

# A NATIONAL TIGER ACTION PLAN FOR THE UNION OF MYANMAR



Myanmar Forest Department,  
Ministry of Forestry, Myanmar

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Wildlife Conservation Society  
International Program

# A National tiger Action Plan For The Union of Myanmar

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Cover illustration: The tiger (*Panthera tigris*) recorded by camera-trap in Htaung Pru Reserve Forest, Tanionthayi Division.

## A GUIDE TO USING THIS DOCUMENT

This document is divided into three sections. An executive summary of findings and general recommendations and a National Action Plan with specific recommendations, a schedule for the implementation of these actions, and responsible agencies is provided in pages 8-13. This is **minimum reading** for decision makers. For readers with some time to appreciate the background and rationale for these actions, PARTS 1-5 of this document (pages 14-43) is **essential reading**. PART 6 (pages 44-62) provides details of the field program that was mounted to acquire the information that provides the foundation for the Action Plan, and is **optional reading**.

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# Errata National Tiger Action Plan for the Union of Myanmar

1. Inside cover. Cover illustration caption is from "Thayet Chaung Township, Dawei District, Taninthayi Division."
2. Contents. Fig. 3 is on p.6, Figs 4-8 are on p.7, Table I is on pages VII-X.
3. p. IV. 1st para. Schedule for implementation is on pages VII-X, PARTS 1-5 is pages 1-12, and PART 6 is pages 23-35.
4. p. VIII. Table I. item 2. k) scheduled for 2004, item 2. l) scheduled for 2004. item 5. a) should read "including recommendations in 2, 3, 4, and below"
5. p. IX. Table I. Item 5. c) should read "soften"; item 7. should read "Monitoring the status of the tiger and prey population to assess the effectiveness of conservation efforts."
6. p. 3. 2<sup>nd</sup> para, 3<sup>rd</sup> to last sentence should read "...for a deposit of US\$12."
7. p. 5. 1<sup>st</sup> para, remove "(see Essay Box 1)."
8. p. 9. 1<sup>st</sup> para, last sentence "25 CITES listed species."
9. p. 32. 5<sup>th</sup> para. should read "...3 globally near-threatened species. 12 CITES Appendix I, 6 Appendix II and 7 Appendix III.
10. p. 34. Fig. 13 no. 1. should read "Thayet Chaung Township, Dawei District, Taninthayi Division."
11. p. 42. Survey area for Sarawati (SRMT) was 254 sq. mi. (650 km<sup>2</sup>).
12. p. 40. Appendix I. Abbreviation for Thaukdut is (TD). Descriptions for sites 16 and 17 should be reversed.
13. p. 47-48. Appendix II. IUCN status for Wild pig is Not Threatened, not on CITES appendix. CITES status for Wild dog (App II), Malayan sunbear (App I), Yellow-throated marten (App III), Crab-eating mongoose (App III), Elephant, Gaur, Tapir, Serow (all App I), Pangolin (App I), *Rangifer* spp. (App II), Black stork (App II).



## PREFACE

The tiger represents many things to Myanmar people and to the Union of Myanmar and its natural wilderness. It is a national symbol for the country, a flagship for conservation, an indicator of intact and healthy forest ecosystems, and a keystone species upon which other biodiversity and the forest itself are dependent. Despite their importance, the status of Myanmar's tiger population was uncertain for many years due to poaching for the trade in Traditional Chinese Medicine (TCM), hunting of their prey species, and forest clearance to meet human needs at the expense of wildlife. In the absence of detailed knowledge about where the tigers live and how they are threatened in those places, plans to conserve the species were thwarted.

In 1999, the Myanmar Forest Department commissioned a study to determine the current status and distribution of the tigers, and formulate an updated national strategy for their future management and conservation. This document "A National Tiger Action Plan for the Union of Myanmar" is the end product of a three-year program conducted jointly by the Myanmar Forest Department and the Wildlife Conservation Society with funding from the US National Fish and Wildlife Foundation and Exxon Mobile's "Save The tiger Fund". I am pleased to say that the program has gone well beyond my expectations. The Plan details what is needed to save Myanmar's tigers from extinction and so provides a valuable prospectus for future conservation. It will become a part of the Myanmar forest policy for recovery of the species.

U Shwe Kyaw  
Director-General  
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## FOREWORD

It is with great pleasure that I introduce the National Tiger Action Plan to the government and the people of Myanmar. Upon first arriving in Myanmar in 1993, I remember how surprised I was by the intense feeling of "rightness" that overcame me. Having worked more than a decade in other parts of Asia I was feeling despair over the future of conservation in the region. I had grown tired of grappling with issues that never got resolved, despite my best efforts, and I was losing faith in the ability of people to realize how important wildlife and wild lands were to the quality and integrity of their lives. It seemed impossible to me at the time that any place I chose to work again would be different. But I was wrong. Myanmar was different.

I had first become interested in Myanmar because of its potential as one of the world's last strongholds for large mammal species such as the tigers, clouded leopards, and Asian elephants. And I hungered to go into the hinterlands of a country that contained the world's last great stands of teak trees, rugged, unexplored mountain ranges, and a diversity of wildlife almost unparalleled in the Asia-Pacific region. But what I had never anticipated was the intelligence, kindness, integrity, and diversity of the Myanmar people, and how seriously the Myanmar Forest Department and the Wildlife Division took their mandate to protect and conserve the country's remaining forests and wildlife.

I am pleased to have had the opportunity for the last ten years to work with staff of the Myanmar Forest Department. I feel honoured to have played a role in helping survey and designate some of the country's and the region's finest protected areas, such as Hkakabo Razi National Park and Hukaung Wildlife Sanctuary. But our work is only beginning. I was saddened to learn the results of the tiger surveys that were carried out by WCS and the Myanmar Forest Department. Yet I was heartened by the fact that there were still places of intact habitat where the tigers and other wildlife had a chance for the future if proper actions were taken.

This National Tiger Action Plan compiled by Dr. Antony Lynam and the Myanmar Forest Department is a landmark document. Nothing of this magnitude has been compiled for any country where the tigers still roam. But this document should not simply be viewed as a finished product to be placed on a shelf. It is a realistic plan of action that, if followed, could bring the tiger, a national treasure, back to Myanmar in numbers that will guarantee their future in the region for many generations to come. I am optimistic that the government and the people of Myanmar will do what needs to be done to save the tiger and the other spectacular wildlife species that wander their forests. And I hope that I and other WCS scientists will continue to have the opportunity to assist in any way possible towards this end.

I was correct about the feeling of "rightness" when I came to Myanmar in 1993. I hope I am also correct that in the years to come, Myanmar will point to its forests and wildlife with pride, and they will be held up as an example to other countries of what is possible when one cares about its natural heritage.

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## ACKNOWLEDGMENTS

A vast number of people made this project possible. Firstly, the Minister of Forests, Director-Generals U Soe Tint, U Shwe Kyaw, and former D-G U Kyaw Tint, and U Khin Maung Zaw, Director of the Nature and Wildlife Conservation Division. Territorial staff of the Forest Department, the Local Commander of Taninthayi Division, and U Tun Paw Oo, Director of the Taninthayi Forest Department. U Aung Than wrote the first NTAP in 1996. In 1998 at the Saving the tiger Conference in Dallas, Texas, he and U Uga made the call for a revised NTAP. The field assessments were carried out by U Saw Htoo Tha Po, U Myint Aung, U Myint Maung, U Kyaw Thinn Latt, U Tin Mya Soe, U Sein Aung Min, U Thein Lwin, U Khin Maung Htay, U Tun Tun Lwin, U Moe Myint Aung, U Zaw Naing Tun, Daw Myint Myint Oo and Daw Khin Htay. U Kyaw Thinn Latt assisted with data management and analysis. U Saw Tun Khaing and U Than Myint coordinated with the Forest Department to initiate and guide the project. Drs Alan Rabinowitz, Joshua Ginsberg, Madhu Rao of the Wildlife Conservation Society provided advice on project design and implementation. They and Drs Tim O'Brien and Dale Miquelle (WCS) provided comments on this Plan. Workshops with WCS the tiger workers in New York (1999) and Thailand (2001) inspired some of the considerations for conservation action described in this report. Thanks to Dr Alan Rabinowitz for helping us see the big picture of the tiger conservation, and to Dr Ullas Karanth who showed us how the tigers can recover from the seemingly most impossible situations. Finally, the project was made possible with a generous grant from the "Save The tiger Fund", a joint project of the US National Fish and Wildlife Foundation and ExxonMobile Corporation, and from the Michael Cline Family Foundation. Initial funds for implementation of this conservation strategy are being made available by USFWS, the Nancy Abraham Conservation Fund and the "Save The tiger Fund".



# EXECUTIVE SUMMARY OF FINDINGS AND RECOMMENDATIONS

## 1. Background

A hundred years ago the tiger (*Panthera tigris*) occurred across Asia from eastern Turkey to the Russian Far East and south to the Indonesian archipelago. Myanmar is one of fourteen countries in Mainland Asia where the tigers persist today.

Reports and anecdotal information from surveyors, hunters, foresters, consultants and researchers attest to the former widespread occurrence of the tigers in Myanmar, except in higher elevation areas in the north. That the tigers existed over wide areas in the past was partly due to the existence of large expanses of intact habitat where human population density was low and disturbance to the tigers and their prey was minimal.

Recent attempts to quantify Myanmar's the tiger population were hampered because while rapid assessments for wildlife had been made in many areas, standardized survey methodologies for the tigers were not yet available.

While the tiger status remained uncertain, the trends for the tigers and their habitats are well understood. Widespread loss of habitat with changing land use patterns, and the uncontrolled hunting of the tiger prey, along with sport hunting, and commercial hunting for the tigers spurred by a recent demand for traditional medicines in Asia led to the demise of the tigers in the past. By the early part of the 20th Century thousands of the tigers had been reported killed in Myanmar.

Myanmar lost 25% of its forest cover, potential habitat for the tigers and other wildlife between the 1940's and 2000 (FAO, 2000). By 2002, 4.73% (31,792 km<sup>2</sup>) of the country was either formally protected or proposed for protection. The tigers require large areas of contiguous habitat, usually 3,000- 15,000 km<sup>2</sup> in size for long-term survival. While forest areas of this size exist in the country only three areas are currently protected. Nearly 80% of the protected areas are less than 1,000 km<sup>2</sup>, with 10 areas less than 100 km<sup>2</sup>.

## 2. Summary of activity and main findings

As a first step towards long-term future planning for the tigers in Myanmar, and to guide efforts to identify new areas for protection, a project to develop an updated National The tiger Action Plan was initiated in 1998. The primary objective of the program was to determine the tiger occurrence via direct field survey across potential the tiger habitats, and use this information to select areas for special protection for the tigers.

The tigers may serve as conservation "umbrellas". This is the concept that protecting places with the tigers effects the conservation of other wildlife and biodiversity elements with smaller ranges.

The Myanmar Forest Department and the Wildlife Conservation Society initiated the program with financial support from the "Save The tiger Fund," a joint project of the US National Fish and Wildlife Foundation and Exxon Mobile Corporation.

A the tiger conservation and survey techniques training workshop was conducted for Forest Department and NGO junior staff at Alaungdaw Kathapa National Park, historically known for its the tigers. From the training, a team of seven participants was recruited to carry out field surveys, and conduct awareness work in communities adjacent to survey areas.

Using the results of a previous planning analysis for the tigers, and updated maps of forest cover, a set of 17 potential tiger areas were identified from large blocks of forest. Interviews of local people were done to determine likely places where the tigers existed in these forest complexes and guide the selection of survey locations.

Using a field technique first developed in India, and modified for use in Southeast Asia, a team of trained staff conducted presence-absence surveys for the tigers at each site. A field survey effort during 1999-2002 involving > 15,000 nights with camera-traps, and > 1,300 hours of sign searching across 5,500 km<sup>2</sup> of potential the tiger habitat

revealed the following results:

- The tiger occurred in less than a quarter of the potential areas;
- Based on the results of field surveys, the tigers have disappeared from five areas surveyed; Alaungdaw Kathapa, Thaungdut, Mahamyaing, Nankamu, Panlaung-Pyadalin;
- Based on the results of field surveys, the tigers have disappeared or occur at very low density in eight of the areas surveyed; Paletwa and Kaladan river catchment area, Sumprabum, Khaunglanphu, Paunglaung, Momeik-Mabain, Central Bago Yoma, Rakhine Elephant Range, Saramati Taung and adjacent areas;
- Based on reports from forestry officials, the tigers may occur at low density in two other areas that were not surveyed; Shan Yoma (Kayah-Kayin) and S. Kachin;
- Based on the results of field surveys, the tiger occur in Htamanthi Wildlife Sanctuary, Sagaing Division and surrounding areas. The population is small (<10 individuals) and is threatened with extinction;
- Based on the results of field surveys, the tigers occur in a large intact forest landscape comprising Hukaung Valley and surrounding areas, in Kachin State. Moderate numbers (<50) of the tigers are thought to exist there;
- Based on the results of field surveys, the tigers occur in a large intact forest landscape in northern and southern Taninthayi Division. A relatively large (>50) population is thought to exist there. Together these areas represent the largest, intact habitats for the tigers in Mainland Southeast Asia;
- In all areas where they persist in Myanmar the tigers are threatened by poaching for commercial international trade, and poaching of prey for local consumption and local trade;

Based on information collected during the field survey program, probably no more than 150 the tigers now exist in the wild in Myanmar and the population is rapidly declining. The tiger might soon be on the verge of extinction in Myanmar if action is not taken immediately.

#### **Recommendations for addressing conservation needs of the tigers**

Although the situation is critical, the tiger populations may potentially be recovered if the Government makes an immediate and long-term plan of action.

The priority actions necessary in the short-term (2-5 years) for saving the tigers are;

- Establish protected areas, protected corridors and priority management areas in and around the Hukaung Valley, and in Taninthayi Division to protect wild the tigers and their habitat;
- Establish monitoring programs for the tiger and prey population in these places to assess the effectiveness of conservation efforts;
- Reduce killing of the tiger prey species and trade that has developed around those species. Train government staff in anti-poaching and anti-trafficking techniques and develop systems for patrolling these areas to ensure the preservation of these resources;
- Suppress all killing of the tigers and the illegal trade in the tiger products. Amend existing wildlife legislation to fall in line with international laws. Conduct wildlife conservation and awareness training for government personnel and recruit them to help identify and suppress wildlife trade;
- Define roles and responsibilities of field staff responsible for the tiger conservation;

The priority actions necessary for saving the tigers in the long-term (6-20 years) are;

- Improve public awareness and develop education curricula concerning the importance of the tiger conservation to increase support from local people;
- Stop further loss of the tiger habitat and to restore degraded habitat by practicing sustainable forest management;
- To conduct zoning of forest areas so as to avoid development and human intrusions inside the tiger critical habitats;
- Strengthen international cooperation to maintain connectivity of the tiger habitat across international boundaries possibly through the establishment of cooperative management of contiguous protected areas along borders.

TABLE 1. NATIONAL TIGER ACTION PLAN FOR MYANMAR

Action	Organisation collecting		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
1. Suppressing all killing of tigers and the illegal trade in tiger products at national, Provincial Wildlife and Protected Areas Law enforcement of international conventions within Myanmar. This would include articles prohibiting the sale to port level of products originating or implying origin of tiger bone, tiger organs, blood, teeth, claws or hair.	Myanmar Govt		✓				
1a Impose heavy fines for offenders and use national authorities implementing international legislation.	Myanmar Govt		✓				
1c Conduct wildlife conservation and awareness training for 1000 government personnel including military, customs, police, immigration, provincial administrative staff in Yangon, Mandalay, Naypyitaw and other international transit points for wildlife. This would include border, customs, immigration, wildlife personnel, border, and international, application and knowing their protection status.	Myanmar Govt & WCS	WCS and other NGOs	✓				
1d Conduct wildlife enforcement and awareness training for all staff in tiger sites and landscapes.	Myanmar Govt & Ministry of Forestry	WCS and other NGOs	✓				
1e Recruit local government staff to help identify illegal trade and encourage them to report such observations to relevant authorities.	Myanmar Govt	WCS and other NGOs	✓				
2. Reducing killing of tiger prey species and associated trade	Myanmar Govt	WCS and other NGOs		✓			
2a Amend the Protected Wildlife and Protected Areas Law to make the enforcement of international laws within Myanmar. Ministry of Forestry Article 15 to recognize the international classifications of wildlife species, and their associated protection status.	Myanmar Govt	WCS	✓				
2b With the view to protecting tiger prey species, allow the commercial farming of only selected wildlife species only in facilities designated by the Forest Department.	Myanmar Govt		✓				
2c Take action to stop all killing of prey species at places where tigers are naturally or potentially found.	Myanmar Govt	WCS and other NGOs				✓	
2d Train government staff in the Kung Valley and Phawngtharyin to anti-poaching and anti-trafficking techniques. Where possible involve local military personnel as instructors.	Myanmar Govt	WCS	✓				
2e Recruit teams of 200 persons whose sole responsibility is protection. Numbers of 100 persons should be at least 2 rounds 100 km2 for effective management. Training for 100 persons with necessary equipment and salary incentives to motivate them to combat poaching.	Myanmar Govt	WCS		✓			
2f Develop warrents patrolling major all protected areas using beatrangers. Main patrolling a mandatory management activity with a monthly schedule and budget.	Myanmar Govt			✓			



Action	Organization delivering	Timeframe / to be completed by				
		Lead	Other possible relevant partners	2003	2004	2005
g) Update the Wildlife Law to include protection for wildlife outside protected areas, and empower government staff to enforce the legislation.	Myanmar Govt		WCS	✓		
h) Outside protected areas, study patterns of hunting and consumption of wildlife to determine its sustainability, especially for prey species.	WCS				✓	
i) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Protected status to Completely Protected, such as Wild buffalo ( <i>Bubalus bubalis</i> )	Myanmar Govt.			✓		
j) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Seasonally Protected status to Protected status: Hog deer ( <i>Axis porcinus</i> ) and barking deer ( <i>Muntiacus muntjak</i> ).	Myanmar Govt.			✓		
k) Wildlife conservation and awareness training for all wildlife offenders.	Myanmar Govt.		WCS	✓		
l) Impose fines for wildlife offenders in tiger areas with proceeds towards supporting tiger conservation activities.	Myanmar Govt.					
<b>3. Improving forestry management to stop further loss of tiger habitat and to restore degraded habitat</b>						
a) The National Code of Forest Harvest Practice involves 30 year cutting cycles, a no use of elephants for removal of logs reduce environmental damage over other practices. Apply this traditional method of forest harvest effectively in a fewness in the country.	Myanmar Govt.		WCS, FAO, UNDP		✓	
b) Ban the hunting of wildlife in forest reserve areas.	Myanmar Govt.		WCS			✓
c) Provide wildlife conservation awareness and education training to timber harvest staff.	WCS		Myanmar Govt.	✓		
d) Define Strict Conservation Zones for Hkakum Valley and Hkamti where no human use of natural resources is allowed. Create buffer areas to a low restricted use by local people (including extraction of non-timber forest products, fuel wood collection, and livestock grazing). Ban shifting cultivation and hunting of animals in the buffer area. Use EcoBarge patrol teams to enforce the restrictions.	Myanmar Govt.		WCS	✓		
<b>4. Improving forestry management to reduce intrusions of local people into tiger habitat, and improve planning to avoid development in tiger critical areas</b>						
a) Reclaim plantations and revoke all mining licenses in Hkakum valley and Hkamti Wildlife Sanctuaries.	Myanmar Govt.					✓
b) Consider the location of government, camps and permanent settlements outside of these reserves.	Myanmar Govt.					✓
c) Stop the construction of roads in protected areas and forest reserves.	Myanmar Govt.			✓		
e) Close or limit access along logging roads in Taungtha Division to reduce the risk of collisions with tigers.	Myanmar Govt.				✓	
d) Include wildlife assessment in land development programs for Lamthaung Division.	Myanmar Govt.		WCS	✓		
f) Develop education programs to improve awareness about wildlife for local people living in and around forest reserves in Taungtha Division.	WCS		Myanmar Govt.	✓		
<b>5. Establishing protected areas, ecological corridors and priority management areas to protect wild tigers and their habitat</b>						
a) Review current management plans for the Hkakum Valley and Hkamti to include specific actions for conserving tigers, including recommendations in 6.2.2, 6.3.2, and 6.4.2, and below.	Myanmar Govt. & WCS			✓		

