

A Biological Assessment of the Central Truong Son Landscape



A BIOLOGICAL ASSESSMENT OF THE CENTRAL TRUONG SON LANDSCAPE

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BACKGROUND TO THE CENTRAL TRUONG SON REPORTS

In response to concerns about the increasing pace of biodiversity loss and the need to increase the scale and integration of global conservation efforts - WWF together with its conservation partners have developed a new approach to conservation – ecoregion conservation. Scientists have undertaken a major analysis of the world’s biodiversity and identified more than 800 ecoregions that reclassify the way we view the natural world. From this global inventory, 238 ecoregions have been identified that comprise the most valuable and representative global biodiversity. These priority ecoregions have been labeled as the Global 200.

In 1998, the Forests of the Lower Mekong Ecoregion Complex (FLMEC) was selected as one of the first locations to initiate an ecoregion based conservation programme. With initial support from WWF-US and USAID, the programme has now been established as one world’s first fully functioning Ecoregion Action Programmes (EAP).

In March 2000, over eighty scientists from Cambodia, Lao P.D.R., Vietnam, and many other countries participated in an ambitious and groundbreaking assessment of biological conservation priorities within the Forests of the Lower Mekong Ecoregion Complex. The results of this biological assessment have since been published in the report entitled “Towards a Vision for Biodiversity Conservation in the Forests of the Lower Mekong Ecoregion Complex”.

After the biological assessment and a ‘situation analysis’ to examine the threats and opportunities, WWF decided to focus on two of the Global 200 ecoregions falling within the Forests of the Lower Mekong Ecoregion Complex – the Greater Truong Son and the Central Indochina Dry Forests.

The Greater Truong Son comprises the most unique and diverse biodiversity within the FLMEC. The discovery of the saola (*Pseudoryx nghetinhensis*) by WWF and Vietnamese scientists in 1992 in Vu Quang Nature Reserve drew the world’s attention to the biodiversity associated with this mountain chain. Since that first remarkable discovery, many other new species have been found, including a number of large mammals such as the large-antlered (giant) muntjac (*Muntiacus vuquangensis*) and the Annamite striped rabbit (*Nesolagus timminsi*). These discoveries highlight the Greater Truong Son as one of the world’s most remarkable and unique ecoregions. In addition to these species totally reliant on successful conservation in the ecoregion, a number of wider-ranging, highly threatened species such as the Asian elephant (*Elephas maximus*), tiger (*Panthera tigris*) and the world’s most endangered large mammal, the lesser one-horned (Javan) rhinoceros (*Rhinoceros sondaicus*) are found in the ecoregion.

The Central Truong Son Initiative* is a pilot initiative being developed by WWF’s Greater Truong Son EAP, with a view towards establishing the process of working at three scales - ecoregional/national policy, landscape and site. The aim of this fledgling initiative is to create a partnership of a broad range of stakeholders - from local communities to international organisations - working together to secure biodiversity conservation and sustainable development in the Central Truong Son Landscape (CTSL).

Following the methodology of the ecoregional approach, the Central Truong Son Initiative is based on coordinated conservation action, designed under a large-scale framework and guided by a long-term vision of success. The approach is based on the recognition that uncoordinated actions at individual sites are neither efficient nor effective at conserving functioning ecological systems or halting the loss of natural resources. In order to be more effective, a more ambitious coordinated effort is required that is developed and designed under an overarching strategy. The need for such a coordinated effort resulted in the establishment of an advisory group comprising 16 government institutions. This unprecedented collaboration will work as a vital support body to the Central Truong Son Initiative in its planning process towards a conservation strategy for the CTSL.

In order to develop such a comprehensive, overarching strategy, there is a great deal of information that needs to be assimilated. Through a process of lengthy and detailed consultations, the necessary information has been identified and collected. This series of reports presents that information in a format that is both suitable for informing those involved with the strategy development process, and conducive to those merely interested in the status and issues of the CTSL.

* Truong Son is also known as the "Say Phou Louang" in Lao P.D.R., and as the "Truong Son" internationally. The Central Truong Son is one landscape in the ecoregion.

EXECUTIVE SUMMARY

The Greater Truong Son Global 200 Ecoregion supports a large number of endemic and near-endemic taxa, including saola (*Pseudoryx nghetinhensis*), large-antlered (giant) muntjac (*Muntiacus vuquangensis*), yellow-cheeked crested gibbon (*Hylobates gabriellae*), Edwards's pheasant (*Lophura edwardsi*) and the conifer *Pinus dalatensis*. A large proportion of these taxa occur in the Central Truong Son Landscape, including some, such as 'grey-shanked' Douc langur (*Pygathrix nemaus cinerea*), black-crowned barwing (*Actinodura sodangorum*) and the conifer *Amentotaxus poilanei*, that are not known from elsewhere in the Greater Truong Son. In addition, the Central Truong Son Landscape supports a diversity of natural habitats, across an elevation range from sea level to over 2,500 m. While extensive areas of the natural habitats within the Central Truong Son Landscape have been degraded or cleared, particularly at low elevations, the remaining areas still support relatively intact animal and plant communities. For these reasons, the Central Truong Son Landscape was identified as a priority landscape (labeled Priority Landscape CA1) at the *Ecoregion-based Conservation in the Forests of the Mekong Biological Assessment Workshop*, held in Phnom Penh in March 2000.

Due to Priority Landscape CA1's outstanding biodiversity value, high level of threat and great need for coordinated conservation action, the Central Truong Son Initiative was launched in November 2000, to bring together government institutions at central and local levels, and international organisations, for an intensive, collaborative conservation effort. The first stage of the Central Truong Son Initiative is to develop a conservation strategy for Priority Landscape CA1. This conservation strategy will be based on a situational analysis to identify threats and opportunities likely to influence the success of the initiative, and a biological assessment to formulate a biological vision for the priority landscape. This document outlines the methodology and results of the biological assessment, and presents the biological vision for the Central Truong Son Landscape.

The first stage of the biological assessment was to define the foci for conservation action in the priority landscape. Conservation foci define the priority landscape, are the focus of conservation action, act as flagships for conservation, and form a basis for monitoring and evaluation of conservation action. The conservation foci were defined with the objective that adequate conservation of all foci in Priority Landscape CA1 would be sufficient to conserve the full range of biodiversity and biological processes within the priority landscape.

Seven of the conservation foci defined were habitats:

1. lowland forest (0-700 m) in sub-landscape CA1a
2. lowland forest (0-700 m) in sub-landscapes CA1b and CA1c
3. lower and medium montane forest (700-1,500 m)
4. upper montane forest (>1,500 m)
5. rapids
6. headwaters
7. middle reaches of main rivers

Ten of the conservation foci defined were groups:

1. all turtle species
2. wide-ranging large mammals
3. all primates

4. lowland galliformes
5. large, congregatory bird species
6. eels in the genus *Anguilla*
7. commercially valuable catfish
8. endemic and near-endemic animal taxa
9. endemic and near-endemic plant taxa
10. taxa severely threatened by over-exploitation

Four of the conservation foci defined were individual taxa:

1. saola
2. tiger
3. 'Indochinese' hog deer
4. Siamese crocodile

Three of the conservation foci defined were landscape features:

1. habitat corridors
2. core areas
3. ecological transitions

The second stage of the biological assessment was to set a series of biological targets: explicit biological objectives for the priority landscape, translated into quantitative targets for conservation action. The biological targets were set in such a way that, if all were met, the full range of biodiversity and biological processes within the priority landscape would hopefully be conserved. Therefore, a series of biological targets was set for each conservation focus. In addition, a number of non-focal biological targets were set, to cover any issues not adequately addressed by the targets set for the conservation foci. Biological targets were grouped into short-term targets and medium-term targets, and, classified into high, medium and low priorities for conservation action.

The third stage of the biological assessment was to map the distribution of the conservation foci within the priority landscape. Mapping the distribution of the conservation foci facilitated the design of a conservation landscape that could potentially conserve the full range of biodiversity and biological processes in the priority landscape. A range of methods was used to map the distribution of the conservation foci, resulting in the creation of GIS coverages for each conservation focus.

The fourth stage of the biological assessment was to design a conservation landscape: a spatial representation of conservation priorities, which facilitates the long-term conservation of the full range of biodiversity and biological processes within a priority landscape. After GIS coverages had been created for all conservation foci and other relevant spatial data, a set of quantitative goals for the conservation landscape was set. These goals were based on the biological targets set during the second stage of the biological assessment. Consequently, the conservation landscape was designed in a way that aimed to meet the conservation requirements of all conservation foci. However, because precise data on minimum area requirements for taxa were not available, the quantitative goals set for the conservation landscape were estimates based on the best available data and the precautionary principle of selecting the upper estimate in each case.

The conservation landscape was zoned into priority 1 areas, the conservation of all of which could potentially support the full range of biodiversity and biological processes in the short term (0-10 years); priority 2 areas, the conservation of all of which, together with that of all priority 1 areas, could potentially support the full range of biodiversity and biological processes in the medium term (10-50 years); and priority 3 areas, the conservation of all of which, together with that of all priority 1 and priority 2 areas, could potentially make a significant contribution to the long term (50-200 years) conservation of the full range of biodiversity and biological processes in the priority landscape.

Six priority 1 areas were defined: Phong Dien/Dak Rong, Xe Sap/Nam Thua Thien Hue, Bach Ma/Ba Na/Hai Van, Ngoc Linh/Song Thanh/Phou Ahyon, Dong Ampham and Kon Ka Kinh/Kon Cha Rang. These priority 1 areas were based on existing protected areas, in order to build on existing conservation action in these areas and make the most efficient use of available resources. However, the existing protected areas were insufficient to meet the quantitative goals for the conservation landscape, and, therefore, the priority 1 areas included additional, contiguous areas.

When meeting the goals for the network of priority 1 and priority 2 areas as a whole, priority was given to rehabilitation of habitat of medium conservation importance within the priority 1 areas already defined to habitat of high conservation importance over addition of priority 2 areas, in order to maximise the integrity of priority 1 areas while minimising the size of the conservation landscape. However, in order to meet all the goals, it was necessary to define six priority 2 areas: A Luoi, East Dong Ampham, Thach Nham, Dak To, Dak Choong and Xe Kong/Quang Nam.

Finally, two priority 3 areas were roughly defined, linking Priority Landscape CA1 with Priority Landscape CA2 (Dong Phou Vieng) and Survey Area CAS2 (Central Annamite Southern Extension).

There were many limitations to the biological assessment process. The most serious of which included time constraints, poor reliability and resolution of data sets, almost complete lack of data on minimum area requirements originating from Indochina, and limited opportunity for review by international experts. Consequently, the biological assessment was a very rapid, preliminary step, and represents the first attempt to synthesise data on the biodiversity of the Central Truong Son Landscape and to use it as a basis for identifying taxa, habitats and areas of conservation priority. There is, therefore, a requirement to continually review and revise the results of the biological assessment and the biological vision for the Central Truong Son Landscape, as new information becomes available.

ACKNOWLEDGEMENT

Central Truong Son Initiative's acknowledgement

The successful completion of the Central Truong Son Initiative's initial stage is thanks to the help, support and advice of a vast number of people and organizations. It is impossible to thank every single one of these contributors within this page, but an attempt has been made to thank as many people as possible and hopefully all organizations involved.

The programme and the entire process behind it recognizes the invaluable support of His Excellency, Vice Minister Nguyen Van Dang, Ministry of Agriculture and Rural Development whose level of involvement and commitment have been integral to the development of the Central Truong Son Initiative. The Initiative must pay a particular debt of thanks to Dr. Nguyen Ba Thu, Director of the Forest Protection Department of MARD, for the constant support and enthusiasm he has provided during the development process.

