing and date, presence of hunting of prey or habitat loss and description.

The likelihood that reports represented actual tiger presence were ranked as follows:

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

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

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

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

Possible: report of depredation of adult buffalo or a human killed

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

1.2.2 Current records: methods and results

Class 1 Landscapes (see map Appendix 4)

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

Camera trapping for tigers and prey was conducted from 2004-2006 in 300 km² of the NPA[13] followed by camera trapping for tigers over 800 km² of the NPA from 2006-2007 (WCS unpublished data). A total of eight individual tigers were detected with camera traps in NEPL NPA from 2003-2007.

From 2006 to present, DNA extraction from large carnivore scats has been used to estimate a minimum number of tigers in the NPA. Nine individual tigers have been detected from analysis of 124 scats from 2006-2009. One tiger was seen in the NPA by enforcement staff in July 2009.

From January-June 2008, prey occupancy surveys were conducted in the NPA core zone[49]. The 2600 km² area was divided into 3.25 km² sub-grids based on biological information on home range of large ungulates. Teams walked approximately 3-6 km within each sub-grid to record presence/absence of ungulate signs every 300 meters. The survey found an estimated prey abundance of 3.25 ungulates per km² in the core zone, of which muntjac and wild pig were the most common, with much less detection of serow, sambar and gaur.

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

(TCL#27) Southern Laos - 19,996 km²

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

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

Class 2 Landscapes (see map Appendix 4)

(TCL#34) Central Laos – 36,317 km²

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

Nakai-Nam Theun NPA: From 2006-2008, ground dwelling mammals were monitored at a total of 300 camera trap points at a spacing of one camera point per 2 km² across 600 km² (three blocks of 200 km² each) in the

3,532 km^2 NNT NPA for a total effort of 11,870 camera trap days[32, 48]. The cameras recorded no tigers and a relatively low level of large prey.

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

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

(TCL#26) Dong Khanthung – 2,526 km^2

No reports have been received from this area since 2005.

Class 3 Landscapes (see map Appendix 4)

(TCL#33) Areas within and adjoining Hin Nam Nor NPA – 7,477 km^2

Tracks (10x12 cm) and a buffalo carcass suspected of being killed by tiger were found on 25 August 2009 in the vicinity of Ban Nong Buao or near Phou Chuang (17^{o}30'09" N 105^{o}54'33" E) (Table 1). The area is located in the corridor between Hin Nam Nor and Nakai Nam Theun NPAs. Also a track (13x15 cm) was reported by NPA staff on 7 September 2009 in the vicinity of Ban Napao.

Areas west and north of Phou Xanghe NPA including Dong Phousor and Xenoi-Xeba, and Lavin-Laveun: Tracks (~11x12 cm) were recorded on May 2005 in the vicinity of Ban Doune, and a buffalo kill was reported during the dry season of 2007 in Phou Xenghe NPA (Table 1). Other reports of tracks were received from Lavin-Laveun PPA in 2009 near Xepone district

(TCL#36) Areas within and adjoining the Nam Ha and Nam Kan NPAs – 7,315 km^2

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

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

Potential Landscapes (see map Appendix 4)

(TCL #32) Areas within and adjoining the Xe Bang Nouan and Phou Xiengthong NPAs – 6,948 km^2

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

Areas within and adjoining Nam Phoun and Phou Phanang NPAs – 14,139 km^2

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

Areas within Phou Den Din NPA – 4,581 km^2

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

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

No	TCL	Name of Protected Area	Prior to 2005[1]	2005 to present[2] (level of confidence)				Sources
				Confirmed	Likely	Possible	Uncertain	
I.		**Class 1 Landscapes**						
1	35	Nam Et-Phou Louey NPA	X	PHO,DNA	TK,TG	BD	TL,RS,SN,CD	NPA staff/WCS staff, camera traps, scat DNA
2	35	Nam Xam NPA	?	-	TK	-	-	NPA staff/village survey
3	27	Dong Phouvieng NPA		-	-	-	-	NPA staff
4	27	Xe Sap NPA	?	-	TK	-	SN,CD	NPA staff, IUCN staff
5	27	Dong Huasao NPA	X	-	TG	BD	CD	NPA staff, village reports
6	27	Dong Ampham NPA	X	-	TG	HK	RS	NPA staff/WWF staff
7	27	Xe Piane NPA	X	-	-	-	TL,RS,SN	NPA staff/WWF report
8	27	Nam Kong PPA	X	-	-	-	SN	IUCN staff
9	27	HHW/Xe Khampho		-	-	-	SN	IUCN staff
10	27	Dak Cheung plateau	X	-	-	-	-	
11	27	Phou Kathong PNBCA	?	-	-	-	-	
II.		**Class 2 Landscapes**						
12	34	Phou Khao Khouay NPA	?	-	-	-	-	NPA staff
13	34	Nam Kading NPA	?	-	-	-	TL,SN	NPA staff/camera traps
14	34	Nakai-Nam Theun NPA	X	-	TG	BD	RS,SN	NPA staff/camera traps
15	34	Khammouan Limestone NPA	?	-	-	-	TL,SN	NPA staff
16	34	Phou Chomvoy PPA		-	-	-	-	
17	34	Upper Nam Ngem Watershed		-	-	-	SN	WCS staff
18	34	Upper Nam Chouan Watershed		-	-	-	SN	WCS staff
19	34	Special Zone (Xaysomboun)		-	-	-	SN	WCS staff
20	26	Dong Khanthoung	X	-	-	-	-	