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2013	2014	2015	2016	2017
b) Expand Hkamti Wildlife Sanctuary to increase its size to at least 3,000 sq. km to ensure long term survival of tigers	Myanmar Govt.	WCS	✓				
c) Create a dedicated tiger reserve including the Hukong Valley and adjacent forest reserves. The reserve will serve to link tiger populations in India with those in Myanmar. Expand the eastern border of Hukong Valley Wildlife Sanctuary to protect potential tiger habitat in the Sangreben area.	Myanmar Govt.		✓				
d) Establish in-tiger human use zones (buffer) that will buffer the edges of Hukong Valley and Hkamti reserves reducing the risk of mortality for tigers.	Myanmar Govt.		✓				
e) Create new protected areas or special tiger management zones (i.e. the Taitung and Eileishan, including the Lanya River, Greater and Lesser Taitung River catchments). These areas will protect tigers and their habitats and allow limited human use of natural resources around the reserves in a manner complementary to tiger conservation.	Myanmar Govt.						✓
f) Use existing GIS capabilities in the PD to identify and delineate special management zones and corridors for tigers.	Myanmar Govt. & WCS		✓				
<b>5. Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of tiger habitat across international boundaries</b>							
a) Corridor wildlife conservation and awareness training for (1) government personnel, including military, customs, police, immigration and local administrative staff; students, researchers and country leaders. This would include basic training in identifying wildlife listed in the Myanmar Protection of Wildlife and Protected Areas Law 1994, and knowing their protection status.	Myanmar Govt. & WCS		✓				
b) Hold 2 internal workshops involving local government officials to discuss trans-border issues including trade, trafficking and wildlife, and develop plans to suppress the trade.	Myanmar Govt.	WCS	✓				
c) Recruit local government officials on both sides of the Thailand border to suppress trans-border wildlife trade at Mae Waung, Prachin Kiri Kiri, Kabinrang Ban 1 Tong, Kawthuan-g-Rang especially Thai Hui Island, Myawady Mae Sot, Thae Pagoda Pass, and Tadulets Mae Sot, and prevent access by professional poachers from Thailand.	Myanmar Govt. Thailand Govt.	WCS		✓			
d) Create a tiger reserve in Taitung Division opposite Thailand protected areas that support large populations of tigers, Western Forest Complex and Kaeng Krachan National Park.	Myanmar Govt.			✓			✓
e) If possible expand the reserve or create new reserves to form a corridor between these two Thai reserves.	Myanmar Govt. & WCS Thailand Govt.	WCS			✓		
f) Develop a specially explicit tiger conservation database for the Huet Kha Khaeng - Thung Yai Naresuan TCU (level 1 TCU T3).	Myanmar Govt.				✓		
g) Where possible coordinate anti-poaching patrols and/or wildlife surveys on both sides of the Thailand-Myanmar border.					✓		
<b>7. Monitoring the status of the tiger and core population to assess the effectiveness of conservation effort for Hukong Valley landscape</b>							
a) Identify critical habitats and core areas for tigers and prey across the landscape.	Myanmar Govt. WCS		✓				
b) Estimate numbers of female tigers within the landscape and ascertain that there is a reproductively viable population of tigers.	Myanmar Govt. WCS		✓				



Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
m) Determine the current threats, demography, sex, and range of human activities that must be taken into account if the proposed landscape is to be successful and sustainable in the long term.	Myanmar Govt. & WCS		✓				
n) Create a GIS map and database to show current and the patterns, possible future land use trends, and tiger and prey source areas.	Myanmar Govt. & WCS		✓				
<b>For Faunahabitat Division, knowledge:</b>							
a) Train local foresters how to identify tiger and prey via sign surveys, use of camera traps for wildlife survey, and methods for making observations and recording data.	WCS			✓			
b) Determine occupancy of habitats at accessible sites across the landscape, including Myanmar sub-habitat and Lantia River areas, away from sites where tigers are known.	Myanmar Govt. & WCS			✓			
c) Determine prey abundances along line transect sampling.	Myanmar Govt. & WCS			✓			
<b>To Determine tiger abundance using double video camera trap sampling:</b>							
<i>For sites in Pakejwa and Kabanla river catchments, Sampraburn, Khawngkengpho, Pampaphang, Monah, Mahab, Central Range Yoma, Rakun, Elephant Range, Saranant Range area.</i>							
ii) Train forest foresters how to identify tiger and prey via sign surveys.	WCS		✓				
iii) Determine occupancy of habitats at the sites using sign surveys.	Myanmar Govt. & WCS		✓				
iv) Establish a logbook to record observations of tiger and prey, and animals use of the logbook.	Myanmar Govt. & WCS		✓				
<b>8. Improving public awareness of the importance of tiger conservation and increasing support from local people</b>							
a) Develop wildlife education programs to discourage hunting by local people in and near tiger reserves. When possible recruit local people, especially ex-hunters to help implement these programs.	WCS			✓			
b) Involve 50 local people in wildlife survey and research activities to make positive use of their local or indigenous knowledge.	WCS	Myanmar Govt.	✓				
c) Collaborate with authorities in charge of development projects to include wildlife conservation as a component of these projects and resolve any potential conflicts between the needs of people and wildlife.	Myanmar Govt. & WCS		✓				
d) Produce a documentary about tiger conservation in Myanmar and broadcast it on National television.	WCS			✓			
e) Dub existing wildlife documentaries about Myanmar into local language and broadcast.	WCS		✓				
f) Adapt WCS education materials about tigers into Myanmar language and implement a special training program for school children at selected high schools in Yangon, and adjacent to tiger reserves.	WCS			✓			
<b>9. Defining roles and responsibilities of personnel responsible for tiger conservation</b>							
a) Provide special training for managers of tiger reserves in management techniques, including leadership skills, decision-making, planning, protection, use of information and technology, and personnel management.	WCS		✓				
b) Assist managers of tiger reserves to observe the day to day operations in selected tiger reserves in India and Thailand.	WCS	Thailand India Govts.		✓			
c) Define roles for junior staff in Hukang Valley and Hukang Valley Wildlife Sanctuaries, and for Tanintharyi Division junior forestry staff and staff in other areas in conducting field monitoring of tigers and prey.	Myanmar Govt.		✓				

# PART 1

## INTRODUCTION

Myanmar is a high priority country for biodiversity conservation in Asia with extensive forested landscapes, high species diversity and endemism (Wikramanayake et al. 2001). This diversity ranges from rich alpine floras and tropical pine forests in the north, to dry dipterocarp and mixed deciduous forest in central dry zone, to tropical rainforests in the Peninsular. Coral reef ecosystems in the Myeik Archipelago are among the least disturbed in the region.

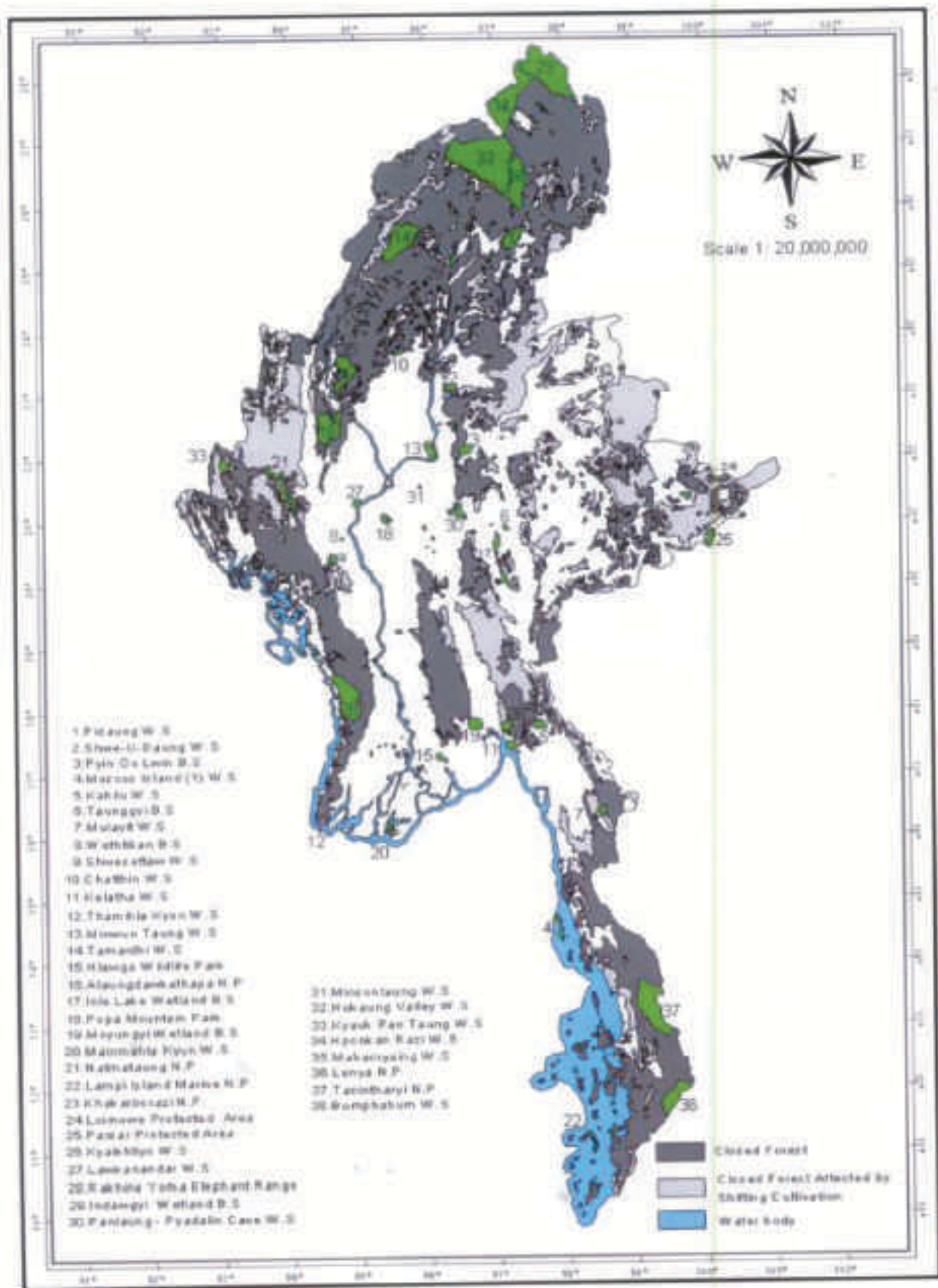
Unique to the region natural forests in Myanmar cover a third of the country, including large intact expanses with low human inhabitation (UNEP 1995). Prior to 1994 the country had <1% of lands in protected areas but by 2002 this had increased to just under 5% (Fig. 1), a 500% increase in size in less than a decade. While most reserves in the system are too small to support the tigers, later additions to the system include large expanses of forest and corridors between areas that are more than enough to support

the tigers as well as other species with large area requirements.

Deforestation in neighbour countries brought about by unsustainable land-use practices has led to pressure on Myanmar's natural resources, especially in border areas in the far north and south which contain high biodiversity but are difficult to access and monitor. Logging, extraction of forest products, loss and fragmentation of forests and hunting have reduced wildlife populations and their habitats.

The remainder of this essential reading section includes a review of the pressing threats to the tigers in Myanmar (Part 2), a review of the history of conservation planning for the tigers (Part 3), a summary of the current status and distribution of the tigers in the country (Part 4), and a rationale for the National Tiger Action Plan (Part 5), with proposed solutions for addressing the threats, for recovering the tiger populations and guiding future conservation efforts in the country.

FIG. 1. FOREST COVER, EXISTING AND PROPOSED PROTECTED AREAS OF MYANMAR – 2002.





## PART 2

### THREATS TO THE TIGERS

Although the tiger is potentially found over a wide range of habitat and disturbance conditions, it is sensitive to a variety of human influences. The prospects for the tiger survival in places where they occur in Myanmar are affected by a number of key threats;

#### **2.1 Hunting for commercial trade in the tiger products**

The hunting of the tigers has a long history in Myanmar- (Pollok & Thom 1900). The tigers were traditionally considered pests and until 1931 the government provided licenses and rewards for killing them. This led to depopulation on a massive scale through sport hunting. For example, during a 4 year period from 1928- 1932, 1,382 the tigers were reported killed in British Burma (Prater 1940), an order of magnitude larger number than the current the tiger population in Myanmar. The tigers were historically widespread in Myanmar (Fig. 2) although their densities were not uniform across intact habitat, possibly a result of variation in hunting pressures from place to place (Prater 1940). More recently, declining the tiger populations across the range combined with increasing prosperity of Asian countries, have led to an increasing demand for the tiger products for traditional Chinese medicines.

Various tribal groups hunted the tigers to supply the trade (Rabinowitz 1995) leading to their extirpation in some areas (Rabinowitz 1998). The sale of the tiger products was banned by CITES since 1975 but thrives in the black market, especially in some border areas where it is uncontrolled (Fig. 3a). Although it is difficult to measure the size of the trade, at least 10,000 kg of the tiger bone representing 500-1,000 the tigers was imported by East Asian countries between 1970 and 1993 (Hemley & Mills 1999). The tiger hunting continues in those areas that still contain the tiger (Fig 3b.). As the population declines every the tiger killed makes the harvest an increasingly unsustainable one. To demonstrate the efficiency of the trade, Myanmar shopkeepers on the Thai border claim they can provide a tiger within 3 days for a deposit of only 500 Baht. Direct hunting of the tigers threatens to drive the Myanmar population to extinction. Improved domestic legislation combined with monitoring of markets and law enforcement can contribute to reducing the trade in the tiger parts.

#### **2.2 Prey depletion**

Because it is dependent on a relatively large intake of food to support its metabolism, the tigers are sensitive to loss of prey through hunting (Karanth & Stith 1999). The erosion of available energy has a "bottom-up" effect on ecosystem structure (Seidensticker 2002). Myanmar's per capita income in 1998 was US\$1,200, making it one of the poorest countries in the world. People living in and around forested areas traditionally hunted wildlife for subsistence. More recently local people hunt to supplement increasingly meager incomes from farming. This trend is widespread (Rabinowitz 1995) occurring in up to 70% of protected areas (Rao et al. 2002). Trade in the tiger prey species occurred near all the places where the National tiger Team conducted field surveys during 1999-2002. The illegal trade in wildlife is globally worth \$7 billion a year, only less than the trade in arms and drugs (Kanwatanakid et al. 2000). Myanmar is a part of the trade in Asia with a network of markets and routes established to supply the demand in China and Thailand. Markets for the sale of wild, meat and trophies, of the tigers and prey species have existed along the Thai border at Tachileik, Myawady, Three Pagodas Pass and Maung Daung for a long time and continue to offer wildlife prohibited by CITES (Bradley-Martin & Redford 2000; Hill 1994; International 1999; Bennett and Rao 2002).

The volumes of wildlife in the trade fluctuate according to the security situation, and decreased following the cancellation of Thai logging concessions after 1993, and escalation of hostilities between KNU and the Myanmar government after 1996 (International 1999). There is some evidence to suggest that some of the Thai border wildlife trade may have moved to Yangon. As an example, several restaurants and shops in central Yangon offers a range of wild meat dishes, and tonics made from animal parts (A.J. Lynam personal observation). In contrast, wildlife trade is rampant and uncontrolled in Shan State, especially towns near the China border (Than 1998) (see Essay Box I; Fig. 4.). Prey and the tiger populations may be restored in the wild if they can be protected from hunting and wildlife trade (Madhusudan & Karanth 2002).

Fig. 2 Historical Records (Pre - 1999) of Tiger Occurrence in Myanmar.

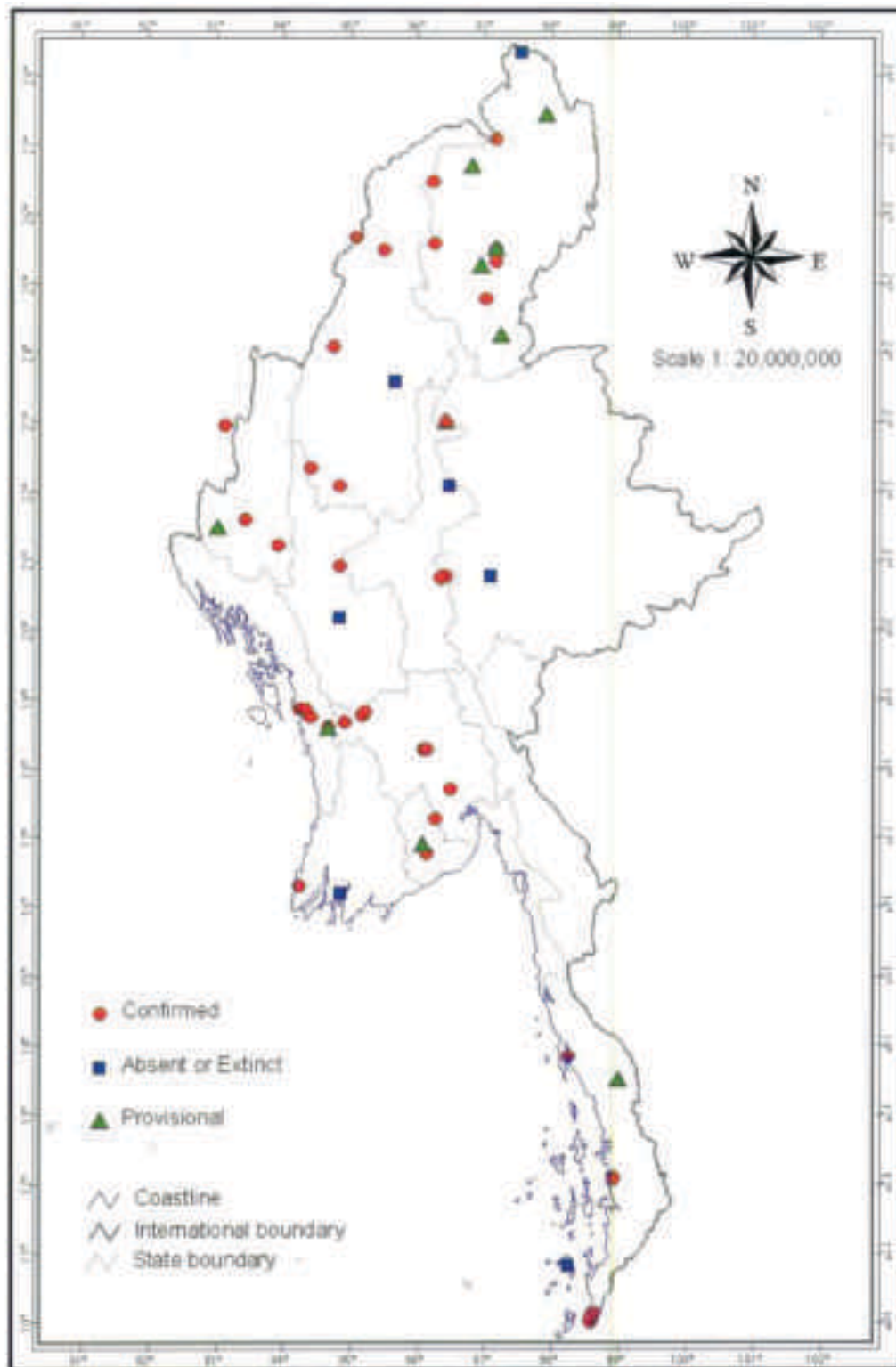






Fig. 3a. Tiger skin for sale in Tachileik market, Shan State.