The six-member core consultative group was a driving force behind the shaping of this programme. Therefore, special acknowledgement for the key role in the process undertaken by the core advisory group is due to Mr. Tran Quoc Bao, Prof. Le Quy, Mr. Vu Van Dung, Mr. Tran Lien Phong, Mr. Nguyen Lam Thanh, Prof. Dr. Pham Nhat.

The technical and administrative support for the development of the Initiative was provided by the Ecoregion Action Programme office at WWF Indochina in Hanoi led by Michael Baltzer together with Mac Tuyet Nga, James Hardcastle, Nguyen Thi Dao and Rob Shore. Also from WWF Indochina Programme, special thanks are due to Eric Coull, Hoang Thanh, Tran Minh Hien, Barney Long, Mai Ky Vinh, Martin Geiger, Le Trong Trai and other staff from WWF Indochina for their support and involvement, Jenny Springer and Kristin Clay from WWF-US for their invaluable support during the process.

Finally, an gratitude is due to the provincial People's Committees, Forest Protection Departments, Agriculture and Rural Development Departments and all the other local stakeholders consulted in the Central Truong Son Landscape provinces (Quang Tri, Thua Thien Hue, Da Nang, Quang Nam, Kon Tum, Gia Lai and Binh Dinh).

USAID and WWF-US has provided the invaluable financial support for the development of the Central Truong Son Initiative.

AUTHORSHIP OF THIS DOCUMENT

This document has been prepared as part of the ecoregion-based conservation programme in the Forests of the Lower Mekong Ecoregion Complex (FLMEC), currently being implemented by the WWF Indochina Programme. This document presents the methodology and results of the biological assessment of the Central Truong Son Landscape. The purpose of the biological assessment was to develop a biological vision for the priority landscape, which will clarify conservation priorities, and set ambitious targets for conservation action.

This document is a collaborative piece of work, compiled from a review of published and unpublished literature, coupled with a series of meetings and consultations with scientists in Lao P.D.R. and Vietnam.

The principal literature sources were four desk studies compiled as part of the biological assessment process for the FLMEC as a whole. The authors of these desk studies were **Robert Timmins** and **William Duckworth**, who co-authored the desk studies on mammals and birds, **Peter Davidson**, **Colin Poole**, **Keo Omaliss** and **Craig Robson**, who co-authored the desk study on birds, **Philip Rundel**, who authored the desk study on vegetation and flora, and **Maurice Kottelat**, who authored the desk study on fish.

On 11 May 2001, a meeting was held in Hanoi, to agree on a methodology for stage one of the biological assessment. On 24 May 2001, a second meeting was held in Hanoi, to define the conservation foci. On 6 July 2001, a third meeting was held in Hanoi, to formulate the methodology for mapping the distribution of the conservation foci. On 13 July 2001, a fourth meeting was held in Hanoi to map the conservation foci and formulate the methodology for designing the conservation landscape. On 21 September 2001, a final meeting was held in Hanoi to formulate the vision statement for the priority landscape and outline constraints to achieving the vision. The participants at these meetings, who also reviewed sections of the draft document, were members of the Vietnamese biological advisory group, together with **Mike Baltzer**, **Rob Shore** and **Nguyen Thi Dao** from the WWF Indochina Programme.

Between 14 and 17 May 2001, a series of consultations were held with representatives of international organisations in Lao P.D.R.: **Arlyne Johnson**, **Michael Hedemark** and **Troy Hansel** from the Wildlife Conservation Society; **Latsamay Sylvavong** and **Sulma Warne** from IUCN; and **William Robichaud** from the Lao-Swedish Forestry Programme.

Powerpoint presentations were prepared by **George Powell** of the WWF-US Conservation Science Program and **Susan Palminteri**, who also provided advice on the methodology for designing the conservation landscape. Finally, **Bryan Stuart**, **Douglas Hendry** and **Maurice Kottelat** made comments on sections of the draft document.

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CONVENTIONS USED

Mammal names (common and scientific), sequence and species limits follow the mammal desk study, apart from the recently described Annamite striped rabbit (*Nesolagus timminsi*). Bird names (common and scientific), sequence and species limits follow Inskipp *et al.* (1996), except for Annam partridge (*Arborophila merlini*), which follows Sibley and Monroe (1990). Reptile and amphibian names, sequence and species limits follow Duckworth *et al.* (1999), except for species that do not occur in Lao P.D.R., which follow Nguyen Van Sang and Ho Thu Cuc (1996). Fish names, sequence and species limits follow Anon (1992).

Glossary of Terms

Biological target refers to one of a set of explicit biological objectives for a priority landscape, translated into quantitative targets for conservation action.

Biological vision refers to an ambitious aim for concerted, long-term conservation action within a specified area.

Conservation focus refers to one of a set of habitats, groups, taxa and landscape features that define a priority landscape; are the focus of conservation action; act as flagships for conservation; and form a basis for monitoring and evaluation of conservation action.

Conservation landscape refers to a spatial representation of conservation priorities, which facilitates the long-term conservation of the full range of biodiversity and biological processes within a priority landscape.

Endemic Bird Area (EBA) refers to an area supporting at least two restricted-range bird species. A restricted-range bird species is one with a global breeding range of less than 50,000 km² (Stattersfield *et al.* 1998).

Forests of the Lower Mekong Ecoregion Complex (FLMEC) refers to all non-marine, non-estuarine parts of Cambodia, Lao P.D.R. and Vietnam, excluding the northern highland areas of Lao P.D.R. and Vietnam.

Greater Truong Son refers to a Global 200 Ecoregion within the FLMEC, encompassing the Annamite chain and associated foothills and lowlands, as defined in Baltzer *et al.* (2001).

Indochina refers to the biogeographical region of Cambodia, Lao P.D.R. and Vietnam.

Priority 1 area refers to one of a series of areas within the conservation landscape, the conservation of all of which could potentially support the full range of biodiversity and biological processes in the priority landscape in the short term (5-10 years).

Priority 2 area refers to one of a series of areas within the conservation landscape, the conservation of all of which, together with that of all priority 1 areas, could potentially support the full range of biodiversity and biological processes in the priority landscape in the medium term (10-50 years).

Priority 3 area refers to one of a series of areas within the conservation landscape, the conservation of all of which, together with that of all priority 1 and priority 2 areas, could potentially make a significant contribution to the long term (50-200 years) conservation of the full range of biodiversity and biological processes in the priority landscape.

Priority Landscape CA1 refers to the Central Truong Son Landscape as defined in the biological assessment of the FLMEC (Baltzer *et al.* 2001). The boundaries of Priority Landscape CA1 follow those defined in this document.

Sub-landscape CA1a refers to the part of Priority Landscape CA1 located within Quang Tri and Thua Thien Hue provinces in Vietnam.

Sub-landscape CA1b refers to the part of Priority Landscape CA1 located within Da Nang city and Quang Nam, Kon Tum, Gia Lai, Quang Ngai and Binh Dinh provinces in Vietnam.

Sub-landscape CA1c refers to the part of Priority Landscape CA1 located within Savanakheth, Salavan, Xe Kong and Attapu provinces in Lao P.D.R..

Vision statement refers to a statement that encapsulates the long-term biological vision for a priority landscape.

Abbreviations and Acronyms

ADB	Asian Development Bank
CA1	Central Truong Son Priority Landscape
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
CTSCL	Central Truong Son Landscape
DEM	Digital Elevation Model
EBA	Endemic Bird Area
FIPI	Forest Inventory and Planning Institute
FLMEC	Forests of the Lower Mekong Ecoregion Complex
FPD	Forest Protection Department
GIS	Geographical Information System
IUCN	The World Conservation Union
MARD	Ministry of Agriculture and Rural Development
NBCA	National Biodiversity Conservation Area
WWF	World Wide Fund for Nature

PART I: INTRODUCTION

1.1 Background

The main central massif of the Annamite chain was identified as a priority landscape (labeled Priority Landscape CA1) for the conservation of the biodiversity of the Forests of the Lower Mekong Ecoregion Complex (FLMEC) (Map 1). Due to Priority Landscape CA1's outstanding biodiversity value, high level of threat and great need for coordinated conservation action, the Central Truong Son Initiative was launched in November 2000. This initiative is an intensive, collaborative conservation effort, involving government institutions at central and local levels, and international organisations in Lao P.D.R. and Vietnam. The initiative will be a pilot for ecoregion-based conservation initiatives in the region, and the lessons learned will inform similar initiatives for other priority landscapes.

The first stage of the Central Truong Son Initiative is to develop a conservation strategy for Priority Landscape CA1, through a collaborative process involving government institutions at central and local levels, and international organisations. This conservation strategy will be based on a situational analysis to identify threats and opportunities likely to influence the success of the initiative, and a biological assessment to formulate a biological vision for the priority landscape (Baltzer 2000). This document outlines the methodology and results of the biological assessment, and presents the biological vision for the Central Truong Son Landscape.