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

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

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

2. Trends in tigers across Laos

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

- *Rarity of sightings of tigers in the forest.* Out of 35 interviews with people working in landscapes in Laos, there were only 8 reports of sightings of tigers since 2005.
- *Rarity of camera-trap photos of tigers in key areas surveyed since 2005.* In Nakai Nam Theun NPA where sightings of tigers were once regularly reported by field workers during 1990s[23], no tigers have been photographed since 2006 despite extensive camera trap surveys (11,870 CTD). Likewise, in Nam Et-Phou Louey NPA, camera trap surveys for tigers over a three-year period from 2005-2007 photographed only four different individuals over 5,979 CTD of survey effort (WCS unpublished survey data).
- *Although tigers are protected by law, direct poaching of tigers has reportedly occurred in several protected areas throughout Laos since 2003* (Table 2). The number of tigers reported killed, as shown in Table 2, are only those that local authorities have strong evidence of. The number of actual kills across the country is uncertain. This is a concern given that scientific studies show clearly that a small population of about 30 individual tigers may become extinct within 15 years with only a 2% kill rate a year. Only a larger population of over 70 tigers could potentially sustain a loss of 10% a year or more[5]. So, based on the known number of tiger killed in each NPA or landscape, and if the trend still continues, it appears that tigers in Laos are presently vulnerable to extirpation.

Table 2. Reports of tiger poaching from national protected areas since 2003.

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

3. THREATS TO TIGERS IN LAO PDR

3.1 Direct killing of tigers

3.1.1 Poaching of tigers for trade

Although tigers are a legally protected species in Laos, they are poached with a variety of methods including snares, poison, and explosives across Laos. This is because of the high demand for tiger parts in international markets for traditional medicines associated with the weak protected area management in Laos. The current estimated price of a tiger ranges from US$ 10,000 up to US$ 70,000 [5,28]. In NEPL, tiger bones sold for up to US$ 11,528 in 2004[13]. Tiger parts, such as skins, teeth, bones and others, were one of the most-traded wildlife items in recorded in Lao PDR during the 1990s[26].

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

A tiger farm was established in Laos in 2002, with the first 20 breeding individuals originating from Taiwan. Now, the farmer claims there are 254 individual tigers in the farm and they will be ready for export in the near future[27]. Although the direct impacts of this tiger farm on wild tigers in Laos is uncertain, the potential threat to wild tigers caused by tiger farms is very high. It is well-known worldwide that the legalizing trade in farmed tiger products allows smugglers to exploit the loophole and take opportunities to sell wild tiger products. This problem occurs because there is no way to distinguish between parts of tigers from the farm and those from the wild, which makes law enforcement difficult.

From an economic perspective, the price of a wild tiger ranges from US$10,000 to US$70,000 in international markets[28], and approximately US$11,528 on local markets in northern Laos[13]. The high price is because customers perceive wild products to be more effective than the farmed ones and thus prefer the wild products over the farmed[29]. In a simple cost analysis of wild versus farmed tigers parts, the cost of raising a tiger to adulthood in captivity is at least US$ 4,000 (range from US$ 4000 to US$ 10,000) and as little as US$15-25 for a bullet to poach a wild tiger. Despite the cost of transportation and an occasional loss due to confiscation by authorities, it is a lucrative trade. This discrepancy provides substantial economic incentive for poachers and smugglers to undercut farmers in any legal markets despite the risks associated with being caught and penalized[30]. In short, tiger farms don't support wild tiger conservation even though farmers often claim that farms are a solution to wild tiger conservation arguing that the legally-supplied captive-bred tiger parts and products in markets would undercut the illegal supply from tiger poachers. Some argue that tiger farmers have no interest in wild tiger conservation. If wild tigers do go extinct, farm investors stand to gain an economic advantage as they can control the supply of tiger parts for the global market[30].