Fig. 3B. Poacher recorded by camera-trap at Paunglaung Catchment, Mandalay Division. Poaching of tigers was the single most important factor causing the demise of tigers in Myanmar in the past.

### 2.3 Habitat loss, degradation and fragmentation -

Myanmar had an estimated 46.6% closed forest cover in 1990, with 37.4% remaining in 1997 (FAO 2000), one of the highest levels in the Asia - Pacific region. The net deforestation rate between 1989 and 2000 was 0.21% (Brunner et al. 2002), a fraction of the deforestation rate in Thailand during the same period. Deforestation is highly concentrated and is largely a result of logging in forest reserves (Rao et al. 2002)(Fig. 5). While forests are easily cut down they are only restored with great investments of time and resources (Elliott et al. 2000), usually beyond the capacity of forestry budgets. Except in parts of Shan State, where remaining forest resembles the highly fragmented situation in Thailand, large extensive tracts of closed forest characterize the Myanmar landscape providing good potential the tiger habitat (Fig. 1). Disturbance that degrades or destroys natural forests, including grazing by domestic animals, shifting and permanent cultivation, mining, permanent human settlements, and plantations occur in 90% of protected areas (Rao et al. 2002). These threats could be reduced by improved agricultural and animal husbandry practices, and improved land-use planning.

### 2.4 Harassment and displacement -

Rural development has progressed slowly in Myanmar so that dams, roads, pipelines, power lines, and settlements -infrastructure that disrupt wildlife populations by creating barriers to dispersal (Goosem 1997) -have had localized effects on the tiger

populations. For example, roads occur in only 25% of Myanmar protected-areas (Rao et al. 2002) (Fig. 6) and most are non-paved and seasonal access only. However, roads whatever their condition provides improved access to forests for poachers. Because the tigers often use non-paved roads as movement corridors, this potentially increases the chances of encounter with humans. Aside from human infrastructure, the disturbance caused by local people entering forests to engage in the extraction of non-timber forest products (Fig. 7.) can have adverse affects on the tiger behaviour. Such disturbances occur in 85% of protected areas (Rao et al. 2002), and



Fig. 4. Wildlife for sale at Mongla market, Shan State.



Fig. 5. Logging reduces available habitat, and alters habitat quality for tigers and their prey.

probably reflect the incidence in non-protected forests, so the effect may be considerable. Improved land use planning and zoning in forest reserves can reduce the threat from internal fragmentation.

## 2.5 Genetic erosion -

A number of studies have shown that small populations are more likely to go extinct than large ones. One of the reasons is that at small size, survival rate or reproductive rate of a population is reduced because its members have difficulty finding mates, sex ratios are skewed, and they tend to breed with related individuals (Allee 1931). This results in a net loss of genetic variation, sometimes expressed by an increase in expression of deleterious mutations



Fig. 6. Road construction opens up the forest facilitating access to poachers.



Fig. 7. The extraction of rattan and other non-timber forest products is often done on a massive scale and affect habitat quality

through homozygosity. Fitness is often reduced in the process. Despite this, many populations have persisted for long-periods of time with low levels of genetic variation e.g. cheetahs (Caro 2000). It is likely that genetic and demographic processes interact so that as populations decline it is increasingly harder to recover them (Gilpin & Soule 1986). The tigers in severely fragmented habitats in Myanmar would fall into this category. Maintaining natural corridors between forest patches inhabited by the tigers can reduce this threat.

## 2.6 Protected area management -

Myanmar is one of the least externally funded and internally protected tropical countries in Asia (Balmford & Long 1995) .As a result while



Fig. 8. Myanmar foresters undertaking basic wildlife tracing with the author, Alaungdaw Kathapa National Park, December 1998.

forests have been conserved for timber production for almost 150 years (Bryant 1997), and the earliest protected area was gazetted in 1918, legislation to protect both wildlife and their habitats was only introduced in 1994. Wildlife training for protected area staff was initiated in 1995 with only a third of staff having received training (Rao et al. 2002) (Fig. 8). Only since 1998 have protected areas been designed to protect entire landscapes and the ecological processes within. Consequently, many of the older protected areas e.g. Pidaung Wildlife Sanctuary, no longer support the tigers and other wildlife because of large-scale degradation and loss of habitat inside them. A recent review found that human activities incompatible with conservation occur in every protected area (Rao et al. 2002). Extraction of non-timber forest products occurred in 85% of the areas, hunting in up to 70%, while buffer zones for the protection of core forest zones were generally lacking. The combined effect is a loss of habitat quality for the tigers. Myanmar protected

areas (Fig. 1.) currently do not provide adequate representation of the diversity of habitats inhabited by the tigers. Reserve managers need training to understand threats to wildlife, and how to best manage available resources to enable effective conservation of wildlife. In general, the roles and responsibilities of protected area staff need to be carefully defined so that available personnel cover important tasks.

## **2.7 Social perception -**

Where the tiger populations have been decimated, their long-term recovery can be ensured only by a combination of political will and acceptance by people living in and around the tiger areas. If the tigers are worth more dead than alive to local people, then efforts to preserve the tigers in the human dominated landscape will fail. Awareness and education of the importance of the tigers can be improved through dedicated learning programs.

## PART 3

### BRIEF HISTORY OF CONSERVATION PLANNING, FOR THE TIGERS IN MYANMAR

Previous attempts to estimate the Myanmar the tiger population were based on habitat models. Using information on existing forest cover (Collins 1991), and assuming the tiger densities of 0.6-1.0 individuals/100 km<sup>2</sup> from other places (Rabinowitz 1993a), a conservation plan estimated 600- 1,000 the tigers for Myanmar across 12 priority areas and other fragmented populations (Myanmar Forest Department 1996). A previous the tiger action plan recommended surveys to estimate population sizes in the priority areas, creation of the tiger reserves, strengthening of institutional capabilities to protect the tigers, a national policy and long-term action plan, increasing public awareness and cooperation with other the tiger range countries.

Uga and Than (1998) revising this plan considered the original population estimates as overestimates and suggested the true numbers might be in the range 250-500. They considered the tigers probably occurred in potential areas defined by The tiger Conservation nits (TCU's) (*sensu* Dinerstein et al. 1997). They defined a set of priority actions for the tigers including training of government staff, mapping of habitats, field assessments to identify critical the tiger populations inside and outside of protected areas, and actions to preserve these populations, including the tiger reserves and protection of corridors, and the formation of mobile education units to provide awareness. This set the stage for the development of a

new updated The National Tiger Action Plan that was proposed to the Myanmar Government in June 1998 (WCS 1998).

A number of important actions were taken as part of the new project;

1. A special the tiger survey and conservation-training course was provided to 23 protected area and forestry staff at Alaungdaw Kathapa National Park, during December 1998.
2. A 7-member National Tiger Survey Team was selected from the training participants to be responsible for spearheading research and conducting the tiger surveys within Myanmar.
3. Priority areas for the tiger surveys were located and mapped.
4. Surveys to determine the tiger presence-absence and prey relative abundance were done in high priority areas, and threats to the tigers documented for these areas.
5. A tiger information database was created from current and historical data for use with designing the tiger conservation activities and decision-making.
6. Official meetings were held with Myanmar government officials, to present information on the tiger status in order to draft and produce a The National Tiger Action Plan for the Union of Myanmar.



## PART 4

# STATUS AND DISTRIBUTION OF THE TIGERS IN MYANMAR -2002

Direct field surveys for the tigers were done at 17 sites (Fig. 9; see also Appendix I for site descriptions). Although the survey efforts covered only 1.3% of areas with forest cover, these sites were places where the tigers were known historically, and where the most recent available evidence, including reports from foresters and local people, suggested the tigers might still be found. The surveys provided new and unique records of occurrence for 19 globally threatened species, 16 CITES listed species and 45 Myanmar protected species (Appendix II).

### 4.1 The tiger status and distribution -

The tigers were reported present at 88% of sites, but confirmed by direct survey in just 23% of sites (Table 2). The rate at which the tigers were "caught" (detected) by camera-traps was just over 3,000 trap nights of sampling per photo-record. For example, if 30 camera-traps were placed in the field each for 100 days, one might expect on average 1 photorecord of the tiger from the survey effort. In comparison, using a similar survey design in Thailand (Lynam et al. 2001), the tigers were reported at all seven potential the tiger sites, and detected at 86% of the sites, for a capture rate of just over 200 trap-nights per photo-record. For example, of 20 camera-traps were placed for 10 nights, one might expect to get a single photo-record of the tiger. The survey effort required to find a tiger at the Myanmar sites was an order of magnitude higher than at the Thailand sites.

\*All Thailand sites were in long-established protected areas

Several features of the data warrant further explanation. Firstly, the tigers were detected at a low proportion of sites where the tigers where they were reported. Some local people living in and near forest areas apparently perceive other animals in the forest

as the tigers. For example in Alaungdaw Kathapa National Park, rangers mistook tracks of Golden cat and Asiatic leopard for the tiger, and because these two species were abundant near park headquarters, the rangers reported the tiger as common (Lynam et al. 1999). As a result, a conservation agency mounted a campaign to "Save the tigers of Alaungdaw Kathapa", when direct survey efforts across 25% of the park found no the tigers. A wider monitoring of habitats found no further evidence of the tigers suggesting that they are now extirpated from the Park. Clearly, some rangers and local people cannot resolve the tiger track and sign from other cat species, and need further training to be able to do so with some degree of confidence. Almost a third of the reports of the tigers were of direct sightings made after 1990 (Appendix III). The two extreme explanations are that all local people made mistakes in identifying the tigers e.g. they saw something else but reported the tiger, or that all local people actually saw the tigers when they reported seeing the tigers. The truth probably lies somewhere between the extremes. It is possible, at least for more disturbed sites, that the tigers are no longer resident but populations instead consist of transient individuals that hold no territory or defined home range (G. Schaller pers. comm., 2002). These transient individuals might cover relatively large areas in search of food and mates, returning to a place only after a lengthy period of time. This would explain their absence during the surveys but infrequent recent reports from locals.

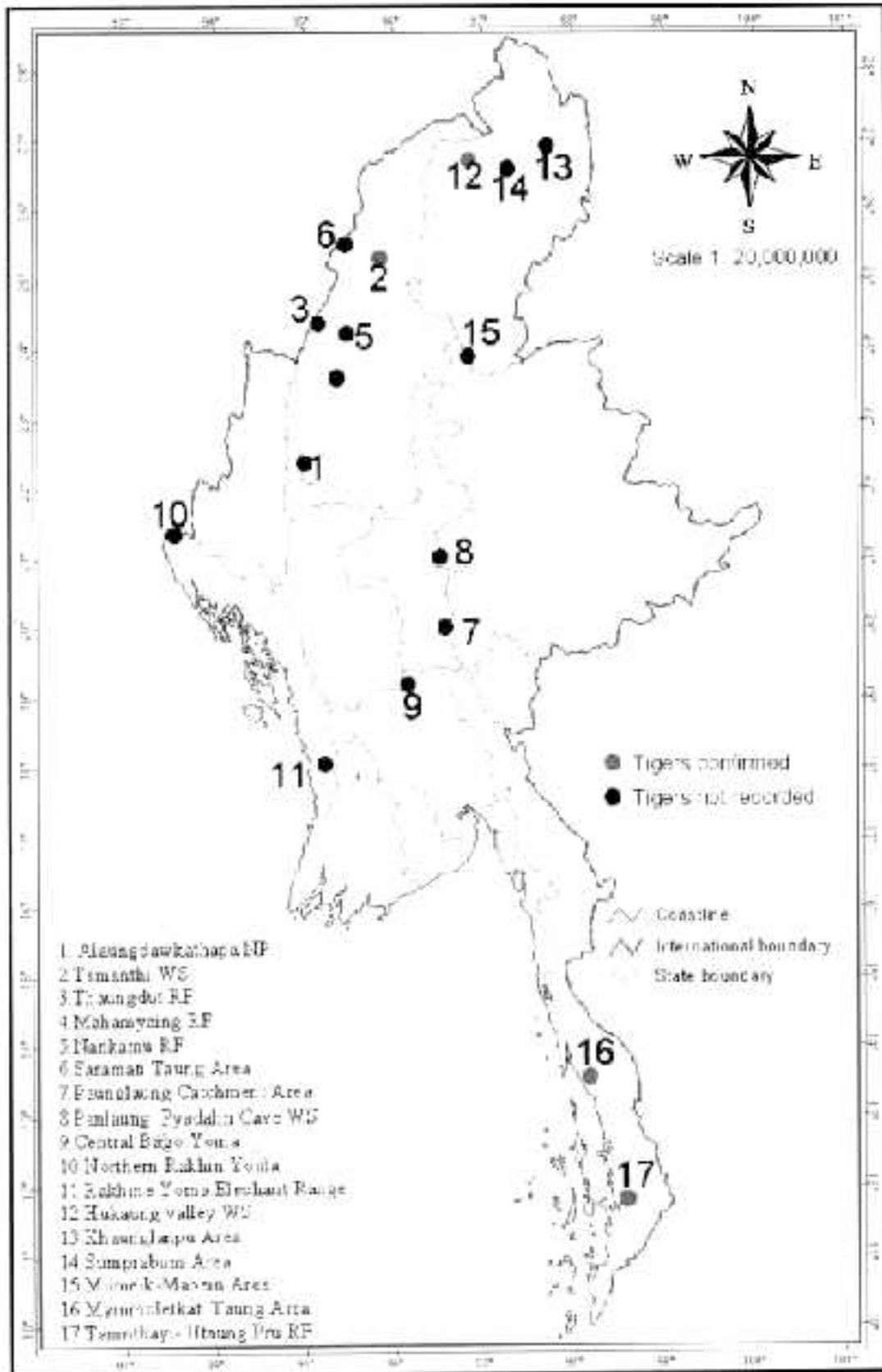
Differences in survey technique or skill levels are unlikely to explain the differences between the tiger occurrence at Myanmar and Thailand sites. Training for field staff was standardized and given by the same trainer (A.J. Lynam). Sign surveys were conducted with the same degree of rigor and camera-trap

Table 2. Comparison of the tiger survey results in Myanmar and Thailand.

Results of survey	Myanmar (17 sites)	Thailand (7 sites)*
1. Reports of tigers (Sites)	88%	All
2. Tiger confirmed	23%	86%
3. Capture rate – tigers (Days per capture)	3,112	217
4. Capture rate – large mammals (")	5	5
5. Species richness (large mammals)	16.4 $\pm$ 1.3	15.2 $\pm$ 1.8
6. Human traffic (Walk pasts per 100 days)	2.3	3.4



Fig. 9. Survey For Tigers in Myanmar, 1999-2002.



locations chosen in the same ways by teams in the different countries. If the tigers were present they should have turned up in the surveys in Myanmar. However, if the tigers are absent or not continuously present at a site, then their probability of detection by any survey method would be less than one. Where the tigers occur at very low density e.g. <0.38 the tigers/ 100 sq. km, a mammoth survey effort is required with camera-traps to detect the tigers (Carbone et al. 2001). That the tigers were found in only three of 17 areas surveyed, whereas other large mammals were detected at frequencies similar to the Thai reserves, suggests that the observations are real. The tigers were either absent or non-resident, or occurred at very low density at most of Myanmar survey sites, at the time of survey. Since the sites chosen were the best potential sites given all the information available prior to the surveys, the suggestion is that the tiger in Myanmar has suffered a range collapse and is in an advanced state of decline towards extinction.

Important to note is that the Thailand sites were all established protected areas with a history of protection. Only two Myanmar sites were protected areas, and the tigers were found in one of the areas. Protection at Thai sites, combined with a lower intensity of directed poaching for the tigers there explains why the tigers have persisted there better than at Myanmar sites. Despite the differences in occupancy patterns for the tigers, sites in both countries had similar richness and abundance of large mammals, suggesting similar availability of prey for the tigers. Therefore, Myanmar the sites have good potential for the recovery of the tiger populations.

#### 4.2 The tiger population size -

It is impossible to know the true number of the tigers

remaining in Myanmar and difficult to estimate numbers. Because of their rarity and cryptic behaviour, the tigers cannot be directly counted, and sampling is required to estimate numbers. However, it is impossible to sample every square mile of every potential habitat using camera-traps. Despite these limitations, The tiger Team attempted to estimate very roughly how many the tigers might be present across the suite of available habitats. They did this not by considering the extent of available habitat, assuming a density and a correction factor, and extrapolating the tigers numbers (Rabinowitz 1993; Uga and Than, 1998). Instead they used a subjective approach, by sitting down at a table, poring over maps, and field notebooks, considering information from sign surveys and locations of camera-trap captures, and the most reliable interview data, and arriving at a consensus among themselves. Given their expert knowledge - they know more about the recent natural history of the study sites than any other workers - they estimated the numbers in Table 3. These numbers are one estimate of the remaining the tiger population Myanmar. In the absence of independent verification, the numbers are educated "guesstimates". However, it is possible to independently estimate the tiger numbers for the Hukaung Valley using a modification of the approach of Rabinowitz (1993), and the estimate of the tiger density (0.91 - 1.29 the tigers/100 sq. km; see section 6.8.7). If one assumes a 50% reduction in the tiger density because of direct poaching of the tigers within the reserve (the most serious threat to the tigers in Myanmar), and an additional 20% reduction due to hunting, forest fires, smaller settlements and human access provided by the Ledo Road, the number of the tigers in the reserve (6,460 sq. km) is 18- 25. This estimate is strikingly similar to that derived by the consensus approach (15- 20; Table 3). While the estimates may have some validity, carefully designed mark-recapture studies will however be needed to determine the size of the tiger subpopulations in the areas in Table 3.