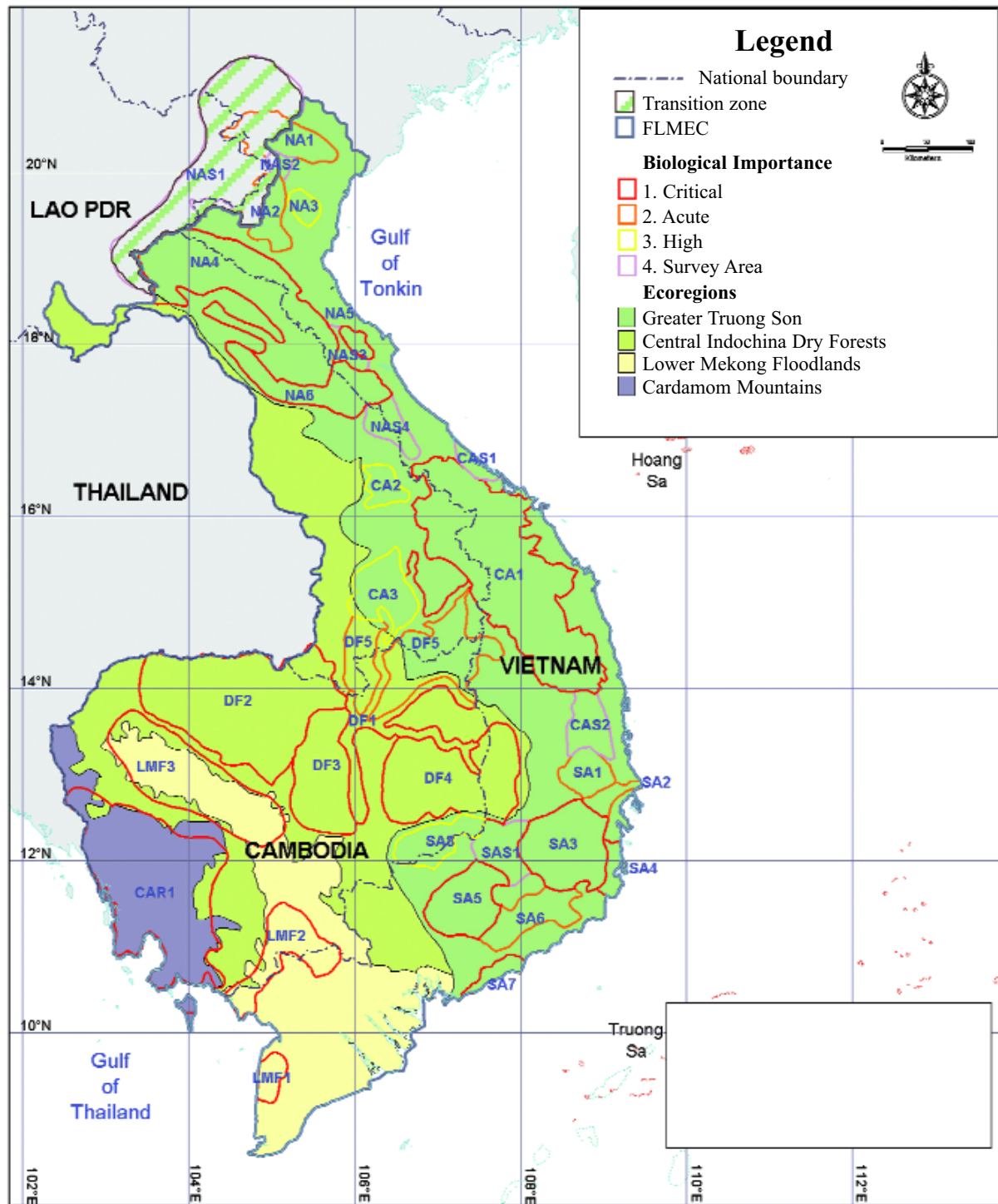
1.2 The biological assessment

The framework for the biological assessment process was formulated by the WWF Ecoregion Conservation Coordinator, broadly based on work by Dinerstein *et al.* (2000), Groves *et al.* (2000) and Margules and Pressey (2000). There were four stages to the biological assessment process. The first stage was to define the foci for conservation action in the priority landscape. The second stage was to set a series of biological targets for each conservation focus. The third stage was to map the distribution of the conservation foci within the priority landscape. The fourth stage was to design a conservation landscape able to support the full range of biodiversity and biological processes in the priority landscape. The biological assessment process resulted in the formulation of a biological vision for the priority landscape, which presents an ambitious aim for concerted conservation action over the next 50 years.

The biological vision for the Central Truong Son Landscape consists of a "vision statement", which encapsulates the long-term biological vision for the priority landscape; a series of biological targets that will need to be met in order to achieve the vision statement; and a conservation landscape that will allow the biological targets to be met:

$$\begin{array}{rcc} & & \text{Vision Statement} \\ & & + \\ \text{Biological Vision} & = & \text{Biological Targets} \\ & & + \\ & & \text{Conservation Landscape} \end{array}$$

There were many limitations to the biological assessment process. The most serious of which



<p>Greater Truong Son</p> <p>NA1- Northern Indochina Limestone NA2- Upper Chu River Watershed NA3- Ben En Lowlands NA4- Northern Truong Son NA5- Ke Go & Khe Net Lowlands NA6- Central Indochina Limestone</p> <p>CA1- Central Truong Son CA2- Dong Phou Vieng CA3- Bolaven Plateau</p>	<p>SA1- Ea So Complex SA2- Deo Ca Spur SA3- Southern Truong Son Main Montane Block SA4- Cam Ranh Dry Coastal Lowlands SA5- Lowlands Dong Nai Watershed SA6- Di Linh Corridor SA7- Southern Coastal Dipterocarp Lowlands SA8- Southern Truong Son Western Slopes</p> <p>Cardamom Moutains</p> <p>CAR1- Cardamom Mountains</p>	<p>Lower Mekong Floodlands</p> <p>LMF1- U Minh Peat Swampforests LMF2- Northwestern Mekong Delta Wetlands LMF3- Tonle Sap Inundation Zone</p> <p>Central Indochina Dry Forests</p> <p>DF1- Mekong River & Major Tributaries DF2- Northern Plains Dry Forests DF3- Central Cambodian Semi-Evergreen Lowlands Forests DF4- Eastern Plains Dry Forests DF5- Cambodian/Lao P.D.R./Viet Nam Tri-border Forests</p>
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Map 1 - Priority Landscapes in the FLMEC defined at the Phnom Penh Workshop in March 2000

included time constraints, poor reliability and resolution of data sets, almost complete lack of data on minimum area requirements originating from Indochina, and limited opportunity for review by international experts. Consequently, the biological assessment was a very rapid, preliminary step, and represents the first attempt to synthesise data on the biodiversity of the Central Truong Son Landscape and to use it as a basis for identifying taxa, habitats and areas of conservation priority. There is, therefore, a requirement to continually review and revise the results of the biological assessment and the biological vision for the Central Truong Son Landscape, as new information becomes available.

1.3 Vision statement

The biological vision statement for Priority Landscape CA1 was formulated by members of the Vietnamese biological advisory group. As the vision statement was formulated from a purely biological perspective, it will need to be revised to incorporate the findings of the situational analysis before being adopted as the vision statement for the conservation strategy as a whole.

It was decided to formulate a vision statement for a period of only 50 years, because it was felt that a vision statement for a longer period could not appropriately account for likely changes in threats to biodiversity, constraints to conservation, and conservation priorities over that period.

The vision statement for Priority Landscape CA1 is as follows:

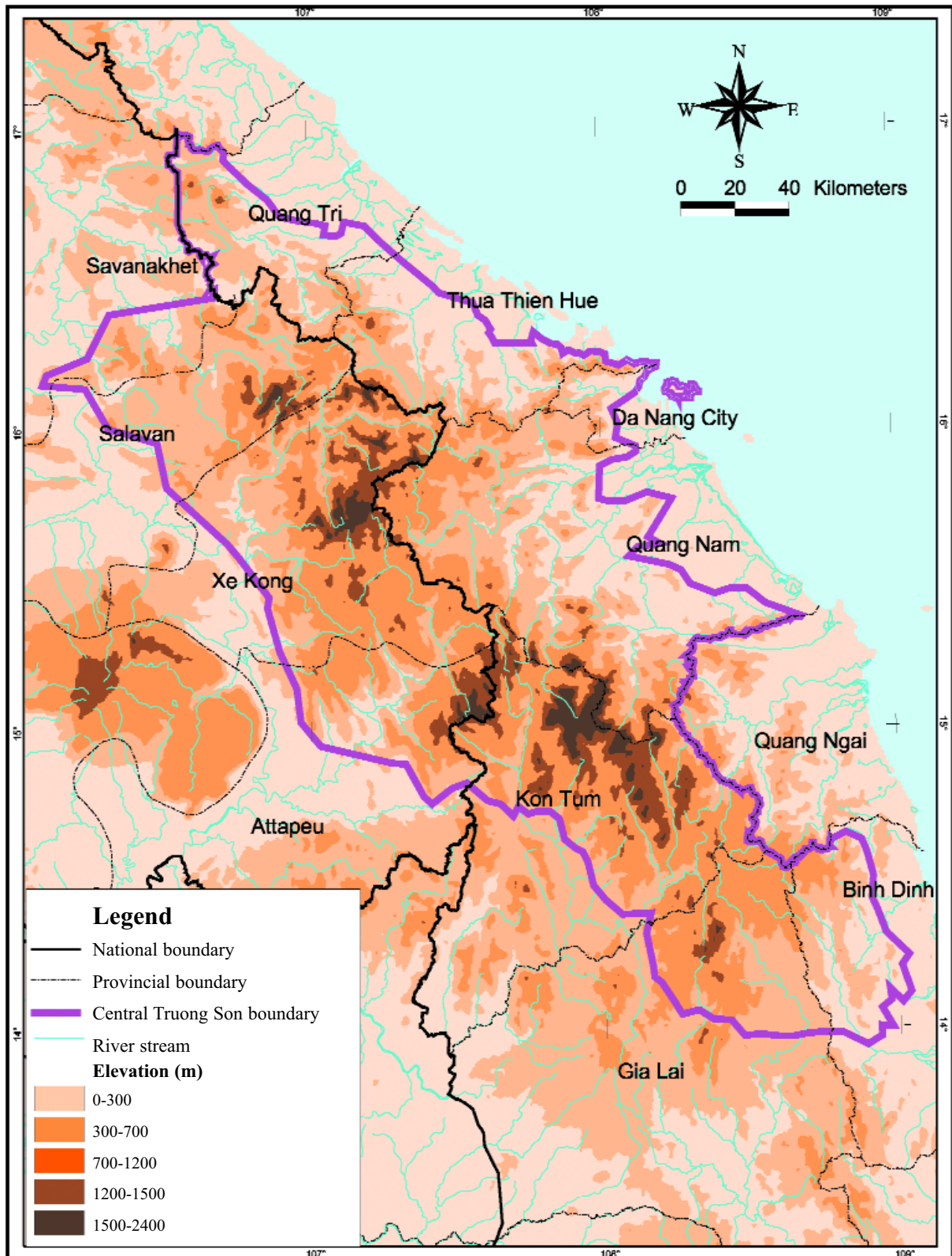
Within 50 years, aided by local socio-economic development, the biodiversity of the Central Truong Son Landscape will be sustainably managed, ecosystems and focal plant and animal species will be maintained and restored, and forest cover will exceed 60% of the total area of the priority landscape. The biodiversity of the Central Truong Son Landscape will make an important contribution to the socio-economic development of the region, and to national and global biodiversity conservation.

1.4 Definition of the Central Truong Son Landscape

The boundaries of Priority Landscape CA1 were provisionally delineated at the *Ecoregion-based Conservation in the Forests of the Mekong Biological Assessment Workshop*, held in Phnom Penh in March 2000. During the biological assessment process for Priority Landscape CA1, the boundaries of the priority landscape delineated at the Phnom Penh workshop were further refined.

Priority Landscape CA1 is a geomorphological entity within the Greater Truong Son Global 200 Ecoregion of the FLMEC. The priority landscape encompasses the central section of the main Annamite chain, together with associated foothills to the west and east (Map 2).

The boundaries of Priority Landscape CA1 were delineated according to geomorphological criteria in preference to biogeographical criteria for a number of reasons. Firstly, while the ranges of a number of taxa broadly define the priority landscape, there is insufficient congruence in their known distributions for the boundaries to be precisely delineated. Secondly, there is insufficient information available about the known distribution and habitat requirements of taxa that might be used to delineate the priority landscape. Thirdly, the concept of a geomorphologically delineated landscape is more meaningful to decision makers and



Map 2 - Priority Landscape CA1 in relation to topography

donors. Finally, a geomorphologically delineated landscape is not constrained by anthropogenic changes in habitat condition and extent, and, therefore, presents a vision for the future and an objective for habitat restoration efforts.

The area referred to as the Greater Truong Son in this document was considered by Vidal (1960) to comprise parts of two distinct geomorphological units: the Annamite chain, stretching from Xieng Khoang province in Lao P.D.R. to the Hai Van pass; and the Central Indochina massif, stretching from the Hai Van pass to the Vung Tau peninsula. Within these units, Vidal (1960) recognised several major geomorphological boundaries, most notably the Lao Bao pass, which separates granite massifs to the north from gneiz massifs to the south; and the Mang Yang pass, which divides the Kon Tum plateau to the north, from the Lang Bian massif to the south. These two geomorphological boundaries mark the northern and southern extent of Priority Landscape CA1.