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

Livestock depredation. Killing of tigers in revenge due to livestock loss has been recorded in many rural areas throughout Laos. About 43.8% of village interviews across Laos during 1988 to 1993 (n=317) reported livestock depredation by tigers, but the proportion of reports truly referring to tigers is unclear[23]. For example, one tiger was shot in Phou Khoun on the Luangphrabang/Vientiane province border in December 1998. Another was shot in Nam Et-Phou Louey on 18 December 1997 with the permission from Viengthong district authorities.

Of particular concern at the present time, given the high price of tiger parts and the associated negative attitude of humans toward tigers, is that when livestock are killed and tigers are suspected, tigers are targeted by the villagers, resulting in opportunistic killing of more tigers rather than taking revenge. For example, in the Nam Et-Phou Louey NPA, a systematic investigation of human-tiger conflict from 2003-2004 found that tiger poaching was closely tied to cattle grazing with farmers opportunistically using livestock to bait tigers more so than retaliation for livestock attacks[13]. Contrary to previous predictions that livestock loss was a widespread problem, the study found depredation affected only 12% of NPA villages and a small fraction of the total herd. Given the opportunity to report attacks in return for possible compensation, farmers lagged in both reporting and removing livestock to villages. NEPL farmers were willing to accept livestock loss and encouraged grazing in tiger habitat as it provided opportunities for tiger poaching to offset livestock loss, which was driven by the increasing lucrative trade in tiger bones.

Man-eating. Although tigers have had a bad reputation as man-eaters in many parts of Laos, very few cases have been reported across the country in recent years. For instance, there are only two cases reported prior to 2005[23] and another other two cases reported after 2005 (WCS unpubl. data). Actually, humans are not the primary or preferred food source for tigers. The occurrence of a human attack is usually in self-defense or protecting their infants, and those man-eaters are usually old, sick or injured[8]. If an incidence occurs, tigers are typically killed in revenge. An example of a recent incident occurred in August 2005 in Meung district, Bokeo province is the following report: "It started when a group of three men went fishing near Hua Nam Kha village. They heard a wild pig screaming and went to investigate, and saw it was a tiger. The tiger ran off when it saw the men. One of the men had a gun, so the other two waited while one man went after it with the intention to shoot it. He didn't come back and it was getting dark. They went back to the village and led a big search party next morning with many people. They found his gun and then him. All that was left was the head and one leg. There were two sets of paw prints, one animal bigger than the other. They carried the bits back to the temple in Meung township."

3.2 Prey depletion

Hunting of ungulates (i.e. gaur, sambar, serow, wild pig and muntjac) for subsistence has long been practiced by rural residents in Laos. However, the picture began to change when the government of Laos introduced the "new economic mechanism (NEM)" during the late 1980s. Since the opening of free markets and the associated increase in the prices of wildlife on both domestic and international markets, hunting of wildlife for subsistence has become more commercially oriented. Various parts of ungulates including horns, antlers, gall

bladders, meat and others were commonly traded domestically, and with Thailand, China, and Vietnam[31,26]. In recent years, wild meats are still sold in markets and restaurants in several townships across the country despite the fact that it contradicts the National Law on Aquatics and Wildlife.

The decline of ungulate populations in Laos is clearly evident from results of research in protected areas. For example, in Nam Et-Phou Louey NPA, a 2008 study found an ungulate abundance index of approximately 3.25 animals/km^2 [49]. Large prey (>100kg) are extremely low at only 0.02 and 0.31 animal/km^2 for gaur and sambar, respectively, whereas muntjac and wild pig are more abundant at 1.38 and 1.36 animals/km^2, respectively (C. Vongkhamheng, unpublished data). The results suggest that wild pig and muntjac are probably the principle prey available for tigers in Laos at the present time. Similarly, in Nakai Nam Theun and Nam Kading, the large prey abundance is very low and only muntjac and wild pig are found in moderate abundance[32].

3.3 Habitat loss and fragmentation

In Lao PDR, habitat loss and fragmentation is a less urgent threat to tigers than the two major threats of tiger poaching and prey depletion. This is based on the fact that Laos still has over 40% of suitable forest cover and a low human population of about 22 people/km^2 at present as compared to neighboring countries (263 people/km^2 for Vietnam, 128 people/km^2 for Thailand, 80 people/km^2 for Cambodia).