**Table 3. Status of the tigers in Myanmar\***

Tiger status	Sites (estimated numbers)
1. Tigers confirmed	1. Tigers confirmed Htamanthi (5); Hukaung Valley (15-20) and adjacent areas (15-20); Htaung Pru (5), Pe Chaung (5), other areas of N. and S. Taninthayi Division (55)
2. Tiger not recorded but possibly present in low numbers	Paletwa and Kaladan river catchment area (3-5), possibly present in 19W numbers Sumprabum (3-5), Khaunglanphu (1-2), .Paunglaung (2-4), Momeik-Mabain (2-3), Central Bago Yoma (2-3), Rakhine Elephant Range (1-2), Saramati Taung area (5-7), Shan Yoma (Kayah- Kayin)**(5-7), S. Kachin** (3-5)
3. Tigers not recorded and assumed absent	Alaungdaw Kathapa, Thaungdut, Mahamyaing, assumed absent Nankamu, Panlaung-Pyadalin

\* Numbers are estimates based on consensus approach of Myanmar The tiger Team surveyors.

\*\* Indicates areas that were not surveyed. Evidence for the tigers comes from unconfirmed reports from local people and foresters

## PART 5

# RATIONALE FOR A NATIONAL THE TIGER ACTION PLAN FOR MYANMAR

Potentially the tigers are recoverable to their former abundance across their range in Myanmar. In practice however, full recovery is unlikely. This section describes a Plan for recovering the tigers to a semblance of their former abundance in key parts of their range where they still exist, and restoring areas where the tigers have been lost so that natural recolonization might in future occur in those places. Broadly, the Plan will work towards increasing the tigers, prey and habitat, which are "measurable currencies" for the tiger conservation (Ginsberg 2001).

The Plan will be implemented over a 5-year period between 2003-2007. This will allow a number of targets to be achieved over spatial scales relevant to the tiger conservation (Ginsberg 2001);

- Site (an area containing at least several breeding female the tigers) e.g. Htamanthi Wildlife Sanctuary is a tiger site.
- Landscape (a larger area containing several populations of females and habitat connections between the populations) e.g. the Hukaung Valley, and forest reserves in Taninthayi Division are the tiger landscapes.
- The tiger Conservation Units (TCU's) (areas encompassing several landscapes) e.g. the Northern Triangle TCU (60) which contains Hukaung Valley, Huai Kha Khaeng'- Thung Yai Naresuan TCU (73) which includes Taninthayi Division.

The targets for the tiger conservation will vary according to timeframes and spatial scales but fit into the general framework given in Table 4. By the end of the implementation period, the short-term targets should be realized. An annual review of progress is suggested with a comprehensive review of progress towards achieving the short-term goals at the end of 2007. Success at reaching the short-term targets will set the stage for meeting the longer-term (10-20 years) targets. Important to recognize is the fact that efforts to save the tigers in Myanmar are part of a larger global effort to save the species. The recovery of the tigers in Myanmar will contribute towards the larger goal of species recovery across the range.

The Plan addresses the key threats to achieving these goals for the tigers in Myanmar, described in section 3 (above); (a) Hunting for commercial trade in the tiger products, (b) Prey depletion, (c) Habitat loss, degradation and fragmentation, (d) Harassment and displacement, (e) Illegal trade in the tiger products, (f) Genetic erosion, (g) Protected Area management, (h) Social perception.

Specifically, implementation of the Plan will reduce the key threats by,

1. Suppressing all killing of the tigers, and the illegal trade in the tiger products.
2. Reducing killing of the tiger prey species, suppress associated illegal trade.
3. Improving forestry management to stop further loss of the tiger habitat and to restore degraded habitat.
4. Improving forestry management to reduce intrusions of local people into the tiger habitat, and improve planning to avoid development in the tiger critical areas.
5. Establishing protected areas, ecological corridors and priority management areas to protect wild tigers and their habitat.
6. Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of the tiger habitat across international boundaries.
7. Monitoring the status of the tiger and prey population to assess the effectiveness of conservation efforts.
8. Improving public awareness of the importance of the tiger conservation to increase support from local people
9. Defining roles and responsibilities of personnel responsible for the tiger conservation.

Specific issues and action items for achieving the targets of the tiger conservation in Myanmar are detailed as follows. For ease of reference the action items are also listed in Table 1 along with a proposed timetable for their implementation, and responsible agencies.

Table 4. Targets for the tiger conservation with various time and spatial scales (adapted from Ginsberg, 2001)

	Targets	
	Short Term (2 – 5 years)	Long Term (10 – 20 years)
<b>SITE</b> (An ear containing several breeding females) e.g. Htamanthi Wildlife Sanctuary, forest reserves in Taninthayi Division	<ul style="list-style-type: none"> <li>• Maintain occupancy of tiger habitat</li> <li>• Define critical areas within sites</li> <li>• Stabilize present tiger populations</li> <li>• Prevent loss of tigers</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain potentially breeding populations of tigers at maximum density</li> <li>• Maintain expanding population (at <math>r &gt; 1</math>)</li> <li>• Strictly protect core areas</li> </ul>
<b>LANDSCAPE</b> (A larger area containing several populations of breeding females) e.g. Hukaung Valley, Taninthayi Division	<ul style="list-style-type: none"> <li>• Maintain potential for dispersal between sites</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain ecologically functioning viable tiger populations</li> <li>• No human intervention required to achieve stable/growing populations</li> <li>• Recolonization of empty habitat</li> </ul>
<b>TIGER CONSERVATION UNIT</b> (An area containing several landscapes) e.g. the Northern Triangle TCU(60), Huai Kha Khaeng – Thung Yai Naresuan TCU(73)	<ul style="list-style-type: none"> <li>• Maintain integrity of intact habitat</li> <li>• Maintain sufficient prey base</li> <li>• Maintain multiple landscapes including transboundary landscapes in each TCU</li> <li>• Coordinate establishing protected areas across boundaries</li> <li>• Promote tiger friendly conservation in each country in TCU</li> </ul>	<ul style="list-style-type: none"> <li>• Re-establish connections between sites and landscapes to ensure genetic exchange</li> <li>• Maintain heterogeneity of ecoregion</li> </ul>

## 5.1 Suppressing all killing of the tigers and the illegal trade in the tiger products

### 5.1.1 Key issues

- The trade in the tiger products is part of the illegal trade in wildlife worth an estimated US\$7 billion annually (Bennett and Rao 2002).
- Myanmar is one of the countries supplying the tiger trade and has a well-developed network involving poachers, middlemen and trafficking routes to move the tiger products from forest to market (Bennett and Rao 2002).
- The hunting of the tigers to supply the trade has been the ultimate cause of extirpation of wild the

tigers from multiple forest and nature reserves e.g. Alaungdaw Kathapa, and entire regions e.g. northern Myanmar (Rabinowitz 1998).

- Knocking off the top predator can have destabilizing effects at lower trophic levels in tropical ecosystems (Seidensticker 2002).
- The tiger populations that exist today are being decimated by hunting and face certain extirpation in the short-term if action is not taken (Kenney et al. 1995; Seidensticker et al. 1999).

### 5.1.2 Key actions

- Amend the Protected Wildlife and Protected Areas Law (SLORC, 1994) to enable the enforcement of international laws within



Myanmar. This would include laws prohibiting the sale or purchase of products suggesting or implying content of the tiger bone, hair, organs, blood, teeth, claws or hide. Completion date: December, 2003

- b) Impose heavy fines for offenders and use partial proceeds towards implementing international legislation. Completion date: December, 2003
- c) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff in Yangon, Mandalay, Myitkyina and other internal transit points for wildlife. This would include basic training in identifying wildlife protected by domestic and international legislation, and knowing their protection status. Completion date: December, 2003
- d) Conduct wildlife conservation and awareness training for all protected area staff. Completion date: December, 2003
- e) Recruit local government staff to help identify the tigers in trade and encourage them to report their observations to relevant authorities. Completion date: December, 2003
- f) Create a Wildlife Investigations Unit to investigate and suppress crime against wildlife, including trade, trafficking, illegal killing and capture, habitat destruction, and other persecution. The unit will enforce domestic and international legislation. The unit would include staff of the Ministries of Home Affairs, Forestry and Tourism and would report directly to the Minister of Forestry. Completion date: June, 2004
- g) Train and recruit government staff to join the Wildlife Investigations Unit. Form mobile units to suppress wildlife crime across the country. Completion date: June, 2004

## **5.2 Reducing killing of the tiger prey species and associated trade.**

### **5.2.1 Key issues**

- a) "The tigers cannot survive where they lack access to ungulate prey that is at least about half their own body mass because of mass-specific energy needs." (Seidensticker 2002)
- b) Because tropical forests support ungulates at relatively low densities, the killing of prey has been the proximate cause of the decline in the tiger populations in Mainland Asia (Karanth and Stith 1999).
- c) Few if any ethnic communities rely on large mammals as a subsistence source of protein but trade in wild meat, horns, fur, hides and other products is part of a massive illegal trade in Myanmar, and is well developed in border areas where enforcement is difficult (Rabinowitz 1998; Martin and Redford 2000).
- d) The commercial farming of wildlife provides a potential legal mechanism for the poaching of wild individuals to supply the trade and may contribute to the extirpation of some species.
- e) Evidence suggesting that hunting can be sustainably managed exists for only a few tropical wildlife species but evidence that wildlife harvest is unsustainable exists for a vast number of species (Robinson and Redford 1994; Robinson, and Bennett 1999).
- f) Protected areas are currently understaffed and ill equipped to prevent the loss of wildlife to poachers (Bennett and Rao 2002).
- g) The presence of forest guards in sufficient numbers can mitigate against hunting of wildlife (Bruner et al. 2001).
- h) Outside of protected areas, laws governing wildlife are difficult to enforce because staffing is low and capacity is low.

### **5.2.2 Key actions (in addition to those described above for the tigers but are generally relevant)**

- a) Amend the Protected Wildlife and Protected Areas Law (SLORC 1994) to enable the enforcement of international laws within Myanmar. Modify Chapter V, Article 15 to recognize the international classifications of wildlife species, and their associated protection status. Completion date: June 2003.
- b) With the view to protecting the tiger prey species, allow the commercial farming of only selected wildlife species only in facilities designated by the Forest Department. Completion date: June 2003.
- c) Allow the hunting of wildlife species only when scientific evidence proves it can be done sustainably. Completion date: June 2003.
- d) Take action to stop all killing of prey species at places where the tigers are currently or potentially found. Completion date: December 2007.
- e) Train all government staff at Hukaung Valley and Htamanthi, in anti-poaching and anti-trafficking techniques. Where possible involve local military personnel as instructors. Completion date: December 2003



- f) Recruit teams of EcoRangers whose sole responsibility is protection. Numbers of EcoRangers should at least be 3 guards /100 sq.km for effective management. Provide EcoRangers with necessary equipment, and salary incentives to motivate them to combat poaching. Completion date: June 2004.
- g) Develop systematic patrolling inside all protected areas using EcoRangers. Make patrolling a mandatory management activity with a monthly schedule and budget. Completion date: December 2004.
- h) Update the Wildlife Law to include protection for wildlife outside protected areas, and empower government staff to enforce legislation. Completion date: December 2004.
- i) Outside protected areas, study patterns of hunting and consumption of wildlife to determine its sustainability, especially for prey species. Completion date: December 2005.
- j) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following the tiger prey species from Protected status to Completely Protected status; Wild water buffalo (*Bubalus bubalis*). Completion date: June 2003.
- k) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following the tiger prey species from Seasonally Protected status to Protected status; Hog deer (*Axis porcinus*) and Common barking deer (*Muntiacus muntjak*). Completion date: June 2003.
- l) Wildlife conservation and awareness training for all wildlife offenders. Completion date: June 2003.
- m) Impose fines for wildlife offenders in the tiger areas with proceeds towards supporting the tiger conservation activities. Completion date: June 2004.

### 5.3 Improving forestry management to stop further loss of the tiger habitat and to restore degraded habitat

#### 5.3.1 Key issues.

- a) Extraction of non-timber forest products, fuel wood collection, shifting cultivation and livestock grazing disturbs the tigers, damage the tiger habitat, and depletes prey resources (Rao et al. 2002).
- b) Clear cutting of plantations, and cutting of other economically valuable hardwoods may seriously compromise the tiger habitats (Rao et al. 2002).
- c) There exist no economic incentives for conducting

environmentally sound forest use practices.

#### 5.3.2 Key actions

- a) The National Code of Forest Harvest Practice involves 30-year cutting cycles, and use of elephants for removal of logs reduces environmental damage over other practices. Apply this traditional method of forest harvest effectively in all concessions in the country. Completion date: December 2005.
- b) Ban the hunting of wildlife in forest harvest areas. Completion date: June 2004.
- c) Provide wildlife conservation awareness education training to timber harvest staff. Completion date: December 2004.
- d) Define Strict Conservation Zones for Hukaung Valley and Htamanthi where no human use of natural resources is allowed. Create buffer areas to allow restricted use by local people including extraction of non-timber forest products, fuel wood collection, and livestock grazing. Ban shifting cultivation and hunting of all kinds in the buffer area. Use EcoRanger patrol teams to enforce the restrictions. Completion date: December 2003.

#### 5.4.1 Key issues

- a) Plantations and mines open up forest areas (Rao et al. 2002), encourage markets that wipe out the tiger prey, and allow the tigers to be hunted more easily.
- b) Permanent camps and settlements seriously compromise the tiger habitat (Rao et al. 2002)
- c) Road construction internally fragments and damages the tiger habitat, facilitates intrusions by poachers, and opens up remote areas to wildlife trade (Bennett and Rao 2002; Rao et al. 2002).

#### 5.4.2 Key actions

- a) Reclaim plantations and revoke all mining licences in Hukaung Valley and Htamanthi Wildlife Sanctuaries. Completion date: December 2007.
- b) Consider the location of government camps and permanent settlements outside of these reserves. Completion date: December 2007.
- c) Ban construction of roads in protected areas and forest reserves. Completion date: December 2004.
- d) Close or limit access along logging roads in Taninthayi Division to reduce the risk of collisions with the tigers. Completion date: December 2005.
- e) Include wildlife assessment in land development programs for Taninthayi Division. Completion date: December 2003.

- e) Develop education programs to improve awareness about wildlife for local people living in and around forest reserves in Taninthayi Division. Completion date: December 2004.

## **5.5 Establishing protected areas, ecological corridors and priority management areas to protect wild the tigers and their habitat**

### **5.5.1 Key issues.**

- a) The minimum area required to support a genetically viable population of large predators would be the area that supports 300 breeding females (Barbault & Sastrapradja 1995).
- b) If female 'the tigers in Myanmar have home ranges the size of Nepali the tigers (10- 50 sq. km; (Smith 1987), the area required would be 3,000-15,000 sq. km.
- c) Landscapes of this size exist in Myanmar but most are not yet protected for wildlife. The largest intact forest expanses in Myanmar are in Kachin State, Sagaing and Taninthayi Divisions.
- d) The tigers may use forest reserves as movement corridors between the Hukaung Valley and Sumprabum, and possibly as far east as Kaunglamphu; within Taninthayi Division, and across the Thai-Myanmar border, and; between northeastern Sagaing Division and western Kachin State.
- e) There is a lack of landscape level planning and analysis for wildlife conservation in Myanmar (Rao et al. 2002).
- f) Management plans for sites containing the tigers do not specifically define actions necessary to conserve the tigers.

### **5.5.2 Key actions**

- a) Revise or create management plans for the Hukaung Valley and Htamanthi to include specific actions for conserving the tigers, including recommendations in 5.2.2, 5.3.2, and 5.4.2, and below. Completion date: December 2003.
- b) Expand Htamanthi Wildlife Sanctuary to increase its size to at least 3,000 sq. km to ensure long-term survival of the tigers. Completion date: December 2004.
- c) Create a dedicated the tiger reserve including the Hukaung Valley and adjacent forest reserves. The reserve will serve to link the tiger populations in India with those in Myanmar. Expand the eastern border of Hukaung Valley Wildlife Sanctuary to protect potential the tiger habitat in the Sumprabum area. Completion date: June 2004.

- d) Establish limited human use zones (buffers) that will "soften" the edges of Hukaung Valley and Htamanthi reserves reducing the risk of mortality for the tigers. Completion date: June 2004.
- e) Create new protected areas or special the tiger management zones in the Taninthayi Division, including the Lenya River, Greater and Lesser Taninthayi River catchments. These sites will protect the tigers and their habitats and allow limited human use of natural resources around the reserves in a manner complementary to the tiger conservation. Completion date: December 2007.
- f) Use existing GIS capabilities in the Forest Department to identify and demarcate special management zones and corridors for the tigers. Completion date: December 2003.

## **5.6 Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of the tiger habitat across international boundaries**

### **5.6.1 Key issues**

- a) Trade and trafficking in the tiger and other wildlife products is often associated with the trade in drugs and arms (Bennett and Rao 2002).
- b) In Myanmar the trade is concentrated in areas with weak enforcement, especially along the border with China and Thailand (Bennett and Rao 2002). The trade is fuelled by the disparity in economies between neighbour countries, creating an underground economy and a drain on Myanmar's wildlife.
- c) Local government officials in border areas are unaware of the Wildlife Law or the importance of wildlife, and sometimes supplement their incomes from wildlife trade.
- d) Local militias effect law enforcement in order areas but National laws are only weakly enforced or not enforced at all.

### **5.6.2 Key actions**

- a) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff, stationed near or on country borders. This would include basic training in identifying IUCN and CITES protected wildlife species. Completion date: December 2003.
- b) Hold internal 2 workshops involving local government officials to discuss trans border issues including trade, trafficking and wildlife, and develop plans to suppress the trade. Completion date: December 2003.

- c) Recruit local government officials on both sides of the Thailand border to suppress transborder wildlife trade at Mawdaung-Prachuap Kiri Khan, Kaleinaung-Ban I Tong, Kawthaung-Ranong (especially Tha Htay Island), Myawaddy-Mae Sot, Three Pagoda Pass, and Tachileik-Mae Sai, and prevent access by professional poachers from Thailand. Completion date: December 2004.
- d) Create a the tiger reserve in Taninthayi Division opposite Thailand protected areas that support large populations of the tigers, Western Forest Complex and Kaeng Krachan National Park. Completion date: December 2004.
- e) If possible expand the reserve or create new reserves to form a corridor between these two Thai. reserves. Completion date: December 2007.
- f) Develop a spatially explicit the tiger conservation database for the Huai Kha Khaeng – Thung Yai Naresuan TCU (Level I TCU 73). Completion date: December 2005.
- g) Where possible coordinate antipoaching patrols and/or wildlife surveys on both sides of the Thailand-Myanmar border. Completion date: December 2004.

## **5.7 Monitoring the status of the tiger and prey population to assess the effectiveness of conservation effort**

### **5.7.1 Key issues**

- a) The success of the Plan will need to be assessed by monitoring the tiger and prey populations.
- b) The Hukaung Valley landscape will be a target for an extensive monitoring program.
- c) Landscapes not yet protected but containing the tigers e.g. Taninthayi Division, should be targets for medium intensity monitoring.
- d) Sites where the tigers were not found but are suspected to occur (Table 3) should be targets for low intensity monitoring (Karanth and Nichols 2002).
- e) Specific methods used for monitoring will depend on the level of knowledge available for the tigers (Karanth and Nichols 2002) (Table 5).