The eastern boundary of the priority landscape follows the transition between the foothills of the Truong Son and the flat coastal plain of central Vietnam. This transition is distinct in most places, although, in some areas, there are outlying hills, separated from the Annamite foothills by areas of lower elevation; these are excluded from the priority landscape along with the coastal plain. The coastal plain and outlying hills are excluded from the priority landscape on the basis of geomorphological criteria, not on the basis of relative importance for biodiversity conservation. If these areas had supported significant areas of lowland forest, they may have been included in a separate priority landscape at the Phnom Penh workshop, in a similar way to the way in which the Ke Go and Khe Net Lowlands Priority Landscape was defined in addition to the Northern Truong Son Priority Landscape (Baltzer *et al.* 2001).

The western boundary follows the transition between the high mountains of the main Annamite chain and the lower hills and plains of southern Lao P.D.R.. This boundary is the least distinct, as the transition is a gradual and topographically complex one. An approximate 500 m contour has been taken as the western boundary of the priority landscape, although this results in a boundary that overlaps slightly with that of Priority Landscape CA2 (Dong Phou Vieng), as delineated at the *Ecoregion-based Conservation in the Forests of the Mekong Biological Assessment Workshop*. As the boundary of Priority Landscape CA2 has yet to be precisely defined, it was not felt possible to precisely define the western boundary of Priority Landscape CA1 at this stage. There may, however, be a need to do so at a later stage, to exclude areas contained within Priority Landscape CA2.

The western boundary of Priority Landscape CA1 is necessarily subjective, taking into account several factors, including the need to keep the priority landscape to a manageable size, primarily including areas important to the conservation foci, and habitats and communities characteristic of the priority landscape, while, at the same time, not excluding large, potentially important contiguous areas of habitat or potential habitat that would add significant benefits if included. In general, in this area, there are natural breaks between contiguous areas of natural habitat and extensive anthropogenic habitats. However, in the south-west of the priority landscape, natural habitat is contiguous with that in the Cambodia/Lao P.D.R./Vietnam Tri-border Forests Priority Landscape (Baltzer *et al.* 2001), and here it should be borne in mind that there are essential habitats outside of the priority landscape boundary that have not been considered. If this area is considered at some other time, it will require a re-evaluation of areas within Priority Landscape CA1, in terms of conservation foci and biological targets developed for this extra-limital area.

Politically, Priority Landscape CA1 comprises parts of Savanakheth, Salavan, Xe Kong and Attapu provinces in Lao P.D.R., together with parts of Quang Tri, Thua Thien Hue, Quang Nam, Quang Ngai, Kon Tum, Binh Dinh and Gia Lai provinces, and Da Nang city in Vietnam.

Climatically, Priority Landscape CA1 is characterised by very high rainfall and low seasonality. The boundary of the priority landscape approximately follows a 3,000 mm annual rainfall contour, with areas to the north, west and south being markedly drier (Gressitt 1970, Schmid 1974). Within the priority landscape, rainfall and temperature vary greatly according to topography and the direction of prevailing winds. Areas on the western side of the main Annamite chain are markedly drier than areas on the eastern side, which are sheltered from the effects of the north-eastern monsoon. The wettest parts of the priority landscape include Bach Ma National Park, with a mean annual precipitation of over 3,600 mm at the base and nearly 8,000 mm at the summit, Ba Na Nature Reserve, with a mean annual precipitation of over 5,000 mm (WWF/EC 1997), and Ngoc Linh (Quang Nam) proposed nature reserve, with a mean annual precipitation of over 3,800 mm (Tordoff *et al.* 2000).

The western parts of Priority Landscape CA1 are drained by tributaries of the Mekong River, including the Xe Kong and Xe San rivers. The eastern parts of the priority landscape, on the other hand, are drained by rivers that flow eastwards, directly into the sea, such as the Thu Bon, Ba and Quang Tri rivers.

Biogeographically, Priority Landscape CA1 is characterised by evergreen forest communities of the Annamite chain. To the south and west of the priority landscape, these communities undergo a gradual transition into communities characteristic of the drier habitats of the central Indochina plain. To the north, there is no clear biogeographical boundary with the Northern Annamite, and the faunas and floras of the two areas show a great degree of similarity.

PART II: METHODOLOGY

2.1 Defining the conservation foci

The first stage of the biological assessment was to define the conservation foci for the Central Truong Son Landscape. Conservation foci:

1. help to define the conservation landscape;
2. are the foci for conservation action;
3. act as flagships for conservation;
4. form a basis for monitoring and evaluation of conservation action.

Conservation foci were defined with the objective that adequate conservation of all foci in Priority Landscape CA1 would be sufficient to conserve the full range of biodiversity and biological processes within the priority landscape. Therefore, conservation foci were defined at four levels:

1. habitats;
2. groups;
3. taxa;
4. landscape features.

A key point is that conservation foci were defined at the most appropriate level for effective conservation action. For instance, for taxa for which maintenance of suitable habitat is sufficient for their conservation, conservation foci were defined at the habitat level. Alternatively, for taxa that require specific conservation measures, conservation foci were defined at the group or taxon level.

The process to define the conservation foci for Priority Landscape CA1 had four steps:

1. initial meeting to agree on the methodology for defining the conservation foci;
2. preparation of provisional lists of priority taxa;
3. workshop to define the conservation foci;
4. final review of the conservation foci.

The methodology for defining the conservation foci was formulated at a meeting of the Vietnamese biological advisory group. The next step was to prepare lists of priority taxa occurring in the priority landscape. Draft lists were compiled from published and unpublished literature, and then reviewed by members of the Vietnamese biological advisory group. The preparation of comprehensive lists of priority taxa was constrained by the availability and accuracy of data on biodiversity in the Central Truong Son Landscape. Similarly, the short amount of time available and other constraints meant that a thorough expert review of the lists of priority taxa was not possible. For these reasons, the lists should be considered to be provisional, and in need of future revision as more information becomes available.

Provisional lists of priority taxa were prepared for those taxonomic groups for which a reasonable amount of information was available about their status and distribution within the

priority landscape: vascular plants, mammals (excluding small mammals and bats), birds, reptiles and amphibians, fish, and butterflies.

For mammals and birds, priority scores had already been assigned in the desk studies (Davidson *et al.* unpublished, Timmins and Duckworth unpublished). However, these priority scores evaluated the importance of the population in the FLMEC as a whole, and could not, therefore, be used for the population in Priority Landscape CA1. For instance, simply because the FLMEC supports a globally significant population of a taxon, it does not follow that a population of that taxon in Priority Landscape CA1 is necessarily of global significance: it might be a marginal or relict population. Therefore, a new set of criteria was devised, broadly based on those used in the desk studies.

For mammals, birds, reptiles and amphibians, all taxa confirmed to occur, provisionally recorded, historically recorded or predicted to occur in the priority landscape were assigned a priority score based upon their global threat level (following IUCN 2000), an assessment of their intrinsic susceptibility to extinction (in the case of birds and mammals, broadly based upon those given in the desk studies), and the significance of the population in Priority Landscape CA1 for their global conservation. Only taxa receiving a priority score of 1 or more were included on the provisional lists of priority taxa. A detailed explanation of the methodology used to assign priority scores can be found in Appendices 2, 3 and 4.

The available data on vascular plant, fish and butterfly taxa were too limited to assign priority scores. Therefore, the provisional list of priority fish taxa comprised only those species known or predicted to occur in the priority landscape that are listed in the *Red Data Book of Vietnam* (Anon. 1992). The provisional list of priority butterfly taxa comprised taxa considered to be of conservation concern in the priority landscape based upon a subjective assessment by Dr. Alexander Monastyrskii. The provisional list of priority vascular plant taxa, comprised species listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000) or the *Red Data Book of Vietnam* (Anon. 1996); species endemic to Indochina; and species with a high economic value, and, thus, considered to be highly susceptible to over-exploitation. In the future, when more detailed information about the distribution and status of these groups becomes available, it will be necessary to identify priority taxa in a more objective manner.

After the provisional lists of priority taxa were prepared, they were then used as the basis for defining the conservation foci for Priority Landscape CA1. First, a list of broad terrestrial and aquatic habitats was prepared by members of the Vietnamese biological advisory group. In order to account for biogeographical variation in community composition within the priority landscape, it was divided into three sub-landscapes: sub-landscape CA1a, comprising those parts of the priority landscape in Vietnam north of the Hai Van pass; sub-landscape CA1b, comprising those parts of the priority landscape in Vietnam south of the Hai Van pass; and sub-landscape CA1c, comprising those parts of the priority landscape in Lao P.D.R.. Habitats in each sub-landscape were considered separately.

The initial intention was to compile, for each habitat in each sub-landscape, a list of all priority taxa for which that habitat was important, and to sum their priority scores. However, because priority scores were not given to plants, fish or butterflies, and because insufficient information was available about the distribution of mammals, reptiles and amphibians with respect to habitat, this was only possible for birds. For other groups, subjective, qualitative assessments

of the importance of each habitat for their conservation were made by members of the Vietnamese biological advisory group. Taken together, these quantitative and qualitative assessments allowed the focal habitats in the priority landscape to be identified.

After the focal habitats had been defined, those priority taxa that were considered to require conservation measures other than protection of existing habitat were identified. Where conservation measures appropriate for several taxa could be identified, focal groups were defined. However, where taxon-specific conservation measures were required, focal taxa were defined. The justification for selecting each focal group and taxon is given in Sections 4.3 and 4.4.

Next, landscape features essential for the maintenance of the full range of biodiversity and biological processes within Priority Landscape CA1 that had not been covered by the foci already defined were identified. Finally, the list of conservation foci was circulated to members of the Vietnamese biological advisory group for review. Because of time limitations and other constraints, it was not possible to undertake the most thorough expert review of the list of conservation foci. Consequently, it may be necessary to revise the list of conservation foci in the future, as further information becomes available.

2.2 Setting the biological targets

The second stage of the biological assessment was to set biological targets for each conservation focus. Biological targets are explicit biological objectives for the priority landscape, translated into quantitative targets for conservation action. Biological targets are set in such a way that, if all are met, the full range of biodiversity and biological processes within the priority landscape can hopefully be conserved.

The process to set the biological targets for Priority Landscape CA1 had two steps:

1. preparation of draft biological targets;
2. workshop to finalise the biological targets.

The conservation foci for Priority Landscape CA1 were defined with the objective that adequate conservation of all foci would hopefully be sufficient to conserve the full range of biodiversity and biological processes within the priority landscape. Consequently, for each conservation focus, one or more biological targets were set, which, if met, would potentially ensure the adequate conservation of that focus. In addition, a number of non-focal biological targets were set, to cover any measures that were essential to achieving the vision statement but were not adequately addressed by the targets set for the conservation foci. However, a degree of caution should be exercised when interpreting the biological targets. Given the quality of the available data, it is impossible to be certain that achieving all biological targets will adequately conserve all conservation foci, and, thus, the biological targets should be continually re-evaluated, as new data become available, particularly feedback from any biological monitoring that takes place.

Biological targets were grouped into short-term targets, which should be met within the next ten years, and medium-term targets, which should be met within the next 50 years. It was not considered appropriate to set targets for periods longer than 50 years, as it was considered that threats to biodiversity and constraints to conservation are likely to change so significantly in the future as to render inappropriate any targets set more than 50 years previously.

Recognising that resources available for conservation are limited, and are likely to remain so for the foreseeable future, in addition to grouping biological targets according to timescale, they were also classified into high, medium and low priorities for conservation action.

The following 'scenario' criteria were used as a guide when prioritising the biological targets:

- Failure to meet a high priority target would mean that the biological integrity of the priority landscape would probably suffer severely.
- Failure to meet a medium priority target would mean that one or more habitat or taxon population would undergo a significant decline or be eradicated from the priority landscape, thereby compromising the global conservation of that habitat or taxon.
- Finally, failure to meet a low priority target would mean that one or more habitat or taxon population would undergo a significant decline or be eradicated from the priority landscape but that the global conservation of that habitat or taxon would not be compromised.