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

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

4. LEGISLATIVE PROTECTION OF TIGERS IN LAO PDR

The Lao PDR's Constitution (1991) states that "all organizations and citizens must protect the environment and the natural resources including: land, underground minerals, forests, fauna, water sources and the atmosphere" (Article 17)[45]. Legislative protection of tigers has long been taken into account by the government's decrees and regulations addressing tiger conservation (Table 3). More recently, the law on aquatic and terrestrial wildlife states that tigers and their larger prey species (gaur, banteng, sambar, serow) are listed as protected[44]. On the 3rd of April, 2007 the Prime Minister also signed an urgent agreement No. 25/PM, to increase effectiveness of forest management throughout the country. This agreement states how the nation's economic development is linked to the country's environmental status. Additionally, Lao is a signatory to several international conventions that support tiger conservation. These conventions enable the government to address problems affecting tiger conservation beyond the national jurisdiction, including the Convention on Biological Diversity (1994) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora since 2004[43].

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

Legal instruments	Key provision
National Legal Framework	
Decree of the Council of Ministers No. 185/CCM, in relation to the Prohibition of Wildlife trade, 21 October 1986	Prohibits export of all wildlife
Decree of the Council of Ministers No. 47/CCM, on the State Tax System, 26 June 1989	- Lists types of natural resources, including various species of wildlife, aquatic animals and parts thereof and their associated resource tax rates and special fees; 67 species or species group of wildlife are listed - Subsistence level users of natural resources are exempted from resource taxes - 1996 New Tax Law does not mention natural resource tax
Decree of the Council of Ministers No. 118/CCM, on the Management and Protection of Aquatic Animals, Wildlife and on Hunting, and Fishing, 5 October 1989	- Defines wildlife as state property with mandate to MAF to manage it (including through awareness programs) and local people to use it pursuant to regulation. - Allows import/export of wildlife with special authorization - Prohibits hunting and breeding of protected or endangered species, except where human life is endangered - Prohibit hunting by means of mass destruction (explosives, poisons, etc.)
Decree of the Prime Minister No. 164, 29 October 1993.	- Established national protected areas and states that hunting and fishing inside them is illegal - Explosives, chemicals, poisons and other substances harmful to wildlife are banned in NPAs - Measures (warn, fine) for anyone who disobeys the decree, confiscates illegal items
Order 54/MAF on the Customary Right and the Use of Forest Resources, 7 March 1996; followed by recommendations 377/MAF on the Customary Use of Forest Resources	- Secures legal rights for local people to use forest resources for subsistence, including hunting and fishing of non-protected species - Customary rights may be recognized by signed agreement or by law, and local people shall be compensated for loss of customary means of livelihood
Decree 1074 of the Ministry of Agriculture and Forestry, 11 September 1996	- Prohibits wildlife trade - Prohibits hunting of protected species including tiger and "such as Asian elephant, Banteng, Saola, Douc Langur, etc." - Prohibit hunting during a breeding season, and by dangerous methods, and/or by the use of weapons in NPAs and towns - Bans wildlife trade, except for research and conservation - Bans exporting wildlife used for food - Responsibility for PAFO to co-ordinate with other agencies to collect and register weapons used for hunting
Forestry Law, October 1996 and updated 24 December 2007.	- Grants state ownership of and authority to manage wildlife - Prohibits possession of wildlife without permission - Mandates state to define two categories of protected wildlife - Prohibits hunting during a breeding season and/or by means of mass destruction - Prohibits hunting of and trade in prohibited species, with certain exceptions - States that all guns and hunting equipment must be registered with certificates - Article 46, Part 5, establishes by law Wildlife Day on 13th July annually - Zoning NPAs to core (totally protected), managed (controlled use), and corridor zones
MAF Regulation No 0360 (2003) on management of NPAs, Aquatic Animals and Wildlife	- Provides guidelines on establishment and zoning of NPAs - Defines restricted activities on aquatic animals and wildlife - States duties of state agencies and funding support
Provincial and District regulation on management of PA, Wildlife, and Aquatic Animals (e.g. NEPL NPA	- Zoning of NPA into core, managed, and corridor zones and specify clearly activities in those areas - Prohibit hunting of all wildlife and aquatic animals in the core zone

Legal instruments	Key provision
Regulation 2008)	- prohibit trade in wildlife - Guns must be registered with special licenses
Wildlife and Aquatics Law, 24 December 2007	- Update lists of protected (Category 1) and managed (Category 2 and Category 3) species with tiger and large prey listed as Category 1 species that cannot be harvested anywhere in the country at any time. - State activities, management, and development on wildlife and aquatic animals
Prime Minister' agreement No.25/PM regarding forest management	- Assigned at least 15 staff in each NPA - Provide basic equipment and financial support for NPA management
International Commitments and Obligations	
United Nations Convention on Biodiversity (signed in 1996)	- Requires State Parties to prepare Biodiversity Strategies and Action Plan. - Laos has agreed; • To develop a national strategy for conservation and sustainable use of the nation's biological diversity • To develop regulatory provisions for protecting threatened species and populations • To integrate conservation and sustainable use of biological resources into national decision-making • To conduct an Environment Assessment (EA) of proposed development projects with a view to minimize harmful effects • To take measures for an equitable sharing of the results of research and development in genetic resources
ASEAN Agreement on the Conservation of Nature and Natural Resources (1985)	- Parties have agreed on development planning, the sustainable use of species, conservation of genetic diversity, endangered species, forest resources, soil, water, air and processes of environmental degradation and pollution. - Promotes joint and individual state action for the conservation of the natural resources in the ASEAN region.
Convention on International Trade in the Endangered Species of Fauna and Flora (signed in 2004).	- Provides international umbrella for management and control of trade in endangered fauna and flora. Tiger is listed as CITES Appendix 1 species for which all international trade is prohibited.