### **5.7.2 Key actions for Hukaung Valley;**

- a) Identify critical habitats and core areas for the tigers and prey across the landscape. Completion date: June 2003.
- b) Estimate numbers of female the tigers within the landscape and ascertain that there is a reproductively viable population of the tigers. Completion date: December 2003.
- c) Document the current threats, demographics, and range of human activities that must be taken into

account if the proposed landscape is to be successful and sustainable in the long term. Completion date: June 2003.

- d) Create a GIS map and database to show current land use patterns, possible future land use trends, and the tiger and prey source areas. Completion date: December 2003. For forest reserves in Taninthayi Division;
- e) Train local foresters how to identify the tiger and prey via sign surveys, in use of camera- traps for wildlife survey, and methods for making observations and recording data. Completion date: December 2004.
- f) Determine occupancy of habitats in accessible sites across the landscape, including Myintmoletkat and Lenya River areas, which away from sites where the tigers are known. Completion date: December 2005.
- g) Determine prey abundance using line transect sampling. Completion date: December 2005.
- h) Determine the tiger abundance using double-sided camera-trap sampling. Completion date: December 2005. For sites in Paletwa and Kaladan river catchment, Sumprabum, Khaunglanphu, Paunglaung, Momeik Mabain, Central Bago Yoma, Rakhine Elephant Range and Saramati Taung area;
- i) Train local foresters how to identify the tiger and prey via sign surveys. Completion date: June 2003.
- j) Determine occupancy of habitats at the sites using sign surveys. Completion date: December 2003.
- k) Establish a logbook to record observations of the tiger and prey, and encourage use of the logbook. Completion date: December 2003.

## **5.8 Improving public awareness of the importance of the tiger conservation to increase support from local people**

### **5.8.1 Key issues**

- a) Local government officials encourage local people to hunt the tigers and split profits from the sale of wildlife products.
- b) Professional hunters and hill tribal people (Kachin, Lisu, Naga, Khanti Shan) who consume wildlife live in villages adjacent to the Hukaung Valley, and pose a threat to wildlife.
- c) Little public information exists about wildlife in Myanmar.
- d) Wildlife education essentially does not exist in schools.

### **5.8.2 Key actions**

- a) Develop wildlife education programs to scourage

hunting by local people in and near the tiger reserves. Where possible recruit local people, especially ex-hunters to help implement these programs. Completion date: December 2004.

- b) Involve 50 local people in wildlife survey and research activities to make positive use of their local or indigenous knowledge. Completion date: December 2003.
- c) Collaborate with authorities in charge of development projects to include wildlife conservation as a component of those projects and resolve any potential conflicts between the needs of people and wildlife. Completion date: December 2003.
- d) Produce a documentary about the tiger conservation in Myanmar and broadcast it on National television. Completion date: June 2004.
- e) Dub existing wildlife documentaries about Myanmar into Myanmar language and broadcast. Completion date: June 2003.
- f) Adapt WCS education materials about the tigers into Myanmar language and implement a special training program for schoolchildren at selected high schools in Yangon, and adjacent to the tiger reserves. Completion date: June 2004.

#### 5.9 Defining roles and responsibilities of personnel responsible for the tiger conservation

**Table 5. A guide to research methods for the tiger conservation**

Knowledge Base	Goal	Technique
No information	Determine occupancy	Sign surveys for tigers <sup>1</sup>
	Determine occupancy but sign survey inappropriate	Camera trap surveys for tigers
Tigers present	Potential carrying capacity (K) for tigers	Line transect for prey Dung surveys for prey
	Determine Occupancy	Sign surveys for tigers
		Camera trap survey for tigers using single camera sets
	Determine tiger and prey abundance	Camera trap survey using single camera sets
		Line transect sampling for prey/dung
	Determine abundance of tigers	Camera trap survey for tigers using double camera sets
		DNA population estimation
Abundance/distribution data available	Determine K for tigers	Line transect sampling for prey/dung
	Habitat analysis	GIS to extend results of intensive habitat surveys
	Monitoring	Camera trap monitoring of tigers
		Calibrated sign surveys
	Ecological Studies	Radio telemetry
		Diet studies
		Demographic studies
		GIS

<sup>1</sup> 'for the tigers' implies that sampling is designed to maximize the probability of encountering the tigers

#### 5.9.1 Key issues

- a) Wildlife conservation is hampered by a lack of understanding of roles and responsibilities of government staff.
- b) The efficiency of protected area management can be improved by defining tasks and expectations for staff.
- c) Park managers need leadership training to be able to perform their jobs successfully, and to direct human resources to effect conservation.

#### 5.9.2 Key actions.

- a) Provide special training for managers of the tiger reserves in management techniques, including leadership skills, decision-making, planning, protection, use of information and technology, and personnel management. Completion date: December 2003.
- b) Invite managers of the tiger reserves to observe the day-to-day operations in selected the tiger reserves in India and Thailand. Completion date: June 2004.
- c) Define roles for junior staff in Hukaung Valley and Htamanthi Wildlife Sanctuaries, and for Taninthayi Division junior forestry staff, and staff and in other areas in conducting field monitoring of the tigers and prey. Completion date: December 2003.



## PART 6

# HISTORICAL DATA, FIELD SURVEY METHODS AND DATA ANALYSIS

This section is optional reading for researchers and others interested in the historical distributions of the tigers, specific field methods used to collect information on current distributions, and data analysis techniques. All of this material provided the background for developing the Action Plan described in the previous section.

### 6.1 Past distributions of the tiger in Myanmar.

In order to provide a framework for understanding the current situation for the tigers, information on where the tigers used to occur and the factors that brought about their decline was considered. For the purposes of this report, historical records were considered as those pre-1999, when this study began. A number of sources were used to reconstruct former distributions of the tigers in Myanmar:

#### 1. *Published scientific papers.*

Prior to 1999, few biological surveys had been attempted in the country. Milton and Estes (1963) conducted the first dedicated biological surveys in the early 1960's. They identified declining wildlife populations in areas such as Pidaung Wildlife Sanctuary. Then during the 1980's a series of wildlife assessments were done in the context of assessing areas for forest protection by UNDP/FAO (1985). These reports prescribed the formation of new protected areas as critical for the future conservation of wildlife. In the 1990's WCS made efforts to document and define new areas for inclusion in the protected area system.

#### 2. *Hunter records.*

The majority of historical records come from published reports and books written by hunters. Game hunting was popular during the period of occupation by the British (pre-1948). These publications describe in detail the circumstances in which the tigers were shot, trapped, snared or otherwise encountered by humans.

#### 3. *Survey reports.*

A number of reports by foresters and surveyors attest to the former occurrence of the tigers.

### 6.2 Quality and reliability of information.

A gazetteer was assembled from historical the tiger records. The information was categorized as follows;

- (a) *Confirmed presence* -where there was no reasonable doubt the observation was of the tiger. These observations were from direct sightings, the tigers killed, or reports of attacks by the tigers on humans or livestock;
- (b) *Provisional presence* -where there was a possibility that leopard or other species was in fact observed but was mistaken for the tiger. These were observations of tracks and sign, or reports from other sources e.g. villager reports.
- (c) *Provisional absence* -where a lack of evidence of the tigers was reported. True absence over a given area can only be confirmed through monitoring over a period of time ranging from several months to several years (depending on the size of the area) but except for recent efforts at Alaungdaw Kathapa this has yet to be attempted at any of the study sites. Verbal reports were not considered as historical records due to the persistent problems with identifying large cats from track and sign (Duckworth & Hedges 1998; Lynam 1999) and because reports not written down at the time of observation invariably change in content and accuracy and become unreliable.

### 6.3 Characteristics of past distribution.

A total of fifty-eight observations provided an historical record of the tigers for the period 1903 – 1999 (see Fig. 2.; Appendix IV). The tigers were historically recorded from all areas but gaps in information exist for the delta area, the central east (Shan State) and the

far north. The absence of records probably reflects that the tiger was not reported rather than it never existed in these places. The tigers can survive in mangrove forests although the habitat is sub optimal (U. Karanth, pers.comm. 2002). Similarly, the absence of documented records from Shan State is due to the inaccessibility of the area rather than lack of the tigers. (Rabinowitz 1998) reported the tigers had disappeared from the far north but evidence from hunters suggests their existence there in the past.

#### 6.4 Potential the tiger areas.

During the early 1990's with the advent of new techniques for assessing population viability through consideration of genetics, the focus on conserving the tigers shifted towards a small population paradigm (*sensu* Caughley & Gunn, 1996). The idea was that the tigers were fast being driven towards extinction in the wild so that captive breeding and genetic management would be necessary to save them' (Tilson et al. 1995). There is no doubt that for some critically endangered species such as Guam rail, Black footed ferret and Arabian oryx, and the subpopulation of the tigers in southern China, species survival depended primarily on successful management in zoos. However, this approach ignored the fact that potentially viable populations of the tigers still existed across most of their range in the wild but that their status remained unknown (Rabinowitz 1999), so that effective conservation planning could not happen. In an attempt to refocus attention on the plight of wild the tigers, WWF and WCS attempted a geographic assessment of the extent and availability of habitat, and potential prey resources (Dinerstein et al. 1997). This analysis identified a series of potential areas – The tiger Conservation (TCU's) – in which the tigers could conceivably occur. For example, it was considered that the tigers might occur across large expanses of potential habitat. In Myanmar, four areas with the greatest potential for the tigers (Level I TCU's) are large and relatively intact forest transboundary forests in the west along the Myanmar – Bangladesh and Myanmar – India frontier; and forests in central Bago Yoma (Fig. 10). A series of much smaller, highly fragmented forest areas provide lower potential for the tigers. These are termed Level II and III areas. According to the analysis, forests in the far north, central east and delta areas had unknown occupancy for the tigers. These areas were considered priorities for immediate survey reflecting large gaps in historical information on the tiger occurrence.

Several characteristics of the potential the tiger habitats are worthy of mention. Firstly, despite the relative intactness and contiguity of forests in the level I category, the tigers may not be uniformly found across available habitat (Prater 1940; Rabinowitz 1995). Secondly, the Level I TCU's include areas of degraded or completely cleared habitats. The tigers if occurring there would likely be nonbreeding transient individuals (G. Schaller pers. Comm., 2002), a small percentage of the population that are prepared to risk movement across hostile areas in the landscape to cross between forest patches. Finally, the TCU analysis was a very useful exercise because it did two things; it refocused attention on the plight of wild the tiger populations, defined areas where information on the status of the wild populations was lacking.

#### 6.5 Rationale for the tiger status survey program.

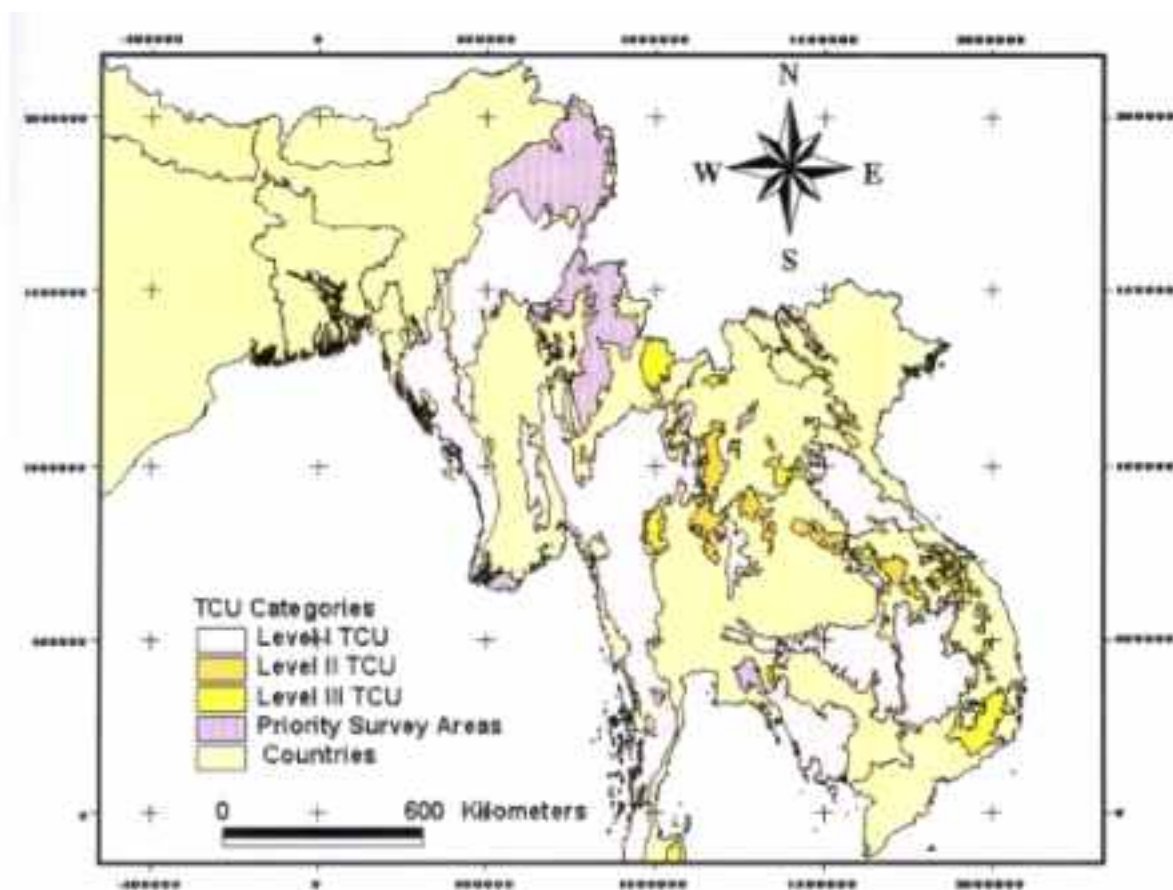
Despite the past distributions and current potential areas for the tigers, areas of natural vegetation available for wildlife declined from 75% of land area to 50% in 50 years (Collins 1991; FAO 2000). Land use patterns changed after 1948 when traditional forest management regimes that regulated and systematized harvest were replaced with less regulated and in some cases opportunistic clearance. For example, while good management of natural forest occurs in most areas, foreign logging companies clear – cut or felled timber outside concessions in near the border during the period 1989 – 1993 (International 1999).

By the early 1990's hunting and illegal trade had reduced the tiger populations to an unknown subset of the potential areas. Some areas with apparently suitable habitat were devoid of the tigers (Rabinowitz 1999). Prior to the commencement of this project in 1999, the state of knowledge of the tigers amounted to reports of the tiger occurrence for a limited number of areas (Rabinowitz 1999). Hunting of the tigers has been going on for a very long time (Pollok & Thom 1900). More recently with reduced supply of the tigers and the tiger parts in the marketplace, demand has increased (Hemley & Mills 1999) with unmeasured effects on wild the tiger populations.

In order for effective conservation planning to take place, there was an urgent need to know where the tigers existed across the vast landscapes of Myanmar, and what was the condition of the tiger subpopulations. A field program was mounted to satisfy the following objectives:

## Part 6: Historical Data, Field Survey Methods and Analysis

Fig. 10. Tiger Conservation Units (TCU's) for Myanmar and Neighbour countries



1. To train government field staff in the tiger assessment methods.
2. Using information on potential the tiger areas from historical records and local knowledge to determine the tiger presence-absence across these areas, and limits of the tiger distributions.
3. To define threats to the tigers and their habitats.
4. To redefine priority areas for future the tiger conservation.

#### 6.6. Training and selection of The tiger Team members.

The capacity of field staff to conduct independent wildlife survey and research is generally poor in Asia and this had led to problems with interpreting basic information on species occurrence and abundance for protected areas (Duckworth & Hedges 1998). Park staffs are generally unfamiliar with animal tract and sign thus making reports of the tiger occurrence

unreliable. As an example of this, at Alaungdaw Kathapa National Park, historically one of the better-known the tiger areas (UNDP/FAO 1982), park staff reported the tigers as common in 1998 but plaster casts of tracks purported to be of the tiger were on inspection found to be of Asiatic leopard and Golden Cat (Lynam et al. 1999). Part of the problem in Myanmar is a general one across Asia in that training of government staff has traditionally focused on production forest management and silviculture. Protected areas conservation is relatively new task for foresters and wildlife training is generally unavailable at the college or university level.

Wildlife training for Myanmar foresters began with a WCS program in 1995. The training based on a standard curriculum (Rabinowitz 1993b), provides instruction in techniques for observing and recording wildlife, and basic survey and analytical techniques. Since 1995, 270 protected area field staff, and local

NGO staff have received the WCS basic training Smithsonian Institution, and the California Academy of Sciences provided other specialist training in wildlife monitoring techniques to Forest Department staff.

As a starting point for the National The tiger Action Plan project, the Wildlife Conservation Society – Myanmar Programme in collaboration with the Myanmar Forestry Department provided a training course in the tiger survey techniques and conservation at Alaungdaw Kathapa National Park, from December 7 – 21st, 1998. The objectives of this training were,

1. To train junior forestry staff in basic techniques of map and compass, wildlife observation and data recording.
2. To provide specialized training in describing the tiger habitats, conservation and census techniques for the tigers and the tiger prey species.
3. To identify talented Forest Department staff for inclusion in a National The tiger Survey Team (NTST).

WCS staff from New York, Thailand and Myanmar conducted the training. Dr. Alan Babinowitz, Director of Science, Asia Programs, an expert on large carnivore conservation ecology, and the author, lectured to the trainees and directed a variety of classroom based and field based training activities. WCS Myanmar Country Programme Coordinator U Saw Tun Khaing and Research and Training Coordinator U Than Myint supported them. This was the first time this kind of training had been done in Myanmar, and the first time anywhere in Southeast Asia.

Twenty trainees and three observers attended the 14-day training (Fig. 8.). Those staff came from twelve national parks and sanctuaries, the Institute of Forestry, and the Forest Resources and Environment Development Association (FREDA). The trainees were assessed on their participation in group assignments and a 4-day field project, and on their individual performance in class and practical assignments, a comprehensive exam, and overall level of participation in the training.

From the training a group of six talented young forestry professionals were selected to form the first roving the tiger field survey team to participate in field assessments for the tigers at selected forest sites across Myanmar.

## 6.7 Methodology.

The surveys were intended to determine presence – absence for the tigers, and relative abundance for prey species, so as to permit the evaluation of study areas for their potential for the tigers. The surveys were not intended to determine numbers of the tigers in the reserves.

The tigers, like other tropical mammals, are generally difficult to observe directly due to their rarity, cryptic behaviour, partial nocturnality and avoidance to humans (Griffiths & van Schaik 1993; Schaller 1967). A combination of indirect and direct survey methods was used to detect the tigers and other large mammals; potential prey species.

Field observations of the tigers can be categorized so as to facilitate interpretation of their ecological status. Four types of observations are given in Table 6. The tigers may be detected or not detected by a given survey technique. The detection of the tigers confirms presence but may or may not indicate a reproductive population. Where the tigers are not recorded, this could indicate problems with sampling, for example where the tigers are missed due to extreme rarity, or true absence.