2.3 Mapping the distribution of the conservation foci

Once the conservation foci for Priority Landscape CA1 had been defined and biological targets for each had been set, the next step was to map the distribution of the conservation foci within the priority landscape. Mapping the distribution of the conservation foci facilitated the design of a conservation landscape that could potentially conserve the full range of biodiversity and biological processes in the priority landscape.

The process to map the distribution of the conservation foci within Priority Landscape CA1 had four steps:

1. initial meeting to agree on the methodology for mapping the distribution of the conservation foci;
2. preparation of draft maps of the distribution of the conservation foci by review of the scientific literature, GIS analysis and consultations with scientists;
3. workshop to finalise the maps;
4. digitisation of data and creation of a GIS coverage for each conservation focus.

The methodology for mapping the distribution of the conservation foci was formulated at a meeting attended by members of the Vietnamese biological advisory group. At this meeting, it was decided that it was not possible to adequately map all of the conservation foci. In some cases, where lack of data prevented accurate mapping, surrogates were identified and mapped. In the case of focal landscape features, it was decided not to map them but, instead, to incorporate them into the criteria for designing the conservation landscape.

A range of methods was used to map the distribution of the conservation foci. Some conservation foci were mapped onto paper maps, which were then digitised; other conservation foci were mapped from existing GIS coverages. Each coverage used the UTM zone 48N projection system, and all raster data had a 100 m resolution. In general, data for the Lao component of Priority Landscape CA1 were derived from coarser scale coverages, and were, therefore, less accurate than those for Vietnam. Another major limitation was that the

coverages for different data sets were not in precise alignment with each other, with the result that errors were introduced into the figures calculated during the process to design the conservation landscape. A detailed description of the methods used to map each conservation focus is given in Section 5.

2.4 Designing the conservation landscape

A conservation landscape is a spatial representation of conservation priorities, which facilitates the long-term conservation of the full range of biodiversity and biological processes within a priority landscape. It must be stressed that a conservation landscape is zoned into areas of different conservation priority, and is not, by itself, a map of management zoning. However, in combination with biological targets and relevant socio-political data, such as current and projected land-use, human demographics, and infrastructure development, a conservation landscape can facilitate the zoning of a priority landscape into areas of different management regime. This is a future step in the process to conserve the priority landscape, and was not undertaken during the biological assessment.

The process to design the conservation landscape for Priority Landscape CA1 had four steps:

1. initial meeting to agree on the methodology for designing the conservation landscape;
2. creation of GIS coverages for relevant spatial data;
3. definition of quantitative goals and secondary criteria for the selection of priority areas by consultation with scientists;
4. GIS analysis to design the conservation landscape.

The methodology for designing the conservation landscape was formulated at a meeting attended by members of the Vietnamese biological advisory group. The methodology was based on the principles that the conservation landscape should promote the long-term survival of all conservation significant taxa within the priority landscape by maintaining natural processes and viable populations, and by excluding, as much as possible, threats; and that it should represent the full range of biodiversity, at all levels of organisation, present in the priority landscape (Margules and Pressey 2000).

After GIS coverages had been created for all conservation foci and other relevant spatial data, a set of quantitative goals was defined for the conservation landscape. These goals were based on the biological targets set for the conservation foci. Consequently, the conservation landscape was designed in such a way that it aimed to meet the conservation requirements of all conservation foci. In addition, a number of secondary criteria were defined to assist the selection of priority areas. Finally, a network of priority areas that met the quantitative goals for the conservation landscape was identified. A detailed description of the methods used to identify each priority area is given in Section 6.

PART III: BIOLOGICAL STATUS OF THE CENTRAL TRUONG SON LANDSCAPE

3.1 Flora

3.1.1 Status in Priority Landscape CA1

Within Indochina, Schmid (1989) identified nine areas of special floristic interest. The boundaries of one of these (number VI) follow almost exactly those of Priority Landscape CA1. The flora of Priority Landscape CA1 is extremely diverse, comprising elements of four floristic regions: Indian, Malesian, Sino-Himalayan and Indochinese. As de Laubenfels (1975, p199) states, "the complex merging of floras in the highlands of Southeast Asia has no parallel in any other part of the world".

Within the Indochinese floristic region, Priority Landscape CA1 lies within the Annamese province (Takhtajan 1986). This floristic province is rich in endemic taxa in the Orchidaceae, Fagaceae, Euphorbiaceae, Rubiaceae, Annonaceae and Celastraceae. Other families containing endemic taxa include the Theaceae, Styracaceae, Rosaceae, Ericaceae, Malpighiaceae and Cycadaceae. The taxonomically isolated genus *Poilanedora* (Capparaceae) is endemic to this floristic province, as is the globally threatened conifer *Pinus dalatensis* (Roundel unpublished). Additionally, representatives of a number of genera endemic to the Indochinese floristic region are found within the priority landscape, including *Deuzianthus*, *Tsoongia* and *Bousignonia*.

Of eight Centres of Plant Diversity identified in Lao P.D.R. and Vietnam by Davis *et al.* (1995), one, Bach Ma-Hai Van, is located within Priority Landscape CA1. However, the less well studied Ngoc Linh massif potentially supports higher levels of floral richness and endemism, and should be considered the priority site for floral conservation in the priority landscape (A. Kuznetsov pers. comm. 2001).

Almost all of the priority vascular plant taxa and vegetation formations in Priority Landscape CA1 are found within forest habitats. This is not surprising as, historically, closed canopy forests were the major natural terrestrial habitat of the priority landscape. Therefore, it is these habitats that are of greatest importance for the conservation of floral diversity. Forest loss has been extensive within the priority landscape, particularly in lowland areas, and some vascular plant species have undoubtedly already been lost. Plant taxa and vegetation formations restricted to lowland forest are, therefore, among the most threatened within the priority landscape. Another group of highly threatened plant taxa are those of high economic value as sources of timber or traditional medicine, which are often exploited unsustainably as a result.

3.1.2 Priority taxa

A total of 133 priority vascular plant taxa were provisionally identified in Priority Landscape CA1 (Appendix 1). These included 46 species listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000) and 38 species listed in the *Red Data Book of Vietnam* (Anon. 1996). Based upon known distributions, 21 plant species are believed to be endemic to the priority landscape. A further 56 species are believed to be endemic to Vietnam (although they could

also occur in peripheral areas of Lao P.D.R.), and two species are believed to be endemic to Indochina.

Fifteen of the priority taxa are gymnosperms, comprising nine conifers, five cycads and one gnetophyte. All except four of these species are listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000) or the *Red Data Book of Vietnam* (Anon. 1996). The Dipterocarpaceae is represented by 12 priority taxa, all of which are globally threatened, including seven listed as Critical. Some of these species are, however, relatively common and widespread in Vietnam, indicating that, perhaps, their global threat status is in need of review. Nonetheless, it is clear that, as a group, members of the Dipterocarpaceae are of conservation concern as they are restricted to lowland forest and, thereby, threatened by habitat loss. Furthermore, many species are over-exploited, due to their economic value as timber trees.

The plant family with the greatest number of priority taxa is the Orchidaceae, with 26. This family contains high levels of endemism: 19 of the priority orchid taxa are endemic to Priority Landscape CA1, Vietnam or Indochina. Caution must be exercised, however, because many of these orchid species are known from only a few specimens, and some have only recently been described; as more information becomes available about the distributions of these species, some may turn out to be much more widely distributed.

There is currently too little information on the taxonomy and biogeography of a number of families for priority taxa to be identified. However, many of these families almost certainly contain more priority taxa, for example the Araceae (in the genera *Rhaphidophora*, *Typhonium*, *Arisaema*, *Pseudodracontium*, *Amorphophallus* and *Pothos*), Gesneriaceae, Melastomataceae, Myrsinaceae, Orchidaceae and several families of fern.

3.1.3 Vegetation formations of conservation concern

In addition to habitats and taxa, the priority landscape supports a number of vegetation formations of conservation concern. The majority of these are monodominant forest formations whose distributions are limited by ecological factors. A smaller group are polydominant forest formations that have undergone a severe restriction of extent or condition as a result of habitat loss or selective timber extraction.

There are several important formations of pine *Pinus* spp. within Priority Landscape CA1. These include mixed broadleaf and coniferous forest containing *P. dalatensis*, which has a very limited distribution on ridges and summits at high elevations; natural, monospecific stands of *P. kesiya*, which are found only on slopes above 1,000 m; and monospecific stands of *P. merkusii*, which are found in small areas of sub-landscape CA1c and in the Kon Plong Forest Complex (Steinmetz *et al.* 1999, Eames *et al.* 2001). The *P. merkusii* stands in Lao P.D.R. are, however, a secondary formation, which is not particularly threatened.

Any formation with *Keteleeria* spp. is of the highest importance for conservation, as these species have very specific habitat requirements, being found only on well drained ridges, gentle slopes and flat areas at high elevations. Within CA1, *Keteleeria* formations are only known from Ngoc Linh (Kon Tum) Nature Reserve, Bach Ma National Park and the Phou Ayhon massif (Le Trong Trai *et al.* 1999a, Anon. undated, R. Timmins pers. obs.).

The valuable timber species *Fokienia hodginsii*, which is widespread in polydominant mixed broadleaf and coniferous forest on ridges and slopes, also forms monodominant stands on

ridges and plateaux above 1,200 m, for example at Kon Ka Kinh Nature Reserve (Le Trong Trai *et al.* 2000). These formations have a very limited distribution, are threatened by timber extraction, and are, therefore, of high importance for conservation.

There are several important formations of Podocarpaceae within the priority landscape, most of which are widespread. These include monodominant and polydominant stands of *Dacrydium elatum*, which are distributed on plateaux and ridges above 900 m; polydominant stands of *Dacrycarpus imbricatus*, a canopy species, which are usually found above 900 m; and polydominant stands of *Podocarpus neriifolius*, an understorey species, which are distributed above 400 m.

Other important formations of conifers include those containing members of the Taxaceae and Cephalotaxaceae. There is currently almost no information about the distribution and ecology of these families in Vietnam.

Lowland forest formations of the highest conservation significance in the priority landscape include those dominated by members of the Dipterocarpaceae. A number of rare taxa have an association with Dipterocarpaceae stands, for example cycads. One notable Dipterocarpaceae formation is forest dominated by *Parashorea stellata*, one of the most valuable timber species in central Vietnam (FIPI 1996), and one which is severely threatened by over-exploitation and clearance of lowland forest for cultivation. Other important lowland forest formations containing valuable timber species are formations containing large trees in the Fabaceae and Ebenaceae.

Important medium montane forest formations include primary formations containing *Betula alnoides* and *Quercus macrocalyx* forest, both of which are found in the Kon Plong Forest Complex (Eames *et al.* 2001).

In upper montane forest, some of the most important formations are those dominated by *Rhododendron* spp. These formations are distributed on summits and narrow ridges, and include unique elfin forest and moss forest formations.