5. OPPORTUNITIES AND CONSTRAINTS FOR TIGER CONSERVATION IN LAO PDR

5.1 Opportunities for tiger conservation

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

Low human population

Laos has a low human population density (22 persons per km^2) as compared with other tiger range states in Indochina (263 people/km^2 for Vietnam, 128 people/km^2 for Thailand, 80 people/km^2 in Cambodia). Tigers require large home ranges to meet their ecological needs so availability of adequate space results in low human-tiger conflict.

High forest cover

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

Well developed protected area system

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

Existence of key prey

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

The role of tigers in economic development and environmental protection

As a top predator, the existence of a viable populations of tiger indicates a healthy ecosystem, which is important to human well-being in forms of "ecological services", food, medicine, and shelter provided by a healthy ecosystem. Economically, tourism is one of the fastest growing industry in the country, contributing substantially to the overall growth of the national economy of Laos. Ecotourism development is a government priority[50] and there are initiatives underway in some protected areas (e.g., Nam Ha, Xe Pian, Nam Et-Phou Louey and Nam Kading NPAs) that could provide incentives for protection of wild tigers and their habitats.

Good legislation.

Law on aquatics and wildlife is already promulgated, providing important guidelines in management and conservation of wildlife in the country. Tigers and key large prey (gaur, sambar, and serow) are listed as Category 1 -protected species[44]. In addition, Laos as a signatory to the CITES, agreed to prevent any trade in endangered species, which includes tiger.

Public attractiveness/support.

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

5.2 Current constraints for tiger conservation

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

Lack of baseline data on tigers and prey

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

Weak law enforcement

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

A high demand for tiger parts in the international market

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

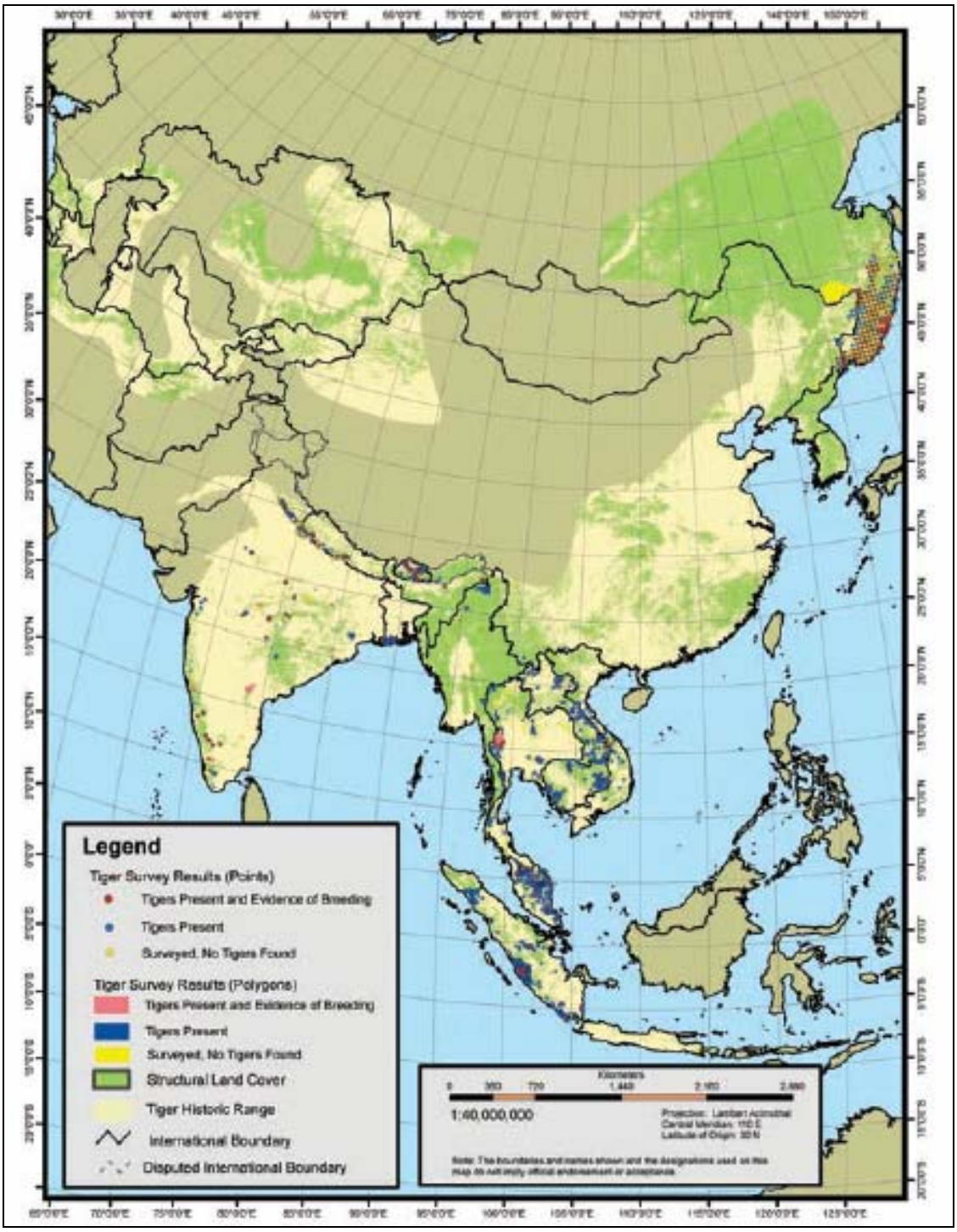
Limited human resources and financial support