Where the tigers occur at densities under 0.38 the tiger/100 square kilometer, very large amounts of sampling with camera-traps (>1,000 trap nights) needs to be done in order to detect them (Carbone et al. 2001). In this study sampling of > 1,000 trap nights were not feasible so that the tigers might not be recorded at some low – density sites though they were present.

### 6.7.1. Choice of study areas –

Given the time frame of the project (3 years) it was not possible to investigate the tiger occurrence in all forest areas. Using information from historical records and potential the tiger areas, 17 sites with the highest probability of supporting the tigers were chosen for survey (Fig. 9). These areas represented a non – random subset of available landscape and habitat options for the tigers spanning the geographic extent of the country from approximately 11o – 27oN, and 93o – 99o30'E.

1. Alaungdaw Kathapa National Park (AKNP)
2. Htamanthi Wildlife Sanctuary (HTM)
3. Thaungdut Reserve Forest (TD)
4. Mahamyaing Reserve Forest (MHM)



**Table 6. Interpretation of The tiger Population Status from Field Observations**

Observation	Population Status	Interpretation
1a Tigers recorded	Reproductive population	Indicated by observations of pregnant females, juveniles and/or cubs
1b Tiger recorded	Present but not necessarily reproductive	Indicated by observations of adult male or non – pregnant adult female individuals
2a Tigers not recorded	Low density, ecological effective absence	Tiger may be present at low density but are not recorded due to sampling errors e.g. tigers not present in survey area. A tiger population may be disrupted, sex ratios skewed, or individuals have difficulty finding mates so that reproduction is not possible (Allee effect)
2b Tigers not recorded	True absence	Tigers are not recorded over a period of monitoring at a site.

5. Nankamu Reserve Forest (NKM)
6. Saramati Taung (SRMT)
7. Paunglaung Catchment (PGL)
8. Panlaung Pyadalin Cave Wildlife Sanctuary (PPDL)
9. Central Bago Yoma (BGY)
10. N. Rakhine (RN) or Paletwa and Kaladan river catchment
11. Rakhine Elephant Range (RER)
12. Hukaung Valley (HKV)
13. Khaunglanphu (KLP)
14. Sumprabum (SBP)
15. Momeik – Mabain (MB)
16. Myintmoletkat (MMLK)
17. S. Taninthayi (TNTY)

Descriptions of each site are given in Appendix I.

#### 6.7.2. Interview surveys –

Interviews of people living in suspected tiger areas are potentially useful because they draw upon local knowledge of wild animals accumulated over long periods of time, and may help determine the status and identify threats to the tigers and other mammals (Rabinowitz 1993b). However, the reliability of information to be gained depends upon a number of factors, especially the correct interpretation of local information by the interviewer (Duckworth 1999), the manner and disposition of the interviewer, and how the interviewee perceives this. An interview protocol (Appendix V) was designed during the tiger – training course (Lynam et al. 1999) and this was used by Myanmar – speaking interviewers to gain indirect evidence on the tiger occurrence in the 17 potential

areas. Direct survey was done in and around locations of the most recent reliable reports of the tigers from interviewees.

#### 6.7.3 Track and sign –

Large mammals produce tracks, faeces, scrapes, scratches, kills and other signs so that under certain circumstances the substrates on wildlife trails, streambeds and ridges may indicate their recent presence (Wilson 1996). However, there is significant overlap between large cats (Duckworth & Hedges 1998; Kanchanasakha et al. 1998) so that the tiger may be confused with other species (Lynam et al. 1999). For these reasons sign was considered not sufficient for the identification to species level for cats, dogs, civets, deer muntjak, wild cattle, and otters. However, the abundance of sign was generally indicative of the level of mammal traffic in an area. Ungulate sign was additionally used to indicate possible areas of carnivore activity, and as such to help guide the placement of camera – traps for detecting the latter (below).

Standardized datasheets were used to record date, time of day, weather, location (latitude/longitude) type of sign, dimensions of track/sign, probable species/genus identity, age, substrate, and habitat type (Appendix VI). Locations where mammal sign was encountered were recorded with a Global Positioning System (GPS) device capable of resolving position information beneath tree canopies, accurate to + 100 m\* (Garmin 12XL, Garmin Corporation, Kansas USA). Feline tracks with total

length 120 mm or pad width 7cm, and scat 3.5cm in diameter were considered to be indicative of the tigers (A.J. Lynam, A Rabinowitz & R.K. Laidlaw unpublished data; Cutter 1999; Duckworth & Hedges 1998). Where the size of a feline track was ambiguous because of the substrate or age of a track, the track was identified only as "large cat" meaning either the tiger or leopard. Other species were identified using a field guide to Thai mammal tracks (Green World Foundation 1999). An index of abundance "Encounter Rate (CR)" was estimated from sign surveys as  $ER = \text{No. Sign detected/hr.}$

#### 6.7.4. Camera – trapping

Remote Camera methods have been used successfully to photographically record wildlife in tropical Asian forests (Chapman 1927; Griffiths & van Schaik 1993). Although these devices are relatively expensive they offer a reliable method for inventory of species that are cryptic nocturnal or rare, including the tigers (Lynam et al. 2001). Passive infrared –based camera – traps (Camtrak South Inc., Georgia USA) (Fig. 11.) were used in all surveys.

To achieve the best possible resolution of species identity from photographs, camera – traps were secured to trees 0.4m above the ground, 3 – 5 from a wildlife trail. All camera – traps were set to allow

continuous recording of wildlife movements day and night. Traps were left in place for at least 24 days to allow for adequate sampling of large mammals species richness (A.J. Lynam unpublished data) and atleast 1,000 trap nights to correctly determine the tiger presence or absence (Carbone et al. 2001). For example, the tigers were considered absent from a site if they were not recorded in any trap, with absence referring to the particular area was estimated by placing a buffer around the outermost locations of camera – traps with the length of the buffer equivalent to half the mean distance between camera – traps. A time delay of 3 or 6 minutes prevented entire rolls of film being taken by groups of animals lingering in front of the camera – trap. An index of abundance "Capture Rate" (CR) was estimated from camera trapping as  $CR = \text{No. Photo records/100 camera – trap nights.}$

#### 6.7.5. Survey design –

Two survey designs were employed for the tigers (Fig. 12.) In both cases, the primary intention was to gain information on

- (1) the tiger presence –absence,
- (2) the tiger and prey micro distribution and activity in each study area.

First, camera-traps were placed at random locations



Fig. 11. Infrared – based camera – traps were used to detect the tigers and prey species.

within 10 x 4 km sampling grids, in alternative 1 km<sup>2</sup> grid blocks. This was termed the plot-based survey design (Lynam et al. 2001). The random locations were reached using Global Position System (GPS) receivers (Garmin 12XL, Garmin Corp. Kansas USA). Traps were established on trails or other suitable positions within 100m of random locations. Grids were located in areas where interviews suggested the tigers occurred, or where the tiger occurrence could not be determined, in the part of a study area least disturbed by humans. The tigers require a core area of undisturbed habitat for their survival (Schaller 1967) although this may be a small part of their entire home range (Miquelle et al. 1999). If the tigers are present in an area they are likely to at least frequent a core undisturbed area and should be detectable there. In the second design, camera-traps were deliberately placed along trails and roads where sign of the tigers, large cats or their prey species were recorded. This was termed the *trail*based survey design (Lynam et al. 2001). Sampling locations where capture probabilities for the tigers are highest (Karanth and Nichols 1998) increases the likelihood of their detection at a site.

Because the stripe patterns of the tigers are unique to an individual (Schaller 1967) but are different on left and right sides, camera-trap photographs of both sides of an animal must be used to distinguish it from other the tigers (Franklin et al. 1999) While specific methods are available for estimating the tiger density from double-sided camera-trap designs (Karanth 1995) this was not the purpose of this study. However, to gain information on the minimum number of the tigers known to be alive (MNKA) inside the survey area, pairs of camera-traps were placed on opposite sides of animal trails, staggered by 2-3 m at locations where field staff considered the tigers were likely using e.g. because of presence of sign of the tiger and/or large ungulates. These “checkpoint” arrangements were established to gain double-sided photographs of the tigers.

In summary, the surveys obtained four types of indices: (i) the tiger presence-absence, (ii) minimum numbers of the tigers known alive (MNKA); (iii) minimum ranges of individual the tigers from linking outermost points of locations where the tigers were captured in camera-traps or identifiable from tracks and sign; (iv) an index of abundance (traffic) of large mammal species, i.e.  $\text{Capture Rate} = \text{No. Captures} / 100 \text{ trap nights}$



Fig. 12. The tiger survey design (see text for details)

#### 6.7.6 Survey personnel.

At all sites surveys were done by Myanmar Forest Department staff in collaboration with WCS personnel (except in Taninthayi Division), and local forestry or other government staff. Local people were hired as porters to carry equipment and assist with field logistics. In security areas teams of military personnel joined the survey team. The size of the field survey teams was 3-7 key staff with 10-40 support staff. The average cost of each survey was US\$ 3,600.

#### 6.7.7. Survey effort, constraints and coverage.

In most cases, the survey areas were remote and difficult to access, and surveys required special permissions and clearances. Surveys were constrained by a number of factors including extremes of weather, topography, and security considerations. The particular sites where camera-trap surveys were done at MMLK and TNTY were *not* optimal sites, and were in fact selected by security personnel assisting the team. At each site, field staff attempted to obtain the maximum coverage of the area suspected in the tiger survey. All surveys were conducted on foot and consumed 26+ 5 days (range: 15-100) to reach the survey area, and 86+ 12



days (range: 10-207) to complete a survey from start to finish. Total survey coverage was 3,432 sq.mi (5,491 km<sup>2</sup>), or 202+ 29 sq.mi (range: 91-525 sq.mi). At Alaungdaw Kathapa and Htamanthi the areas covered by survey (244 and 329 sq.mi, respectively) were each one-quarter the size of the protected areas. Interviews of a total of 990 people, or 58+ 17 interviews (range: 5-276) per site were done to determine areas for direct survey. A total of 1,382 hrs, or 81 + 9 hrs (range: 32-171) per site were spent searching for track and sign of the tigers. Camera-traps were established in a total of 430 locations, or 25 + 3 locations per site (range: 0-45) to detect the tigers.

#### **6.7.8. Data recording and storage-**

Standardized data recording forms were employed to record all field data from surveys (Appendices VI-VIII). In the field, staff recorded information on camera-trap operation, measured a suite of microhabitat characteristics at survey locations, and records of track and sign taken along survey routes. All records of wildlife were spatially referenced in UTM grid format using GPS. Following camera-trap retrieval, films were developed at a laboratory in Yangon, and slides catalogued and scored, with records entered into a spreadsheet. Slides were scanned at low resolution and archived.

In order to manage the volume of information arising from the field program, to facilitate analyses of data, and to develop a clearinghouse of baseline information on the tiger and other wildlife for the 17 survey areas for use in future management efforts, an electronic database was developed for the project. This database, written in Microsoft Access by U Myint Thann, contains 15,021 records including all results of track and sign and cameratrap surveys, as well as measurements of microhabitat structure.

In addition to the Access database, a spatial database was developed using Arcview 3.1 software (ESRI Systems, Inc., Redlands, USA) with the assistance of the Myanmar Forest Department (FD) GIS Facility. The database includes information on forest cover and land use, locations of survey sites, drainages, topography, human settlements, roads and other human infrastructure. In the future, the two databases will be linked to allow quick retrieval of information from surveys directly from the spatial database. This GIS could serve as a template for a National Wildlife Database to which other information on biodiversity might be archived in the future.

## **6.8 Results**

### **6.8.1. Camera-trap operation.**

A total of 4,099 photo records were made by camera-traps including 3,341 records (88%) of wildlife, 358 records (9%) of humans, and 112 records (3%) of domestic animals (Appendix II). A total of 19 globally threatened species and 7 globally near- threatened species were recorded by camera-traps, and eight CITES Appendix I, three Appendix II, and five Appendix III species. Eighty-three percent were Myanmar protected species, with 40% totally protected species.

The mean failure rate per site was 17 + 3% (range: 1-33, N=15). Camera-traps failed to work for a variety of reasons ranging but were mostly a result of mechanical failure. Extremes of heat, cold and moisture may cause internal circuits and sensors to stop working in the field. Theft, and damage from animals, especially elephants, were secondary reasons for trap failure.

### **6.8.2. Species richness.**

Camera-traps revealed a diverse assemblage of fauna at fifteen sites (Appendix II). Forty-two species of large mammals were recorded with an average 16.4 + 1.3 species (range: 6-22, N = 15) per site (Appendix IX). Six species were recorded at MB, the least rich site, while at four sites, AKNP, TMT, RN and SPB, 22 species were documented.

In addition, sixteen species of birds, small mammals and reptiles were recorded. However, these fauna were likely to be recorded as accidents of sampling in camera-traps so that the surveys were not representative of their richness.

### **6.8.3. Wildlife traffic.**

Surveys indicated a range of levels of wildlife traffic across sites. Only large mammal species are considered here. From camera-traps, sites had a mean capture rate of 15.0 + 2.6 animals/100 trap nights (N = 17). MB had the lowest capture rates (5.7 animals/ 10 trap nights) with BGY and RN having the highest capture rates (36.2 and 34.2 animals/ 100 trap nights, respectively). From track and sign surveys, the mean encounter rate of wildlife sign was 4.1 + 0.5 signs/hr. PPDL had the lowest encounter rates (1.7 signs/hr) with NKM the highest (8.3 signs/hr).



#### 6.8.4. Human traffic.

Levels of human traffic also varied across sites. From camera-traps, sites had a mean capture rate of  $2.1 \pm 0.7$  photorecords/100 trap nights ( $N = 17$ ). TMT and SRMT had the lowest human traffic (0.15 and 0.18 photorecords/100 trap nights) with PPDL having the highest traffic (11 photorecords/100 trap nights, respectively). From track and sign surveys, mean human traffic was  $0.3 \pm 0.05$  signs/hr. TMT and RER had the lowest encounter rates ( $< 0.1$  signs/hr) with TPTY the highest (0.7 signs/hr).

#### 6.8.5. Occurrence of carnivores.

One or more of the large carnivores—the tiger, Asiatic leopard (*Panthera pardus*), Malayan sunbear (*Helarctos malayanus*) and Asiatic black bear (*Selenarctos thibetanus*) and Asian dhole (*Cuon alpinus*) were recorded by cameratraps at all 17 survey sites (Appendix IX). Sunbear occurred at all but two sites, SRMT and PPDL, making it the most frequently occurring large carnivore species. Dhole occurred at all but four sites, TMT, SRMT, PLG, and MB. Leopard occurred at just over half the sites. Asiatic black bear occurred at just under one-quarter of sites.

#### 6.8.6. Occurrence of the tigers across study sites

Interviews. A total of 990 local people were questioned about the occurrence of the tigers and other wildlife at the 17 sites (Appendix III). These individuals were local villagers, hunters, and government officials living in or around forest areas. Two hundred and thirty eight (24%) individuals interviewed reported having either seen the tigers, encountered sign, or heard the tigers. One hundred and seven (45%) records were direct sightings. Eighty-seven (81%) of these eyewitness accounts were made after 1990. Direct survey. Signs of large cats (the tiger or leopard) were recorded at all survey sites. The tigers were confirmed by camera trapping at four of 17 sites, TMT, HKV, MMLK and TPTY (Appendix IX; Fig. 13.).

1. TMT: a single photo of a the tiger was recorded during October 1999 along with two sets of tracks during the trap retrieval exercise. After the survey team left the area, a tiger was reported killed by hunters from an area adjacent to the survey site.
2. HKV: Fresh sign was found on both sides of upper

and lower Shipak Hka between Tarung Hka and Brangbram Hka, and at Numpraw Hka on 3rd February 2002, during the camera-trap set up exercise. Three photos of the tiger were recorded by camera-traps on 11.2.01, 10.3.01, and 11.3.01. The tigers are thought to be resident in the upper Brangbram Hka, upper Tanaing Hka, Maingkwan and surrounding area, and around Shingbweyang.

3. MMLK: Fresh tracks were found during the camera-setup (26.9.01-4.10.01) and retrieval exercises (7.11.01-14.11.01) and plaster cast records made. A single photo of a tiger was recorded from a camera trap unit set up on a trail on 10.10.01. Nine of 25 units failed to operate so more photo-records might have been made.
4. TPTY: a set of tracks was encountered during the camera-setup operation (17- 20.1.02) and a plaster cast made. Although no photo records were made local people reported a killing of a tigress on 17.1.02 at Kyachaung Village, 2 mi S of Manoron

#### 6.8.7. The tiger density.

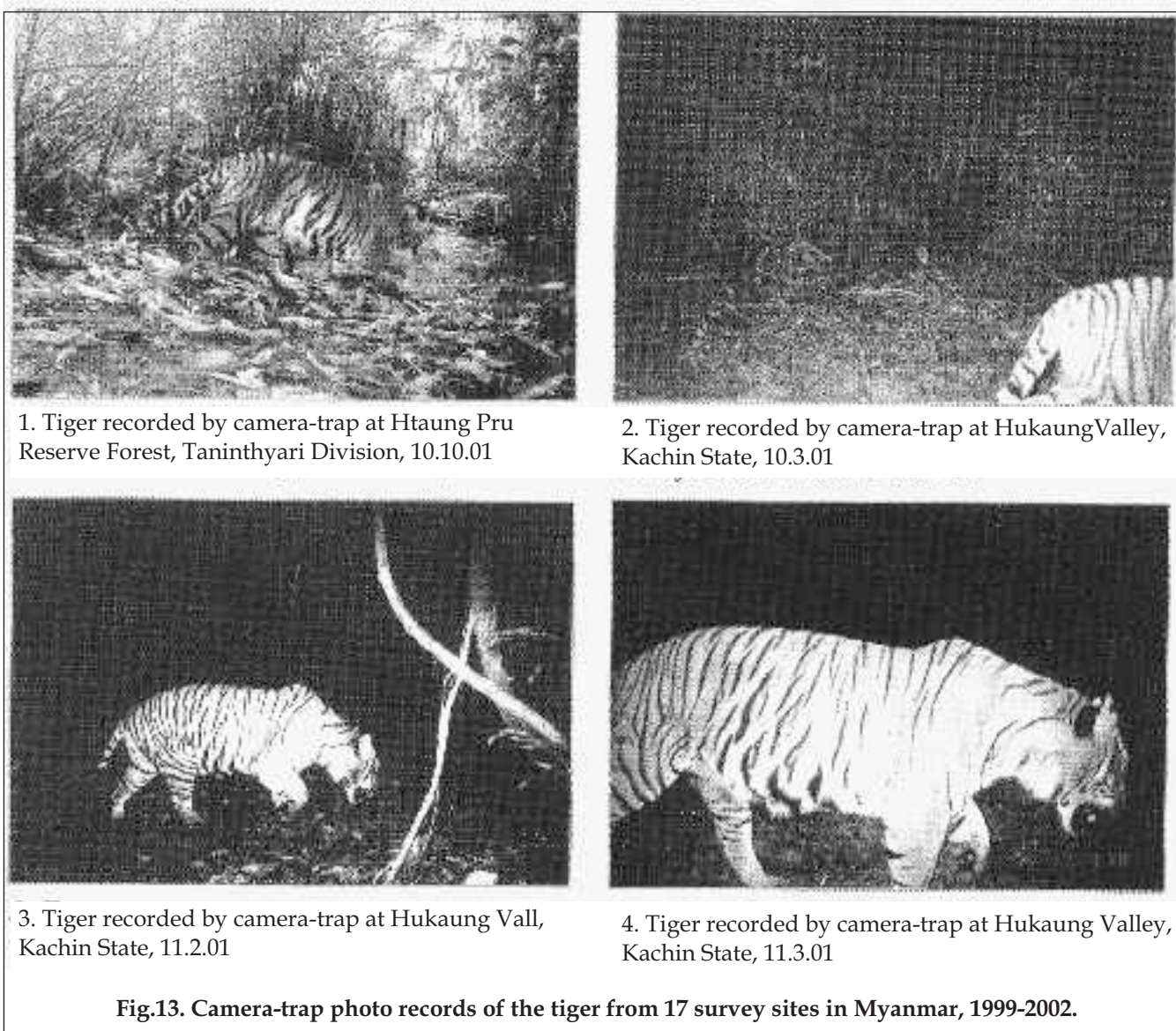
(Karanth & Nichols 2000) estimated the tiger density for multiple sites in India. One of their study sites—Bhadra—is similar in topography and vegetation to northern Myanmar forests. Using information from single sided captures, the tiger density was estimated for the Hukaung Valley, where captures of two individual the tigers were made. Using a mark-recapture approach (Karanth and Nichols 1998) and assuming a capture probability for the tigers (0.788) and a sampling buffer (2 km), densities were estimated for the tiger populations at HTM, HKV and MMLK (Table 7).