3.2 Mammals

3.2.1 Status in Priority Landscape CA1

The Greater Truong Son appear to be a major centre of mammal endemism: apart from a small suite of species characteristic of central, open habitats, most mammal taxa endemic to mainland South-East Asia occur in the Greater Truong Son (Timmins and Duckworth unpublished). Most of these ‘Annamite endemics’ occur, or are predicted to occur, within Priority Landscape CA1, including saola, large-antlered (giant) muntjac (*Muntiacus vuquangensis*), Annamite muntjac (*M. truongsongensis*), Heude’s pig (*Sus bucculentus*), ‘grey-shanked’ Douc langur (*Pygathrix nemaus cinerea*) and Annamite striped rabbit (*Nesolagus timminsi*). Although the most important populations of some of these Annamite endemics are located outside of Priority Landscape CA1, all populations within the priority landscape are of global conservation importance, because of the restricted global ranges of these taxa.

In addition to the Annamite endemics, Priority Landscape CA1 supports, or is predicted to support, globally significant populations of other mammal taxa, including Owston’s civet (*Hemigalus owstoni*), which has a restricted distribution in Vietnam, Lao P.D.R. and southern China, and ‘Indochinese’ hog deer, a distinct subspecies, which is on the brink of extinction.

It is these taxa, together with the Annamite endemics, that are of the highest conservation importance within the priority landscape.

Priority Landscape CA1 also supports remnant populations of a number of globally threatened large mammal species, such as Asian elephant (*Elephas maximus*), gaur (*Bos gaurus*), tiger and Asiatic black bear (*Ursus thibetanus*). In the global and regional contexts, however, the priority landscape is of lower importance for the conservation of these taxa, as larger, more viable populations exist elsewhere. The main significance of the populations of these taxa within Priority Landscape CA1, therefore, stems not from their global conservation importance but from their importance as ‘keystone’ species, whose impact on a community or ecological system is disproportionately large for their abundance (Simberloff 1996). Efforts to conserve these taxa at every site where they occur are neither feasible nor justifiable in terms of available resources. Consequently, action to conserve these taxa within the priority landscape should be limited to maintaining representative populations (Timmins and Duckworth unpublished).

Compared to other areas in the Greater Truong Son, habitat fragmentation is greater in the Central Truong Son Landscape, on both the eastern and western slopes, indicating that the priority landscape has lower potential for the conservation of large mammal populations than other parts of the FLMEC (Timmins and Duckworth unpublished). However, biogeographical differences with other parts of the Greater Truong Son are likely to result in differences between the composition of mammal communities in Priority Landscape CA1 and those of areas to the north and south. Therefore, the mammal community of Priority Landscape CA1 is not only representative of the Greater Truong Son but also distinct, and, therefore, a high regional and global priority for conservation.

Within Priority Landscape CA1, there is considerable variation among sites with respect to the composition of mammal communities. These variations are partly explained by two patterns in the distribution of mammal taxa. Firstly, the eastern slopes of the Truong Son appear to be markedly wetter and less seasonal than the western slopes, as a result of the effects of the north-eastern monsoon. This may explain the apparent absence of certain taxa from sub-landscape CA1c, for instance saola. Secondly, there appear to be latitudinal patterns in the distribution of a number of taxa, with one taxon being replaced by another. For example, the distribution of ‘red-shanked’ Douc langur (*Pygathrix nemaeus nemaeus*) is concentrated in the north of the priority landscape, while ‘grey-shanked’ Douc langur is distributed in the south. Similar patterns are also exhibited by white-cheeked and yellow-cheeked crested gibbons (*Nomascus leucogenys*) and (*N. gabriellae*), and Rhesus and long-tailed macaques (*Macaca mulatta*) and (*M. fascicularis*).

Many large mammal species appear to tolerate at least moderate degrees of habitat degradation, although some species are intrinsically susceptible to changes in habitat condition or extent, due to their narrow habitat requirements, restricted distribution, low natural density or high range requirements of individuals (Timmins and Duckworth unpublished). One obstacle to designing a conservation landscape for mammals in Priority Landscape CA1 is that the precise distribution and habitat requirements of many mammal taxa are poorly known. Consequently, there is an urgent need for detailed research on the ecology, distribution and status of mammal priority taxa within the priority landscape.

3.2.2 Priority taxa

A total of 41 priority mammal taxa were provisionally identified in Priority Landscape CA1, comprising 28 taxa that are confirmed to occur in the priority landscape, and 13 taxa that are expected to occur but for which there are no confirmed records to date (Appendix 2).

Of the 28 priority mammal taxa confirmed to occur in the priority landscape, 25 are listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000), and 20 are listed in the *Red Data Book of Vietnam* (Anon. 1992). Ten of the priority mammal taxa confirmed to occur in the priority landscape were listed as Priority 1 (the highest level) for conservation in the FLMEC in the mammal desk study (Timmins and Duckworth unpublished). Furthermore, seven are endemic to Indochina, including one, ‘grey-shanked’ Douc langur, that is believed to be endemic or near-endemic to Priority Landscape CA1 (although the current lack of information about this newly described taxon necessitates caution when drawing conclusions about its distribution).

Although no mammal taxon was assigned a priority score of 5 (the highest possible), three mammal taxa confirmed to occur in the priority landscape were assigned a priority score of 4: ‘red-shanked’ Douc langur, ‘grey-shanked’ Douc langur and saola. A further four mammal taxa received a priority score of 4, pending the confirmation of their occurrence in the priority landscape: ‘black-shanked’ Douc langur (*Pygathrix nemaeus nigripes*), white-cheeked crested gibbon (southern subspecies) (*Nomascus leucogenys siki*), Lowe’s otter civet (*Cynogale lowei*) and ‘Indochinese’ hog deer.

The vast majority of the priority mammal taxa confirmed to occur in Priority Landscape CA1 are concentrated in three orders: primates (eight taxa, combined priority score of 21); carnivores (11 taxa, combined priority score of 21); and even-toed ungulates (six taxa, combined priority score of 15). Therefore, the priority landscape can be considered to be of high importance for the conservation of these groups.

3.3 Birds

3.3.1 Status in Priority Landscape CA1

Historically, the bird diversity of Priority Landscape CA1 received relatively little study compared to other regions of Vietnam and Lao P.D.R.. The principal exceptions were surveys of present day Thua Thien Hue province and parts of Kon Tum province by Delacour and Jabouille (1927), Delacour (1929) and Björkegren (Eames and Ericson 1996). In recent years, however, a series of surveys in both the Lao and Vietnamese components have added greatly to the available knowledge about the bird diversity of the priority landscape. Since 1989, 394 bird species have been confirmed in the Vietnamese component alone, equivalent to nearly half of Vietnam’s avifauna. Among the known avifauna of the priority landscape, the most important, from a conservation perspective, are endemic taxa.

With the one exception of Priority Landscape SA3 (Southern Annamite Main Montane Block), which incorporates the Da Lat Plateau Endemic Bird Area (EBA), Priority Landscape CA1 is unrivalled in Indochina as a centre of bird endemism. The priority landscape supports at least 12 restricted-range bird species, including three whose global ranges are restricted to the priority landscape: chestnut-eared laughingthrush (*Garrulax konkakinhensis*), golden-winged laughingthrush (*G. ngoclinhensis*) and black-crowned barwing (*Actinodura sodangorum*) (Table 1).

Table 1: Recorded localities of restricted-range bird species in Priority Landscape CA1

Common Name	Scientific Name	DK	PD	BM	BN	QN	KT	KP	KK	KC	XS	PA	DP	DA
[Vietnamese pheasant]	[<i>Lophura hatinhensis</i>]													
Imperial pheasant	<i>Lophura imperialis</i>	X												
Edwards' pheasant	<i>Lophura edwardsi</i>	X	X	X										
Annam partridge	<i>Arborophila merlini</i>	X	X	X										
short-tailed Scimitar babbler	<i>Jabouilleia danjoui</i>	X	X	X			X	X	X	X				
crested argus	<i>Rheinardia ocellata</i>	X	X	X	X	X	X	X		X	[X]	X		[X]
grey-faced Tit babbler	<i>Macronous kelleyi</i>		X	X					X	X				X
white-cheeked laughingthrush	<i>Garrulax vassali</i>		X				X	X	X	X	X	X	X	X
golden-winged laughingthrush	<i>Garrulax ngoclinensis</i>					X	X	X						
yellow-billed nuthatch	<i>Sitta solangiae</i>					X	X	X	X		X	X	X	
black-hooded laughingthrush	<i>Garrulax milleti</i>					X	X	X	X	X		X		X
black-crowned barwing	<i>Actinodura sodangorum</i>						X						X	
chestnut-eared laughingthrush	<i>Garrulax konkakinhensis</i>							X	X			[X]		

The species in square brackets is not confirmed from Priority Landscape CA1. Records in square brackets are unconfirmed. Sites: DK = Dak Rong; PD = Phong Dien; BM = Bach Ma; BN = Ba Na; QN = Ngoc Linh (Quang Nam); KT = Ngoc Linh (Kon Tum); KP = Kon Plong; KK = Kon Ka Kinh; KC = Kon Cha Rang; XS = Xe Sap; PA = Phou Ahyon; DP = Dakchung Plateau; DA = Dong Ampham.

In addition, the Central Truong Son Landscape region as a whole supports at least 35 subspecies endemic to Lao P.D.R., Vietnam, Cambodia and Thailand, including around 20 that are endemic to the Central Truong Son Landscape (Davidson *et al.* unpublished). Subspecies endemic or near-endemic to Priority Landscape CA1 include subspecies of Rufous-throated partridge (*Arborophila rufogularis guttata*), silver pheasant (*Lophura nycthemera beli*), Indochinese green magpie (*Cissa hypoleuca chauleti*), Sultan Tit (*Melanochlora sultanea gayeti*), sooty-headed bulbul (*Pynonotus aurigaster dolichurus*), lesser necklaced laughingthrush (*Garrulax monileger pasquieri*) and Rufous-throated fulvetta (*Alcippe rufogularis kelleyi*) (Nguyen Cu 1995).

The boundaries of sub-landscapes CA1b and CA1c correspond closely to those of the Kon Tum Plateau EBA, except that they include lowland areas not included within the EBA. The Kon Tum Plateau EBA supports nine restricted-range species, most of which are restricted to montane forest habitats above 800 m. Therefore, with the exception of crested argus, which is concentrated at lower elevations, most of the restricted range species of the EBA are not under any immediate threat from habitat loss, although the very limited distributions of some species makes them vulnerable in the long term.

Sub-landscape CA1a contains the southern part of the Annamese Lowlands EBA, and supports seven or eight of the nine restricted-range species known from this EBA. The only restricted-range species characteristic of this EBA that definitely does not occur within Priority Landscape CA1 is sooty babbler (*Stachyris herberti*), a limestone specialist whose global range is restricted to Priority Landscape NA3 (Central Indochina Limestone). Vietnamese pheasant (*Lophura hatinhensis*) is known from Priority Landscape CA1 only from a single record from Huong Thuy district, Thua Thien Hue province. This record is anomalous for several reasons (Eames and Tordoff in prep.), and further information is required to clarify the status of this species in the priority landscape. An additional note must be made regarding Imperial pheasant (*L. imperialis*): recent studies indicate that this bird may be a hybrid

between Edwards' pheasant (*L. edwardsi*) and silver pheasant (*L. nycthemera*) (Rasmussen 1998). Consequently, of the three endemic *Lophura* pheasants, only of Edwards' pheasant does Priority Landscape CA1 support a population of undoubted global significance.

Five of the restricted-range species characteristic of the Annamese Lowlands EBA are lowland galliformes. These species are threatened by habitat loss (which is most extensive at lower elevations), indiscriminate snaring, and, potentially, changes in habitat as a result of over-exploitation of timber or non-timber forest products. The populations of these species within the priority landscape are, therefore, of the highest conservation importance.