Although there are 21 established national protected areas across the country and several more provincial protected areas, very few of these are currently being managed and are dependent on financial support from

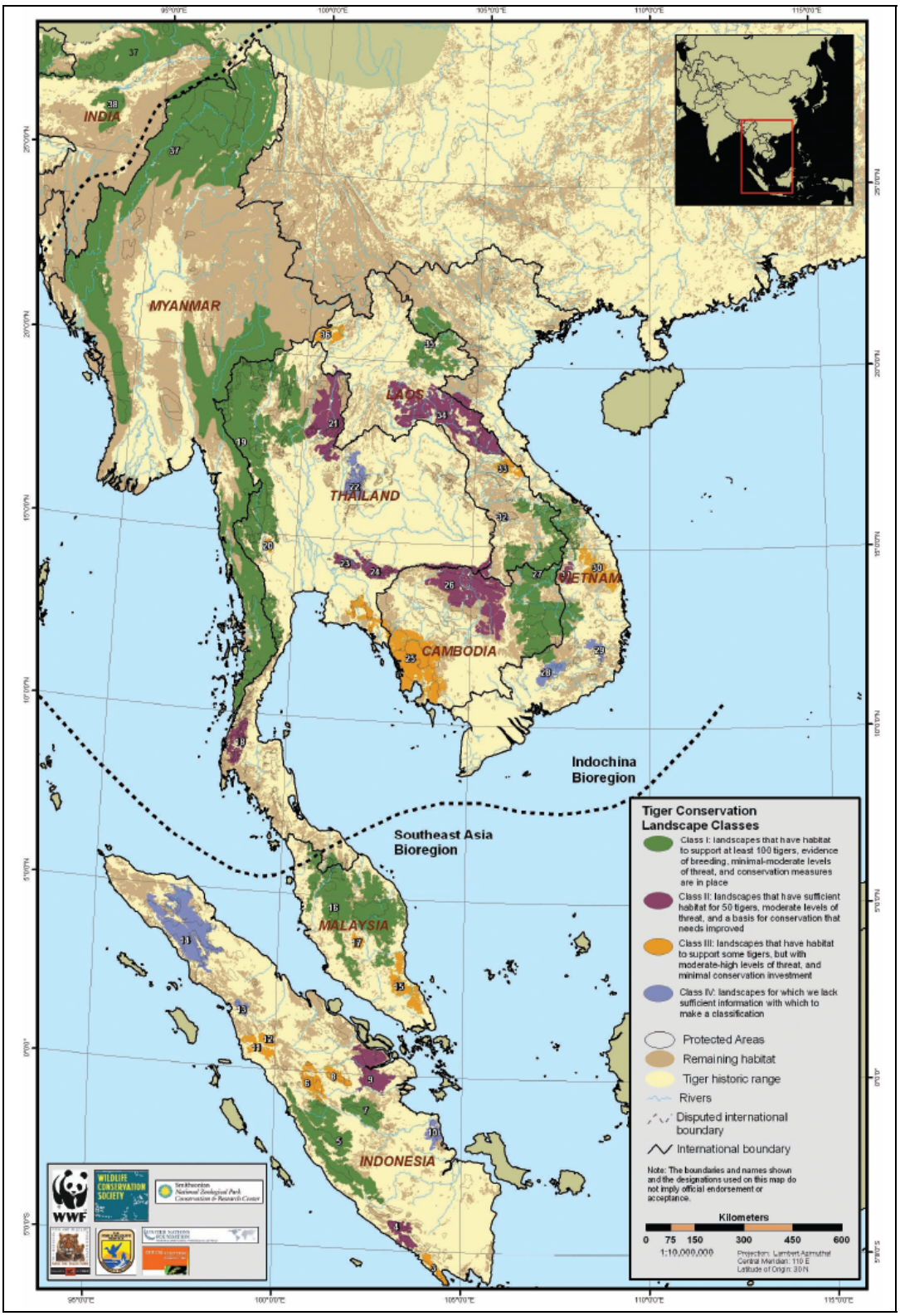
international organizations. The currently estimated level of support for the protected area system (national and provincial protected areas) is only $US0.09/hectare. It is estimated that at least eleven times that amount ($US1.00/hectare) is needed to achieve a minimum level of management in Lao's protected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