#### 6.8.8. Occurrence of other large mammals.

Large ( $> 1$  kg) herbivores were recorded from all survey sites (Appendix IX). Common muntjak (*Muntiacus muntjak*) was the most abundant species in camera-traps and was found at all sites. Wild cattle were recorded at all sites except SRMT, PPDL, and MMLK. Banteng (*Bos javanicus*), a globally threatened species was found at 3 sites, AKNP, MHM and BGY. Sambar (*Cervus unicolor*) was present at all sites except SRMT, PPDL, and MB. Serow (*Capricornis sumatraensis*) was recorded at just fewer than 50 % of sites.

#### (Footnotes)\*

As of 1 May 2000 the United States Department of Defence, the agency that controls GPS satellites, turned off Selective Availability (SA) or “scrambling” of GPS satellite signal information. Prior to this date the accuracy of GPS position fixes was limited to  $\pm 100$  m. Most recreational GPS devices are now capable of real time position fixes accurate to  $\pm 20$ -25m.



#### 6.8.9. Human traffic within study sites.

amera-traps recorded suspected poachers at 8 (47%) of sites (Appendix IX) with villagers recorded at all but three sites, HKV, SPB, MB. Traps at AKNP recorded park rangers on patrol, while traps at MMLK and TNTY recorded military personnel on patrol.

**Table 7. The tiger Densities at Some Rainforest and Evergreen Forests in Myanmar and other Southeast Asia Countries.**

Country	Site	No. the tigers detected	Density est.* (the tigers/100 km <sup>2</sup> )	Min density	Max density
<i>India</i>	<i>Bhadra</i>	7	3.42	2.58	4.26
Thailand	Kaeng Krachan	4	2.82	1.96	3.67
Thailand	Hala	3	2.68	2.42	2.93
Thailand	Bala	2	1.79	1.50	2.07
<i>Malaysia</i>	<i>Temenggor</i> <sup>1</sup>	2	1.78	0.94	2.63
<i>Indonesia</i>	<i>Bukit Berisan</i> <sup>2</sup>	9	1.60	1.2	3.2
<b>Myanmar</b>	<b>Hukaung Valley</b>	<b>2</b>	<b>1.10**</b>	<b>0.91</b>	<b>1.29</b>
<b>Myanmar</b>	<b>Myintmoletka</b>	<b>1</b>	<b>0.67**</b>	<b>0.38</b>	<b>0.96</b>
Thailand	Phu Khieo	1	0.62**	0.35	0.88
<b>Myanmar</b>	<b>Htamanthi</b>	<b>1</b>	<b>0.49**</b>	<b>0.28</b>	<b>0.70</b>
Thailand	Khao Yai	1	0.38**	0.22	0.54

\* Single sided M-R estimates using Program CAPTURE

\*\* No recaptures. Density (D) = No. the tigers (N)/ Area, where N = No. the tigers detected/p, and p=0.778 (from Badhra, India; Karanth and Nichols, 2000)

1 R. Laidlaw and DWNP (unpublished data)

2 O' Brien et al. ms

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## APPENDIX I. DESCRIPTIONS OF 17 MYANMAR THE TIGER SURVEY SITES

### 1. Alaungdaw Kathapa National Park (AKNP)

**Location:** Lies between 22°14'–22°29'N and 94°17'–94°36'E between the Chindwin River floodplain and Myittha River valley in Sagaing Province, approximately 100 mi (160 km) west of Mandalay.

**Elevation:** 100–3,440' (30–1048m).

**Survey area:** Centred on Mindon Camp covering an area of 152 sq.mi (390 km<sup>2</sup>).

**Description:** The area is dissected by a number of high elevation 2000–4000+' (700–1219m) ridges that run in a north-south direction, and is drained by the Patolon and Taungdwin Rivers that flow northwards into the Chindwin River.'

**Vegetation:** Varies from Dry Upper Mixed Deciduous (DUMD) forest on the high ridges and slopes to Moist Upper Mixed Deciduous (MUMD) forest on lower slopes. Bamboos are common in the under storey on lower slopes. Semi-Indaing forest, high Indaing forest or Pine forest occur in patches on the tops of some high ridges.

**Access:** Alaungdaw Kathapa is accessed from the east by road from Yinmarbin, and via a newly constructed road that links India with Mandalay and cuts through the northwest of the park. Walking distance from the nearest road was 1 day.

**Rainfall:** The area is subject to two monsoons, a southwest monsoon which brings most of the yearly rainfall between May and October, and heaviest between August and September. Mean annual rainfall is 588" (1,507 mm). Water is available year round in the major drainages with smaller tributaries mostly drying up by the end of March.

**Human impact and landuse:** The park is surrounded almost completely by cultivated land but inside the park the only settlements are of park staff, mahouts and a monastery. Government camps and religious pilgrimages pose threats to wildlife. Other threats are hunting for wildlife trade, extraction of non-timber forest products, livestock grazing and fishing.

### 2. Thaungdut

**Location:** Lies between 24°17'–24°30'N and 94°30'–94°43' E in the Homalin Township, Sagaing Division and includes with Kabaw Valley.

**Elevation:** 432–2,314' (130–695 km<sup>2</sup>)

**Survey area:** Covers an area of 82 sq.mi. (210 km<sup>2</sup>) 10 mi (16 km) from Thuangdut village.

**Description:** The survey area is surrounded by Thaungdut Reserve Forest in the east, southeast and by Kabaw Valley in the north and northwest. The Nantanyit Chaung runs south to north between Minthamee Mountain 1,871' (570m) and Nantanyit Mountain 3,545' (1,080m) and enters the Chindwin River near Thaundut village. **Vegetation:** Varies from DUMD forest, MUMD forest, to Indaing forest. Bamboos such as Myin Wa, Tin Wa, Wa Bo, Wa Nipa, Theik Wa, Kya Khet Wa, as well as rattan are common.

**Access:** Thaungdut village is accessible by boat along the Chindwin River year-round. It takes about 2 days travel by boat from Monywa. From Thaungdut village the survey area can be accessed by elephant or on foot.

**Rainfall:** 74-99" (188-251 mm) of rain per annum. **Human Impact and Landuse:** Timber extraction has occurred in the area for several years, with the Myanmar Timber Enterprise still extracting hard wood, mainly teak. Hunting, timber cutting, and intrusions by elephant workers and fishermen are threats to wildlife in this area. There were no signs of human settlements or cultivation in the area at the time of survey.

### 3. Htamanthi Wildlife Sanctuary (TMT)

**Location:** Lies between 25°16"-25°44' N and 95°19"-95°46" E. It is bounded to the N by Nampilin Chaung, to the E and SE by Pali Taung, Temein Taung, and New-ta-mein Taung 1,000"-2,000' (304-609m) and the Uyu River, to the S by numerous streams, and to the W by the Chindwin River.

**Elevation:** 490-1,100' (149-335m).

**Survey area:** Covers an area of 205 sq.mi (526 km<sup>2</sup>).

**Description:** Vegetation is primarily tropical evergreen forest with dense bamboo and rattan undergrowth. Mixed deciduous teak forest is also found on higher slopes in the eastern part of the sanctuary.

**Access:** The area is accessible by boat from Homalin, the nearest town, 57 mi. (91 km) and a 2 day journey away.

**Rainfall:** 136" (3,491 mm) per annum. The area is drained by the Nampilin, Nam Emo, Nam Ezu, Nam Pagan and Nam Yanyin all of which flow W into the Chindwin River.

**Human impact and landuse:** No permanent human settlements exist inside the sanctuary but the area is used by Lisu hill tribes who hunt wildlife, and by local people who fish and extract non-timber forest products. Oil drilling occurs in the area. 4. Mahamyang (MHM).

**Location:** Lies between 23°31"-23°43' N and 94°51"-94°57' E. The area includes parts of Lawthar, Pyaungtha, Maingwan, Mahamyang and Nonsabai Reserve Forests.

**Elevation:** 226"-2,071' (68-631m).

**Survey area:** 78 sq.mi. (200 km<sup>2</sup>)

**Description:** The landscape is characterized by evergreen, mixed deciduous and Indaing (Dipterocarp) forests. The area is drained in the W by the Kaedan Chaung which originates at Honan Taung Dan 2,017" (614m) and flows into the Chindwin River. In the E the Pyaungthwe Chaung drains into the Mu River.

**Access:** Reached on foot from Aungchanthar Village, 20 mi. (32 km) away on the Monywa-Khanti highway.

**Rainfall:** 46-69" (117-175mm) per annum.

**Human impact and landuse:** Timber extraction from the surrounding areas has taken place since 1973. At present two private companies are extracting dipterocarp timber from part of the area. Numerous current and old settlements occur in the area. Cattle grazing is taking place. Oil drilling occurred in the past.

### 5. Nankamu (NKM)

**Location:** Lies between 24°03'-25°15' N and 94°57'-96°12' E between Paungbyin and Pinlebu Townships. It includes parts of Sanda, Kaingshe and Paungbyin Reserved Forests. In the N it is bounded by the catchment of Thetla Chaung, a tributary of the Chindwin River, to the E by Zibu Taungdan 2,319'-2,910' (706-886m), a catchment of the Mu River, to the S by the Namkawin



and Kodan Chaung, tributaries of the Chindwin River. **Elevation:** 186-2,100' (56-640m)

**Survey area:** 94 sq.mi. (243 km<sup>2</sup>).

**Description:** Vegetation is dominated by moist upper mixed deciduous forest, with evergreen forest and Indaing forest.

**Access:** The area is accessible by the newly constructed Pinlebu-Paungbyin Road. Paungbyin Town is 300 mi (482km) from Monywa. The base camp was 25 mi (40 km) from Paungbyin.

**Rainfall:** Averages 91" (2,342 mm) per annum

**Human impact and landuse:** Teak extraction occurred in the area 15 years ago. Bamboo and mushroom collecting occurs along trails in the area.

## 6. Saramati (SRMT)

**Location:** Lies between 25°20'-25°43'N and 94°50'-95°40'E. To the N it is bounded by the Saramati Range, to the E by the Chindwin River and Laytin Ridge 5,790' (1,764m), to the S by Lawpe Mountain 8,455' (2,577m) and W by the Myanmar-India border.

**Elevation:** 410-12,553' (124-3,826m)

**Survey area:** xx sq.mi. (xxx km<sup>2</sup>)

**Description:** Streams in the Saramati and Laytin catchments flow to the Nantalaik River, one of the principal tributaries of the Chindwin River. The survey area is contiguous with India's Shiloi Reserve Forest. Vegetation cover consists of evergreen, pine, moist hill evergreen and sub-tropical evergreen forest with bamboo under storey.

**Access:** The area is accessible by road from Layshi in the dry, or during the wet season on foot. Mt Saramati, in the N of the survey area is 40 mi (64 km) from Layshi, accessible only on foot.

**Rainfall:** Averages 91" (2,342 mm) per annum

**Human impact and landuse:** Though sparsely populated, shifting cultivation occurs as high up as 7,000' (2,133m) elevation.

## 7. Paunglaung Catchment (PLG)

**Location:** Lies between 19°52'N-20°17'N and 96°24'E-96°35'E in Pyinmana Township, Mandalay Division. It is bounded to the N by Yamethin Township, to the E by Pinlaung Township, to the S by Pyinmana Township, and to the W by Tatkan Township.

**Elevation:** 500-6,252' (152-1,905m)

**Survey area:** 134 sq.mi. (343 km<sup>2</sup>)

**Description:** Riverine evergreen and moist upper mixed deciduous (MUMD) forest occur in the lowlands with dry upper mixed deciduous (DUMD), Indaing (dipterocarp), grassland and alpine forest at higher elevations. The entire catchment is 1,779 sq.mi. (4,608 sq.km). A rugged mountain range dissects the area.

**Access:** Two days walk from Taunggya to the centre of the study area across a 6,000' (1,828m) mountain range.

**Rainfall:** 55-95" (140-241 mm) per annum

**Human impact and landuse:** Numerous villages occur near the study area. Shifting cultivation occurs in the area, encroaching on the reserve forest. The area is sparsely populated owing to difficult access.

#### **8. Panlaung Pyadalín Cave Wildlife Sanctuary**

**Location:** Lies between 20°56'N-21°00'N and 96°16'-96°27'E in Ywa Ngan Township, Shan State, 21 miles (33km) from Kinda Dam and Hydro Power Project

**Survey area:** Covers an area of 61 sq.mi. (157 km<sup>2</sup>) in the Kinda Dam area and includes two reserve forest areas, Panlaung and Pyadalín.

**Description:** The area is bounded by the Kinda Dam in the north, Ywa Ngan Township in the east, Thazi township in the south and Wan Twin Township in the west, respectively.

**Vegetation:** Riverine evergreen forest, Moist deciduous forest, and Dry deciduous forest each with diverse bamboo communities, and rattan.

**Access:** Panlaung-Pyadalín is accessible by road from Kume village, Myittha Township, 1 hour by boat from the Kinda Dam, and one hour's walk.

**Rainfall:** No data available

**Human Impact and Landuse:** Temporary human settlements occur in the area. Bamboo collection for making chopsticks is practiced. Timber extraction, non-timber extraction, fishing, hunting and cultivation are threats to wildlife. Roads passing through the wildlife sanctuary are used for extracting timber and moving cattle.

#### **9. Central Bago Yoma (BGY)**

**Location:** Lies between 19°02'-19°15'N and 95°53'-96°59'E, and includes parts of Sabyin, West Swa and Kabaung Reserve Forests. It is bounded to the N and E by the Sabyin River, to the E by the Swa River, to the W by the Bago Yoma Range 1,865' (568m), and to the S by the Pyu Mountain 1,537' (468m) and the Kabaung River catchment.

**Survey area:** 130 sq.mi. (334 km<sup>2</sup>)

**Elevation:** 330'-1,885' (100-574m)

**Description:** The area is drained by the Sittaung River and its tributaries. Vegetation is characterized by DUMD forest, MUMD forest and evergreen forest. Bamboos are common in the under storey.

**Access:** The area can be reached by 3 days walk from Swa Dam, to the west of Swa Town on the Yangon-Mandalay highway about 200 mi. (320 km) from Yangon by road.

**Rainfall:** 126" (3,235 mm)

**Human impact and landuse:** Large scale extraction of teak and other hardwood, and other signs of human encroachment including bamboo and rattan collection, hunting and fishing was observed during the study period. No evidence of cultivation or permanent human settlement was observed in the study area.

#### **10. Northern Rakhine (RN) (Paletwa and Kaladan river catchments)**

**Location:** Lies between 21°05'-21°22'N and 92°21'-92°29'E is located between and contains the northern Kalapanzin River catchment, Saingdin Ridge and northern Mayu Range.

**Survey area:** 69 sq.mi. (177 km<sup>2</sup>)

**Elevation:** 710' -2,494' (216-760m)

**Description:** The area is bounded to the N by the Myanmar-Bangladesh border, with the Saingdin River to the E, the Obru and Pairwan Rivers to the S, and the Mayu Range in the W. Vegetation is characterized by sporadic evergreen forest in ravines with extensive Kayin bamboo patches. Forest covers approximately 40% of the survey area. Bamboo is more common in shifting cultivation areas at lower altitudes with dry evergreen forest at higher elevations. Due to logging and bamboo cutting, degraded secondary growth occurs on undulating slopes.

**Access:** The survey area is accessible by boat along the Mayu and Kalpanzin Rivers, and during the dry season by 6' wide paths cleared by the UN.

**Rainfall:** (no data available)

**Human impact and landuse:** A number of tribal settlements occur in areas fringing the forest. The lower Kalapanzin River valley is fertile and supports large villages (100-1,000 households) of Bengali people. Hunting, shifting cultivation and extraction of non-timber forest products all occur in the area.

### 11. Rakhine Elephant Range (RER)

**Location:** Lies between 18o01'-18o59'N and 94o36'-94o45' E on the western side of the Rakhine Yoma Range.

**Survey area:** 57 sq.mi. (146 km<sup>2</sup>)

**Elevation:** 252' -3,416' (77-1,041m)

**Description:** The area is dissected by a series of tall ridges running north to south range from 2000'-4000'. The area is drained by the Tandwe, Salu and Kyeintali Rivers that flow westwards into the Bay of Bengal. Vegetation includes semi-evergreen, mixed deciduous and secondary tropical moist forest, and bamboo brake.

**Access:** The study area was 3 days walk from Bogale Village, which is 48 mi. (77 km) from Gwa by road. Gwa Town is 180 mi (289 km) NW of Yangon by car.

**Rainfall:** (No data available)

**Human impact and landuse:** Thirty-three villages surrounding the Elephant Range consisting of Rakhine tribes (82%) and Chin tribes (18%). They farm rice and groundnut, practice shifting cultivation, and practice commercial hunting of wildlife.

### 12. Hukaung Valley (HKV)

**Location:** Lies between 26o36'-26o42'N and 96o34'-96o53'E in the newly declared Hukaung Valley Wildlife Sanctuary (2,493 sq. miles; 6,459 km<sup>2</sup>).

**Survey area:** 525 sq.mi. (840 km<sup>2</sup>)

**Elevation:** 193' -1,307' (59-398m)

**Description:** To the N an upland area 6,758' (2,060m) divides the Tarung-Tawan watershed and Gedu River catchment, with the Kumon Mountains to the E, the Nambyu and Nampyek River catchments in the S and the Tarung River and old Ledo Road to the W. Vegetation is predominantly dense lowland evergreen forest interspersed with meadows.