Within Priority Landscape CA1, the most important habitats for bird conservation are forest habitats. These habitats support a large proportion of the avifauna of the priority landscape, and almost all of the priority taxa. Although a significant number of species are found in secondary habitats, these habitats are widespread and, in most cases, increasing in area. Similarly, although a number of species are largely restricted to wetland habitats, which are among the most threatened habitats in the priority landscape, most of these species are either not of global conservation concern or do not have a significant population within the priority landscape.

In general, wetland habitats are lower priorities for bird conservation in Priority Landscape CA1 than forest habitats. However, exceptions must be made for habitats that support masked finfoot (*Heliopais personata*) and Blyth's kingfisher (*Alcedo hercules*): forested rivers and large streams. In addition, the upper catchment of the Xe Kong river is of potential importance for the conservation of white-winged duck (*Cairina scutulata*), although the odds are against there being a significant population. An assessment of the status of this species in the area is, therefore, a moderate survey priority.

Overall, the biggest threats to bird diversity in Priority Landscape CA1 are habitat loss and disturbance, and hunting, although the effects of these threats differ among species. The species most susceptible to habitat loss and disturbance are those with very specific habitat requirements, particularly those restricted to lowland forest or wetland habitats. In addition, while rates of habitat loss in areas of upper montane forest are relatively low, species restricted to this habitat are potentially at risk due to the limited distribution of the habitat.

Bird species most susceptible to hunting include congregatory species, such as hornbills and green pigeons, which form large flocks at roosts and fruiting trees; large and medium-sized ground foragers, such as partridges and pheasants, which are at risk from snaring; all wildfowl, which inhabit open water and make easy targets; and open-country birds of prey, which are often large bodied and conspicuous (Davidson *et al.* unpublished). A related threat is capture for the pet trade, which may have potentially serious, if unquantified, effects on populations of parakeets, mynas and other species in high demand (Morris 2001).

3.3.2 Priority taxa

A total of 28 priority bird taxa were provisionally identified in Priority Landscape CA1, comprising 19 that are confirmed to occur and nine that are either provisionally recorded or expected to occur (Appendix 3). Of the 19 priority taxa confirmed to occur, 15 are listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000), and 14 are listed in the *Red Data Book of Vietnam* (Anon. 1992). Furthermore, for 13 of the 19 species confirmed to occur, Priority Landscape CA1 was judged to support a globally significant population.

Although no bird species was assigned a priority score of 5 (the highest possible), one species was assigned a priority score of 4: Edwards' pheasant. A further six species were assigned a priority score of 3. These comprised the four species whose global ranges are confined to the priority landscape, together with crested argus, a globally vulnerable, restricted-range species, and masked finfoot, a globally vulnerable species, which is associated with lowland wetland habitats and susceptible to hunting.

More information is available about the habitat requirements and distributions of birds than of other groups. For conservation planning purposes, therefore, it is possible to predict the distributions of most priority bird taxa within the priority landscape, based on their known habitat requirements. Exceptions must be made, however, for those species that have undergone a severe range contraction within the priority landscape for reasons other than habitat loss. These species include green peafowl (*Pavo muticus*), a species that has undergone a massive decline in the last few decades (Brickle *et al.* 1998). Although green peafowl was identified as a priority taxon, the remaining population in Priority Landscape CA1 is unlikely to be of anything other than local significance.

3.4 Reptiles and Amphibians

3.4.1 Status in Priority Landscape CA1

Little information is available about the distribution and status of reptile and amphibian species within Priority Landscape CA1. However, the information that is available indicates that the priority landscape may be of importance for the conservation of a number of globally threatened and endemic species. At least 11 reptile and amphibian species are listed in the *Red Data Book of Vietnam* (Anon. 1992), while at least three species are listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000). In addition, at least ten reptile and amphibian species confirmed to occur in the priority landscape are believed to be endemic to Indochina.

Little specific information is available about threats to reptile and amphibian populations in Priority Landscape CA1. Extrapolating from what is known about other areas in the region, it can be assumed that one of the major threats is harvest for domestic consumption, and internal and international trade (Duckworth *et al.* 1999). Potentially, the other major threat to reptiles and amphibians in the priority landscape is habitat loss. However, the habitat requirements and distribution of most species are too poorly known to make a detailed assessment of the impacts of this threat.

3.4.2 Priority taxa

A total of 16 priority reptile and amphibia taxa were provisionally identified in Priority Landscape CA1, comprising four that are confirmed to occur and 12 that are either provisionally recorded or expected to occur (Appendix 4). Of these 16 species, all but two are turtles, reflecting the high proportion of globally threatened species within this group, and the seriousness of the threat posed by trade to all turtles. In Lao P.D.R., turtles are considered to be the most heavily exploited group of reptiles and amphibians, both for domestic consumption and export to Vietnam and China (Duckworth *et al.* 1999).

Two species, Indochinese box turtle (*Cuora galbinifrons*) and Chinese three-striped box turtle (*C. trifasciata*), were assigned a priority score of 5 (the highest possible). If current rates of harvesting continue, both species are likely, in the near future, to become extinct in the wild in

Lao P.D.R., and, possibly, throughout their global ranges (Duckworth *et al.* 1999). A further two species, black-breasted leaf turtle (*Geoemyda spengleri*) and wattle-necked softshell turtle (*Palea steindachneri*), were assigned a priority score of 4. Further studies are required to clarify the status of these species within Priority Landscape CA1.

Only a single snake, Burmese python (*Python molurus*), was provisionally identified as a priority taxon. However, a number of other snake species are equally susceptible to extinction in the region due to their high value in trade: reticulated python (*Python reticulatus*), green ratsnake (*Elaphe prasina*), radiated ratsnake (*E. radiata*), red-tailed green ratsnake (*Gonyosoma oxycephalum*), Indochinese ratsnake (*Ptyas korros*), common ratsnake (*P. mucosus*), Malayan krait (*Bungarus candidus*), banded krait (*B. fasciatus*), King cobra (*Ophiophagus hannah*), monocellate cobra (*N. kaouthia*), Indochinese spitting cobra (*N. siamensis*) and (*Naja atra*) (B. Stuart *in litt.* 2001). While none of these species are listed in the 2000 IUCN Red List of Threatened Species (IUCN 2000), this may simply reflect the fact that very little is known about the global threat status of these species. Therefore, it may be necessary to revise the list of priority taxa to include these species. The same applies to Tockay gecko (*Gecko gekko*), Bengal monitor (*Varanus bengalensis*) and water monitor (*V. salvator*).

No amphibians were provisionally identified as priority taxa. However, ten amphibian species confirmed or provisionally recorded from Priority Landscape CA1 are believed to be endemic to Indochina: *Amolops cremnobatus*, *Paa microlineata*, *Rana attigua*, *R. chapaensis*, *R. verrucospinosa*, *Philautus abditus*, *P. banaensis*, *Rhacophorus annamensis*, *R. baliogaster* and *R. exechopygus*. Although insufficient information is available to accurately assess the global threat status of these species, given the restricted distributions of some of these species, habitat loss is a potential long-term threat. In the future, as threats to amphibian conservation in the region become better understood, it may be possible to identify priority amphibian taxa in Priority Landscape CA1.

3.5 Fish

3.5.1 Status in Priority Landscape CA1

The diversity of inland fish in mainland South-East Asia is very high, with over 900 species recorded to date (Kottelat 1989). However, knowledge of aquatic biodiversity is still at the exploratory stage, with large areas unsurveyed, and many species known only from a single locality (Kottelat unpublished), and this is very much the case in Priority Landscape CA1. Consequently, an assessment of the status of fish cannot be based on an evaluation of the status of particular species but only on an evaluation of the status of aquatic habitats presumed to be of high importance for fish conservation.

In most cases, the distribution of fish species is not linked to that of a particular vegetation type, although the presence or absence of forest is often an important factor. Rather, the most important factor determining fish distribution is geomorphology, and the aquatic habitats used in this document are defined accordingly (Kottelat unpublished). At a higher level, because the factors limiting fish dispersal are mostly different from those limiting dispersal of terrestrial organisms, the most appropriate biogeographical units for fish communities are river basins and sub-basins.

Within Priority Landscape CA1, the major basins and sub-basins can be divided into two main groups: those that drain westwards into the Mekong River, and those that drain eastwards,

directly into the sea. The three major basins in the first group are those of the Xe Kong and Xe Bang Hieng rivers, which drain the Lao component, and the Xe San river, which drains parts of Kon Tum and Gia Lai provinces. The major basins in the second group are those of the Ba river, which drains eastern Gia Lai province, the Say (Con) and Lai Giang rivers, which drain northern Binh Dinh province, the Tra Khuc river, which drains parts of Quang Ngai and Kon Tum provinces, the Thu Bon river, which drains most of Quang Nam province, the Bo and Huong rivers, which drain much of Thua Thien Hue province, and the Quang Tri river, which drains much of Quang Tri province. Each of these basins can be expected to support a characteristic fish fauna, including a number of endemic taxa. Therefore, efforts should be made to include, within the conservation landscape, representative examples of each habitat type within each basin.

Although little studied, the fish fauna of sub-landscape CA1a is likely to be distinct from that of sub-landscapes CA1b and CA1c: recent observations indicate that the fish fauna north of the Hai Van pass is most closely related to those of the Red River basin and southern China, while that south of the Hai Van pass is most closely related to the Mekong fauna (Kottelat unpublished). The most important biogeographical barrier to fish communities in the priority landscape, however, is the watershed between the Mekong basin and the basins of rivers flowing directly into the sea.

Detailed studies on the nature and impacts of large scale threats to freshwater biodiversity in the FLMEC have never been carried out. However, anecdotal reports and extrapolation from other parts of South-East Asia allow a few tentative conclusions to be drawn. The fish desk study (Kottelat unpublished) identified six major threats, all of which are expected to apply to Priority Landscape CA1.

Flow alteration and water diversion, resulting from construction of canals, dams or small-scale hydropower generators, can result in habitat change, create barriers to migration and connect river basins, thereby facilitating invasions of non-indigenous species. Pollution, from domestic, agricultural and industrial sources, can have severe impacts of freshwater productivity and fish diversity, as can increased sediment load, resulting from deforestation and infrastructure development. Introductions of non-indigenous species can have severe effects on indigenous fish communities, particularly those of habitats near or downstream of human habitation. Habitat loss is a severe threat to fish diversity, particularly to those species with very restricted distributions. Finally, over-fishing is a threat to many fish species, particularly larger species of commercial value, although indiscriminate fishing methods, such as use of poison, are a threat to all aquatic biodiversity (Kottelat unpublished).

Extrapolating from the region as a whole, populations of large fish species inhabiting major rivers are likely to be in decline as a result of over-fishing. However, many of these species have relatively large ranges, and it is small, endemic headwater species with very localised distributions that are arguably the most vulnerable, due to their susceptibility to relatively localised and limited impacts (Kottelat unpublished).

3.5.2 Priority taxa

A total of 21 priority freshwater fish taxa were provisionally identified in Priority Landscape CA1, comprising 12 that are known to occur and nine that are expected to occur. These species are predominantly large, commercial species.

When more data on the fish diversity of the priority landscape become available, it will be possible to identify additional priority taxa according to criteria other than national threat status. One of the most important criteria will be endemism, as it is expected that the priority landscape will be found to support many endemic species, including some that are endemic to the priority landscape.