Lack of cooperation and coordination among government agencies.

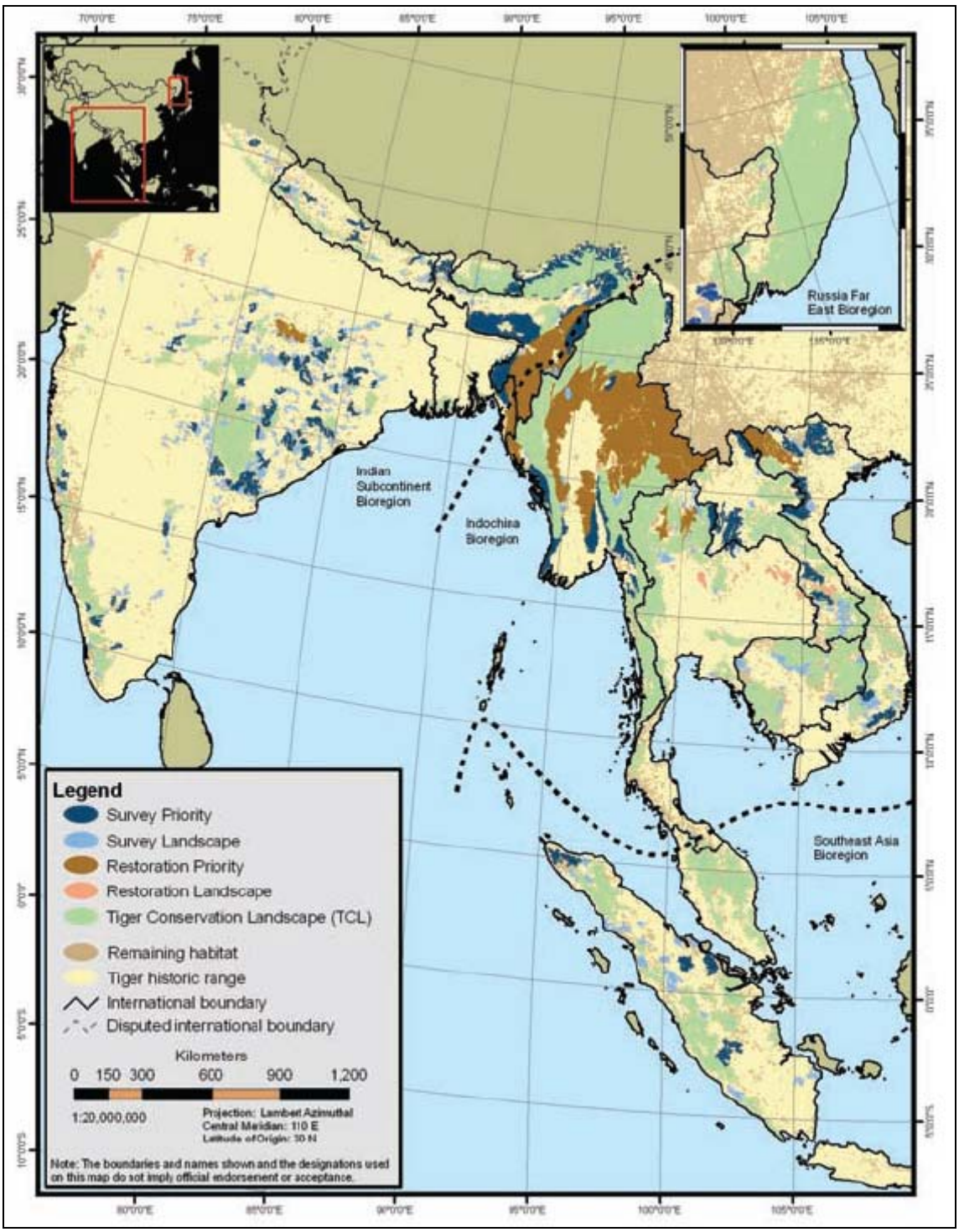
Weak law enforcement is mainly the result of a lack of cooperation and coordination among enforcement agencies including foresters, police, military, commercial and custom officers, and justice. In addition, although national sustainable development strategy shows clear links