**Access:** The area lies 20 miles (32km) N of Tanaing and can be accessed during the wet season by boat and during the dry season by baggage elephant. The Ledo Road is paved for 90 miles (149 km) of its length providing year-round access from Myitkyina.

**Rainfall:** 91" (2,339 mm)

**Human impact and landuse:** Apart from a 5 acre shifting cultivation area near Tawang River there were no permanent human settlements in the area.

### 13. Kaunglaungpu (KLP)

**Location:** The survey area is located in the Kran River and Phet River catchments between 26°44' - 26°53' N and 97°053' - 98°04' E.

**Survey area:** 127 sq. mi. (326 km<sup>2</sup>)

**Elevation:** 200' - 9,080' (61-2,767m)

**Description:** These rivers along with the Shinyan and Hteei Rivers drain the area. The area is covered in natural forest (40%) consisting of tropical evergreen, subtropical hill, warm and cool temperate rainforest and alpine. The remainder (60%) is secondary forest damaged by shifting cultivation in former times. These areas are dominated by bamboo, teat trees, phetwin, and old woody lianas. Extraction of some hard woods was taking place.

**Access:** This area is reached from Putao by road to Mabweza (63mi.; 101 km). The survey area is accessed by a 63 mi. (8 day) walk on foot passing Sunnochat Mountain.

**Rainfall:** (no data available)

**Human impact and landuse:** Intensive shifting cultivation has transformed natural forests into secondary forests. Threats to the tigers and prey include a new road built from the China border, timber extraction, non-timber forest product extraction, mining, subsistence hunting and wildlife trade with China.

### 14. Sumprabum (SPB)

**Location:** The survey area lies 9mi. (15km) east of the Kumaon Range and 10 mi. (17 km) W of Sumprabum at 26°29' - 26°36' N and 97°021' - 98°028' E.

**Survey area:** 130 sq. mi. (334 km<sup>2</sup>)

**Elevation:** 460' - 4,950' (140-1,508m)

**Description:** It is bounded to the N by the Chaukan Pass and hills that receive snow in winter. The Hukaung Valley lies to the W, with Myitkyina Township to the S. The area is drained by the Hpungchan, Hpung-in and Mali Rivers in the east and northwest, and from the south by the Magyeng River. Vegetation is tropical evergreen, sub-tropical moist hill forest, and subtropical wet hill forest. Bamboos and rattan species occur in the under storey. Some swamp land occurs in the area.

**Access:** The area is reached on foot from Sumprabum. Sumprabum is 131 miles (210 km) N by road from Myitkyina.

**Rainfall:** 91" (2,339 mm)

**Human impact and landuse:** The area is sparsely populated (3.8 people/sq. mi.; 2.5/sq. km) with local people practicing shifting cultivation.



### 15. Momeik-Mabain (MB)

**Location:** The survey area is located between 23o45'-23o55'N and 96o43'-96o51' E and includes parts of Manpon, Nampa and Namme Reserve Forests.

**Survey area:** 133 sq.mi (340 km<sup>2</sup>)

**Elevation:** 426'-1,965' (130-599m)

**Description:** It is drained by the Maingthar and Namme River. Alluvial plains dominate the survey area with some rugged, rocky peaks including Parhoke Mountain 3,101' (945m), Wantu Mountain 3,003' (915m) and Kweanung Mountain 2,393' (729m). Vegetation comprises evergreen, MUMD and Indaing forest.

**Access:** From Mabain the study area is accessed by boat (18 mi.; 29 km), then by cart (12 mi.; 19 km), then on foot (18 mi.; 29 km). Mabain is 38 mi. (61 km) by ferry from Momeik. Momeik is 156 mi. (251 km) from Mandalay.

**Rainfall:** 52" (1,338 mm)

**Human impact and landuse:** Development of roads and infrastructure for gold mining has taken place since 1988 resulting in forest disturbance and pollution of natural drainages. Over 300 residents inhabit four goldmines in the forest. In the dry season, miners turn to bamboo and rattan cutting and resin tapping.

### 16. Myintmoletkat (MMLK)

**Location:** The survey area lies in the Htaung Pru Reserve Forest between 11o45'-11o38' N and 99o07'-99o03'E in Taninthayi and Bokpyin Townships, Myeik District.

**Survey area:** 120 mi. (310 km<sup>2</sup>)

**Elevation:** 110'-2,264' (33-690m)

**Description:** The eastern portion is drained by the Naukpyan, La Mu, Tabalat, and Ngawun Streams which flow into the Little Taninthayi River. To the west the Monoron Stream flows into the Lenyar River to the south. The area is partially low-lying with swamp and grassland that is annually flooded, interspersed with mixed evergreen-bamboo forest groves on higher ridges. The area lies on both sides of the new Taninthayi-Bokpyin highway, and is partially under cultivation for rice and areca palm with some shifting cultivation.

**Access:** By road from Myeik (58mi).

**Rainfall:** The area has two monsoons with a prolonged wet season from June-November, and annual rainfall of around 160" (4,127 mm).

**Human impact and landuse:** Base camp was situated 3 miles (5 km) S of Htaung Pru Village containing 15 households, with a further 38 households in adjacent Monoron Village.

### 17. S. Taninthayi (TNTY)

**Location:** The survey area lies in the Pe River Valley at 13o30' N and 98o38'E in Thayetchaung Township, Dawei District.

**Survey area:** 110 mi. (285 km<sup>2</sup>)

**Elevation:** 208'-2,010' (63-612m)

**Description:** Pe River Valley is bounded to the N by the Mintha Reserve Forest, to the E by Myintmoletkat Mountain 6,801' (2,072m) to the S by the fork of the Pe and Plauk Rivers and on the W by Pe Mountain 2,720' (829m). Vegetation is characterized by a mosaic of riverine evergreen forest (30%) with sporadic secondary growth (30%) and shifting cultivation and orchard (40%). Areca palm and catechu plantations dominate the cultivated areas.

**Access:** The area is accessible from the Dawei-Myeik Highway, 53 mi. (85 km) south of Thayetchaung, and on foot 15 mi. (24 km) east of Pedat.

**Rainfall:** The area has two monsoons with a prolonged wet season from June-November, and annual rainfall of around 161" (4,127 mm).

**Human impact and landuse:** Due to the security situation, permanent settlements no longer exist in the area and farmers are permitted only weekly access to maintain and harvest their lands.

## APPENDIX II. WILDLIFE RECORDED BY CAMERA-TRAP SURVEYS AT 17 SITES IN MYANMAR 1999-2002

Species	Scientific name	IUCN Status	CITES Status	Myanmar Status	No. records
The tiger	<i>Panthera tigris</i>	EN	App I	TP	5
Leopard	<i>Panthera pardus</i>	LR	App I	TP	92
Clouded Leopard	<i>Neofelis nebulosa</i>	VU	App I	TP	50
Golden cat	<i>Catopuma temminckii</i>	LR/VU	App I	TP	34
Marbled cat	<i>Pardofelis marmorata</i>	DD	App I	TP	15
Leopard cat	<i>Prionailurus bengalensis</i>	EN	App II	P	80
Wild dog	<i>Cuon alpinus</i>	VU	-	P	34
Small Indian civet	<i>Viverricula indica</i>	-	App III	TP	6
Large Indian civet	<i>Viverricula zibetha</i>	-	App III	P 1	35
Large spotted civet	<i>Viverricula megaspila</i>	-	-	P	1
Common palm civet	<i>Paradoxurus hermaphroditus</i>	VU	App III	P	14
Three-striped palm civet	<i>Arctogalidia trivirgata</i>	EN	-	P	1
Masked palm civet	<i>Paguma larvata</i>	-	App III	P	3
Spotted Linsang	<i>Prionodon pardicolor</i>	-	App I	TP	2
Banded Linsang	<i>Prionodon linsang</i>	-	App II	TP	5
Binturong	<i>Arctictis binturong</i>	VU	App III	P	15
Malayan sunbear	<i>Helarctos malayanus</i>	DD	App II	TP	72
Himalayan black bear	<i>Ursus thibetanus</i>	VU	App I	P	17
Yellowthroated marten	<i>Martes flavigula</i>	-	-	P	16
Wild Pig	<i>Sus scrofa</i>	VU	App I	-	443
Hog badger	<i>Arctonyx collaris</i>	-	--	--	33
Myanma ferret badger	<i>Melogale personata</i>	-	-	-	1
Mongoose species	<i>Herpestes spp</i>	--	--	P	1

Crab-eating mongoose	<i>Herpestes urva</i>	-	-	P	22
Elephant	<i>Elephas maximus</i>	EN		TP	81
Gaur	<i>Bos gaurus</i>	VU		TP	265
Banteng	<i>Bos javanicus</i>	EN		TP	38
Tapir	<i>Tapirus indicus</i>	VU		TP	3
Sambar	<i>Cervus unicolor</i>	-		P 1	66
Serow	<i>Naemohedus sumatraensis</i>	VU		TP	25
Common muntjak	<i>Muntiacus muntjak</i>	-		SP	847
Leaf deer	<i>Muntiacus putaoensis</i>	-		TP	2
Large mouse deer	<i>Tragulus napu</i>	EN		TP	9
Lesser mouse deer	<i>Tragulus javanicus</i>	-		TP	9
Malayan porcupine	<i>Hystrix brachyura</i>	VU		-	128
Brush-tailed porcupine	<i>Atherurus macrourus</i>	EN		-	32
Pangolin	<i>Manis javanica</i>	LR/NT		TP	2
Rhesus macaque	<i>Macaca mulatta</i>	LR/NT		P	97
Pig-tailed macaque	<i>Macaca nimestrina</i>	VU		P	59
Capped leaf monkey	-	-		-	2
Phayres langur	<i>Prebytis phayrei</i>	-		P	1
Dusky leaf monkey	<i>Semnopithecus obscurus</i>	LR/NT	-	TP	1
Squirrel	<i>Ratufa spp</i>	-		-	11
Other small mammal species	-	-		-	24
Blue Whistling Thrush	<i>Myiophoneus caeruleus</i>			SP	1
Green magpie	<i>Cissa chinensis</i>			P	1
Indian pied hornbill	<i>Anthracoceros albirostris</i>			TP	1
Jungle fowl	<i>Gallus gallus</i>			-	80
Laughingthrush species	<i>Garrulax spp</i>			P	1



Orange bellied	<i>Chloropsis hardwickii</i>			SP	17
leafbird Owl	<i>Strigiformes spp</i>			TP	2
Parrot	-			P	4
Pheasant species	-			TP	163
Black Stork	<i>Ciconia nigra</i>			-	2
Quail	<i>Coturnix spp</i>			-	2
Monitor lizard	<i>Varanus spp</i>			P	1
Tortoise	-				P 1
Green viper	<i>Trimeresurus spp</i>			P	1
Unidentified Human sign					165
Domestic elephant					10
Domestic buffalo					29
Domestic cow					46
Domestic dog					27
Villagers Suspected					242
poacher					61
Military Government					30
staff					25
				<b>Total</b>	<b>3811</b>

## APPENDIX III. RESULTS OF INTERVIEW SURVEYS FOR THE TIGERS AT 17 SITES IN MYANMAR

Site	Direct observation (sighting)	Track and sign	Heard	Total observ.	Date of most recent direct observation
AKNP	3	5	9	17	1998
BGY	2	10	1	13	1998
HKV	9	10	0	19	2001
KLP	6	21	0	27	Oct 2000
MB	16	1	1	18	2001
MHM	2	5	0	7	Dec 1998
MMLK	14	6	0	20	Oct 2001
PLG	9	20	1	30	Apr 2000
PPDL	6	7	1	14	2000
RER	6	1	3	10	Jun 2000
RN	7	4	0	11	Jan 2000
SPB	6	10	0	16	1998
TD	3	3	1	7	2000
TMT	4	5	1	10	1996
TNTY	14	4	1	19	Feb 2002
<b>Totals</b>	<b>107</b>	<b>112</b>	<b>19</b>	<b>238</b>	

# APPENDIX IV. HISTORICAL RECORDS OF TIGER IN MYANMAR - PRE-1999

Ref.	Location	Year	Sex	Age	Weight (kg)	Length (cm)	Notes
1	Chindwin River, Mandalay	1890	♂	Adult	150	180	First recorded tiger in Myanmar
2	Chindwin River, Mandalay	1895	♀	Adult	140	170	Second recorded tiger in Myanmar
3	Chindwin River, Mandalay	1900	♂	Adult	160	190	Third recorded tiger in Myanmar
4	Chindwin River, Mandalay	1905	♀	Adult	155	185	Fourth recorded tiger in Myanmar
5	Chindwin River, Mandalay	1910	♂	Adult	170	200	Fifth recorded tiger in Myanmar
6	Chindwin River, Mandalay	1915	♀	Adult	165	195	Sixth recorded tiger in Myanmar
7	Chindwin River, Mandalay	1920	♂	Adult	180	210	Seventh recorded tiger in Myanmar
8	Chindwin River, Mandalay	1925	♀	Adult	175	205	Eighth recorded tiger in Myanmar
9	Chindwin River, Mandalay	1930	♂	Adult	190	220	Ninth recorded tiger in Myanmar
10	Chindwin River, Mandalay	1935	♀	Adult	185	215	Tenth recorded tiger in Myanmar
11	Chindwin River, Mandalay	1940	♂	Adult	200	230	Eleventh recorded tiger in Myanmar
12	Chindwin River, Mandalay	1945	♀	Adult	195	225	Twelfth recorded tiger in Myanmar
13	Chindwin River, Mandalay	1950	♂	Adult	210	240	Thirteenth recorded tiger in Myanmar
14	Chindwin River, Mandalay	1955	♀	Adult	205	235	Fourteenth recorded tiger in Myanmar
15	Chindwin River, Mandalay	1960	♂	Adult	220	250	Fifteenth recorded tiger in Myanmar
16	Chindwin River, Mandalay	1965	♀	Adult	215	245	Sixteenth recorded tiger in Myanmar
17	Chindwin River, Mandalay	1970	♂	Adult	230	260	Seventeenth recorded tiger in Myanmar
18	Chindwin River, Mandalay	1975	♀	Adult	225	255	Eighteenth recorded tiger in Myanmar
19	Chindwin River, Mandalay	1980	♂	Adult	240	270	Nineteenth recorded tiger in Myanmar
20	Chindwin River, Mandalay	1985	♀	Adult	235	265	Twentieth recorded tiger in Myanmar
21	Chindwin River, Mandalay	1990	♂	Adult	250	280	Twenty-first recorded tiger in Myanmar
22	Chindwin River, Mandalay	1995	♀	Adult	245	275	Twenty-second recorded tiger in Myanmar
23	Chindwin River, Mandalay	2000	♂	Adult	260	290	Twenty-third recorded tiger in Myanmar
24	Chindwin River, Mandalay	2005	♀	Adult	255	285	Twenty-fourth recorded tiger in Myanmar
25	Chindwin River, Mandalay	2010	♂	Adult	270	300	Twenty-fifth recorded tiger in Myanmar
26	Chindwin River, Mandalay	2015	♀	Adult	265	295	Twenty-sixth recorded tiger in Myanmar
27	Chindwin River, Mandalay	2020	♂	Adult	280	310	Twenty-seventh recorded tiger in Myanmar
28	Chindwin River, Mandalay	2025	♀	Adult	275	305	Twenty-eighth recorded tiger in Myanmar
29	Chindwin River, Mandalay	2030	♂	Adult	290	320	Twenty-ninth recorded tiger in Myanmar
30	Chindwin River, Mandalay	2035	♀	Adult	285	315	Thirtieth recorded tiger in Myanmar

## APPENDIX V. THE TIGER INTERVIEW PROTOCOL

1. How long have you been in this village?
2. What is your ethnicity?
3. Where do you get bamboo and wood to repair your house?
4. (If you get it from the forest) How far from your house to the forest?
5. How many times do you go into the forest per month?
6. Have you ever seen wild animals when you go inside the forest?

If yes,

Sr.	Animal (Prey)	Quantity		Forest		Human disturbance		Remark
		Many	Few	Unclassified	Reserved	Yes	No	

Sr.	Animal (Predator)	Quantity		Forest		Human disturbance		Remark
		Many	Few	Unclassified	Reserved	Yes	No	

1. Do you have any experience with predators attacking humans or livestock?

Sr.	(Predator)	Livestock						Time occur	Place occur	Remark
		Human	Buffalo	Cow	Goat	Pig	Others			

2. How do people use wild animal products in this area?

Sr.	Animal	Products				Usage		Marketsituation				Remark
		Meat	Bobne	Skin	Horn	Medicine	Food	Traditional	Place	User	Price	

3. What hunting methods do people use? What kinds of tools do they use for hunting?

Sr.	Prey	Hunting methods							Tool					
		Tracking	Smelling	Remnants	of	food	Info	Gun	Crossbow	Bow	Dogs	Snare	Trap	Digginghole



4. (If he/she does cultivation) How much land do you use? What kinds of crops do you plant? Do wild animals destroy your crops? If yes, what animals are they?

Sr.	Crops	Acres			Total acres	Animal that destroyed crops	Time occur		Remarks
		Paddy field	Shifting cultivation	Extended land			Day		

1. What kind of animals do you raise? How do you raise livestock?  
(Free grazing/ farming) How far from village to grazing field? How many acres used for grazing/ (estimate)
2. Have you ever seen a the tiger?  
(Yes-No Place...../ Time...../ Size.....)  
Have you ever heard a roar of a the tiger?
3. Have you ever seen track, scratch, and faeces of the tiger?  
If yes, how big is it?  
(Showing a track of the tiger) Have you ever seen a track like this?
4. Have you ever seen a leopard? Size? Colour pattern?
5. What is your opinion about the usages of the tiger product medicine?
6. How many the tigers do you think live around this region?
7. Is there any the tiger product trade around this region?
8. What is your feeling and opinion about the tigers?
9. Please show animals you have seen from these pictures?
10. Please talk about the tigers that your parents and grandfather/ mother have talked about?

General notes:

## Myanmar Tiger Survey Wildlife Conservation Society, Myanmar Program

### Figure 2 Track & Sign Data

Date .....  
 Title page .....  
 Time first .....  
 Length time .....

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Early 20s .....  
 30s .....  
 40s .....  
 50s .....  
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 70s .....  
 80s .....  
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[illegible]

2000

Chloroform 10.0 ml

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# APPENDIX VII. CAMERA-TRAP FIELD USAGE FORM

**Myanmar Tiger Survey** Wildlife Conservation Society, Myanmar Program

Study Site: .....

Plat. Trail: .....

Form No. 2

Camera trap settings

Date: week/month/year

Checked & called by:

Time:

Photo ID	Photograph		Location		Time		Camera Settings		Notes	
	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID	Photo ID
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## APPENDIX VIII. CAMERA-TRAP RECORD FORM

[illegible]





b. Detections of wildlife from track and sign surveys at 17 sites in Myanmar, 1999–2002

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991	2992	2993	2994	2995	2996	2997	2998	2999	3000
Total Road wildlife specimens	11	2	5	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						