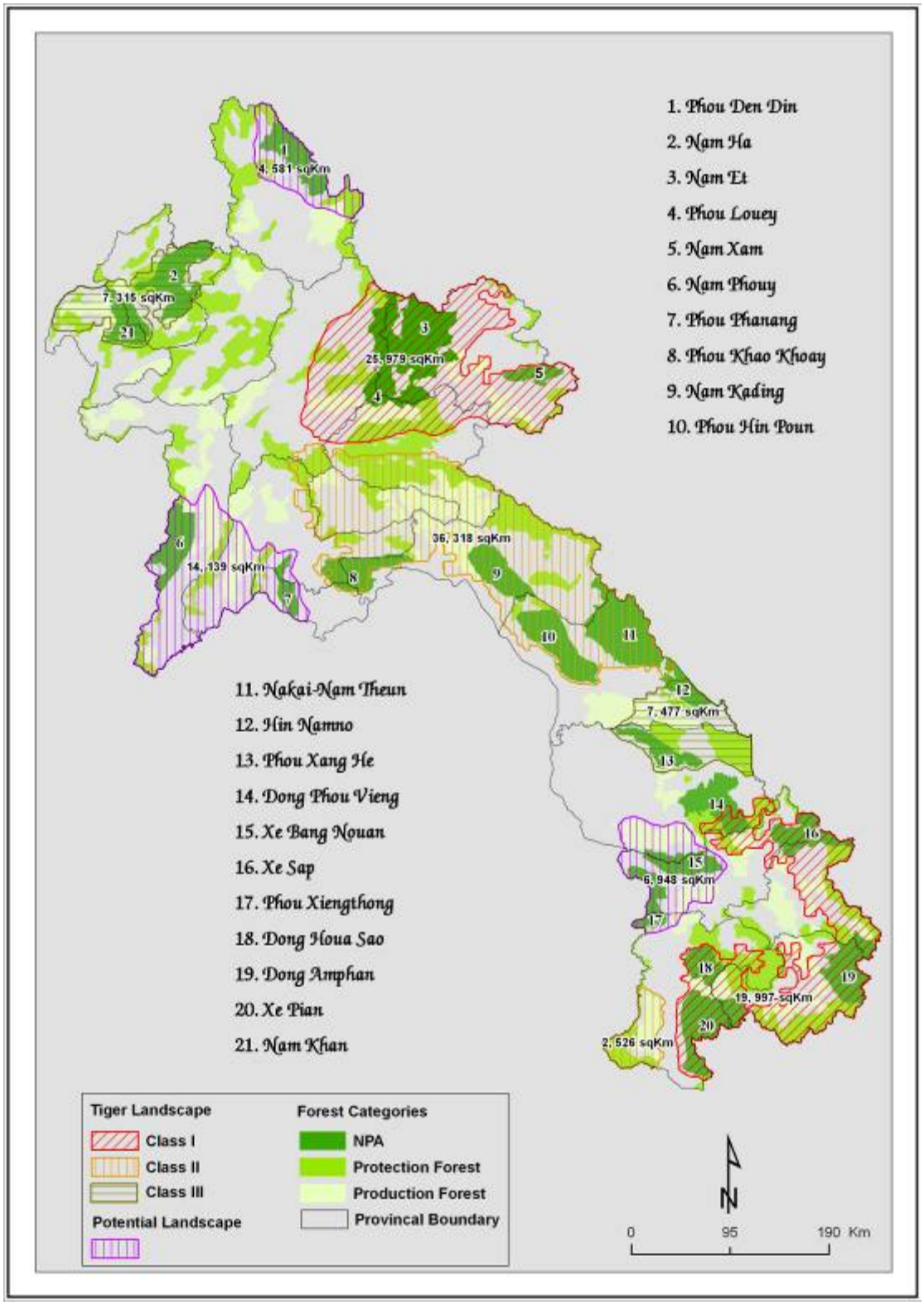
Appendix 1. Tiger survey reports (1995-2005) *(Source: Sanderson et al. 2006)*



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



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



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