3.6 Butterflies

3.6.1 Status in Priority Landscape CA1

Prior to the 1990s, the information available about the butterfly diversity of Priority Landscape CA1 was limited (e.g. Dubois and Vitalis de Salvaza 1921). In recent years, a series of surveys have greatly increased the amount of available information, added many taxa to the list of butterflies in Vietnam, and discovered a number of taxa new for science (e.g. Devyatkin *et al.* 1998, Monastyrskii and Devyatkin 2000). However, survey coverage of the priority landscape has been patchy and entirely restricted to the Vietnamese component. Consequently, further studies are required, particularly of sub-landscape CA1c and lowland habitats in sub-landscape CA1b, before firm conclusions can be made about butterfly conservation priorities in the priority landscape.

The results of surveys to date do, however, allow tentative conclusions to be drawn about patterns of butterfly diversity and endemism in Priority Landscape CA1. Firstly, there appears to be a correlation between butterfly species diversity and diversity of habitat types at a site. For instance, Ngoc Linh (Kon Tum) and Kon Ka Kinh Nature Reserves, which both support a broad range of habitats over a wide altitudinal gradient, support more diverse butterfly faunas (236 and 209 species, respectively) than Phong Dien and Dak rong proposed nature reserves, which support a narrower range of mainly lowland habitats (143 and 150 species, respectively) (Le Trong Trai *et al.* 1999a,b, 2000).

Secondly, the high mountains of the Kon Tum plateau, such as Mount Ngoc Linh and Mount Kon Ka Kinh, appear to be centres of butterfly endemism. This can be explained by the biological isolation of these peaks from other montane areas in South-East Asia. This pattern of endemism is also found in birds and plants.

While many butterfly taxa appear to have relatively specific habitat requirements in terms of altitudinal range and major vegetation type, most appear to be relatively tolerant of habitat disturbance. However, a small but significant number have very specific habitat requirements, and are, therefore, extremely sensitive to disturbance, such as timber extraction.

While none of the butterfly taxa known from Priority Landscape CA1 are listed in the 2000 *IUCN Red List of Threatened Species* (IUCN 2000) or the *Red Data Book of Vietnam* (Anon. 1992), this probably only reflects the lack of information about the conservation status of butterfly taxa. Populations of a number of butterfly taxa within the priority landscape are threatened with extinction because their narrow habitat requirements make them susceptible to disturbance, or because their restricted range makes them susceptible to habitat loss.

In addition, trade is a potential threat to a small number of taxa, and three butterfly taxa found in Priority Landscape CA1 are listed in CITES Appendix II (CITES 1998): *Troides helena*, *T. aeacus* and *Teinopalpus imperialis*. However, compared to other sites in Vietnam, such as Tam Dao National Park, the impact of trade on butterfly populations in Priority Landscape CA1 is currently negligible.

3.6.2 Priority taxa

A total of 46 priority butterfly taxa were provisionally identified in Priority Landscape CA1 (Appendix 6). Of these taxa, 41 are known from sub-landscape CA1b, while only ten are known from sub-landscape CA1a; there are no data available from sub-landscape CA1c. The difference in number of priority taxa between sub-landscapes CA1a and CA1b may partly reflect disparities in survey effort between the two sub-landscapes, although it is probably a result of the greater diversity of montane habitats in sub-landscape CA1b compared with sub-landscape CA1a: 36 of the priority taxa are restricted to elevations above 700 m.

Based upon current known distributions, eight taxa are believed to be endemic to the priority landscape: *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Zeuxidia* sp. nov., *Dodona katerina*, *D. speciosa*, *Heliophorus emeraldus* and *Pintara capilloides*. A further three taxa are believed to be endemic to Vietnam, and two are believed to be endemic to Indochina. Eleven of these endemic taxa are known from sub-landscape CA1b, while only three are known from sub-landscape CA1a. All but one of the endemic taxa known from sub-landscape CA1b are restricted to montane habitats, supporting the theory that the montane isolates of this sub-landscape are centres of butterfly endemism.

3.7 Habitats

3.7.1 Overview

Historically, most of the natural vegetation cover of Priority Landscape CA1 would have been forest, primarily evergreen in character, although with an increasingly deciduous character at lower elevations on the western flank of the Annamite chain. Particular vegetation formations depend upon the following main factors: elevation, topography (relief), soils, climate (temperature and hydrology) and disturbance; areas with the greatest variation in these factors are likely to support the greatest floral richness and diversity of vegetation formations. However, such areas are not necessarily of the highest conservation importance. Rather, the most important areas are likely to be those with the highest total number of taxa endemic or near-endemic to the Central Truong Son Landscape or otherwise restricted in range, or taxa severely threatened by exploitation. The distribution of endemic and near-endemic taxa is likely to reflect factors that are relatively localised in South-East Asia, which include montane isolation, coincidence of high rainfall and low elevation, and, perhaps, soil type (about which current knowledge is limited). The distribution of taxa severely threatened by exploitation is influenced by both topography and elevation, particularly as lowland forest on flat land has almost completely been lost, and riverine habitats also tend to be disproportionately lost.

In the context of Priority Landscape CA1, elevation and topography are the most important factors influencing forest type. In the absence of detailed information about the distribution of vegetation formations, it is important to conserve representative examples of the full range of topographical diversity within each elevation belt, including gentle slopes, steep slopes, summits, ridge crests, valley bottoms and plateaux.

Due to the great diversity of vegetation formations and the extremely restricted distributions of some, only by protecting large, contiguous areas of natural habitat can the full floral diversity of a landscape be conserved. Such areas are of unparalleled importance for plant conservation within the priority landscape, and are worthy of international recognition. Within Priority Landscape CA1, the area that supports the greatest variation in elevation and

topography, and hence, the greatest recorded floral richness, is the Ngoc Linh massif (although the Phou Ahyon massif, which has never been the focus of botanical studies, potentially supports similar levels).

Table 2 shows the altitudinal distribution of natural forest cover within Priority Landscape CA1. This table reveals that there is a strong positive correlation between forest cover and elevation: lower elevations have been more extensively cleared of forest than higher elevations. In fact, the figure for forest cover in the 0-300 m elevation zone is distorted by the fact that large areas on non-forest have been excluded from the priority landscape, and would be even lower if the boundary of the priority landscape were extended.

Table 2 also reveals that Priority Landscape CA1 still supports a significant area of forest below 700 m. However, while forest below 700 m covers a large area, it is both more degraded and more fragmented than other forest habitats.

Table 2: Altitudinal distribution of natural forest cover within Priority Landscape CA1

Elevation zone	Total area (ha)	Natural forest (ha)	Forest cover (%)
0-300 m	697,338	139,890	20.1
300-700 m	1,389,021	565,271	40.7
700-1,200 m	1,497,068	715,969	47.8
1,200-1,500 m	366,048	211,229	57.7
>1,500 m	107,360	85,217	79.4
Total	4,056,835	1,717,576	42.3

3.7.2 Lowland forest (0-300 m)

A division can be recognised between the plant communities and vegetation formations of elevations below 300 m and those between 300 and 700 m. The differences between plant and animal communities above and below 300 m are, however, poorly understood.

The floral richness of lowland forest below 300 m is limited by low soil nutrient content, and low diversity of vegetation formations as a result of relatively uniform topography. It is possible that the floral richness of this habitat was greater in the past but has now decreased as a result of extensive clearance and disturbance.

Lowland forest below 300 m is by far the most threatened terrestrial habitat in Priority Landscape CA1. Large areas have been cleared as a result of clearance for agriculture, human settlement, and the direct and indirect effects of the Second Indochina War. Closed canopy forest now covers only 20.1% of the priority landscape below 300 m (Table 2), and much of this remaining area has been heavily disturbed by over-exploitation.

Habitat loss, as a result of agricultural expansion, road development and settlement of migrants, threatens most remaining areas of lowland forest below 300 m in the priority landscape, with particularly serious implications for species and vegetation formations restricted to this habitat. However, national forestry programmes, particularly Programme 661 in Vietnam, present opportunities to reverse the trend of natural forest loss.

The potential to restore natural forest cover to deforested areas exists in many parts of Priority Landscape CA1, and the most appropriate method for the restoration of natural forest cover is natural regeneration. Consequently, remaining areas of lowland forest below 300 m, although

limited in extent, take on high significance as reservoirs of floral diversity. However, not all areas below 300 m in the priority landscape retain the potential to regenerate into natural forest, because processes such as agricultural expansion and reforestation with exotic tree species preclude the option of restoring natural forest cover to an area.

3.7.3 Lowland forest (300-700 m)

There are two main categories of lowland forest in Priority Landscape CA1: lowland evergreen forest and lowland semi-evergreen forest. Lowland evergreen forest formations occur in areas of perhumid climate with mean annual rainfall greater than 2,000 mm and short dry seasons (Rundel unpublished). In Priority Landscape CA1, these formations are found in the foothills on the eastern flank of the Annamite chain. Lowland semi-evergreen forest formations occur in humid and sub-humid climatic regions where mean annual rainfall is between 1,200 and 2,000 mm and dry seasons are prolonged (Rundel unpublished). In the priority landscape, semi-evergreen forest has a limited distribution in the western foothills of the Truong Son, including within Xe Sap and Dong Ampham National Biodiversity Conservation Areas (NBCAs) and on the Dakchung plateau (Davidson *et al.* 1997, Showler *et al.* 1998, Steinmetz *et al.* 1999). Most of the western slopes are, however, likely to support formations transitional between evergreen and semi-evergreen forest, following gradients of decreasing mean annual rainfall and increasing dry season severity.

As no detailed botanical surveys have been conducted in the Lao component of the priority landscape to date, precise information about the composition and conservation importance of semi-evergreen forest formations is not available. However, semi-evergreen forest is widely distributed across Thailand, Lao P.D.R., Vietnam and Cambodia, and, extrapolating from what is known about other areas, it can be assumed that semi-evergreen forest formations in Priority Landscape CA1 support fewer endemic and near-endemic plant taxa, and are of lower conservation importance than lowland evergreen forest formations.

Across most of the landscape, therefore, lowland forest is characterised by broadleaf evergreen forest formations dominated by members of the Fabaceae, Dipterocarpaceae, Lythraceae and Cycadaceae. Lowland forest between 300 and 700 m is distinguished from lowland forest below 300 m by a greater number of epiphytes, and the presence of some members of the Magnoliaceae, Lauraceae and Fagaceae. Lowland forest between 300 and 700 m is particularly important for *Aquilaria crassna*, *Dialium cochinchinensis*, *Codonopsis javanica*.

While, lowland forest between 300 and 700 m covers a larger area of the priority landscape than lowland forest below 300 m, the threats mentioned in the previous section also apply to this habitat type. As with lowland forest below 300 m, remaining areas of lowland forest between 300 and 700 m are important as reservoirs of floral diversity.

3.7.4 Lower montane forest (700-1,200 m)

Lower montane forest is typically distributed at elevations between 700 and 1,200 m, although the transition between lowland and lower montane forest may be as high as 1,000 m, for example on Mount Ngoc Linh (Le Trong Trai *et al.* 1999a, Tordoff *et al.* 2000). This altitudinal zone experiences higher mean annual rainfall than lowland areas, and, hence, supports vegetation formations that are predominantly evergreen in nature.

The transition from lowland to lower montane forest is quite abrupt, and is characterised by the absence of members of the Dipterocarpaceae, and increasing dominance of members of the

Fagaceae, Lauraceae, Magnoliaceae and Theaceae (Rundel unpublished). Other families characteristic of this habitat are the Pinaceae, Podocarpaceae, Araliaceae and Sapotaceae.

Lower montane forest supports an exceptionally high floral richness. In part, this is because plant communities comprise elements of both the lowland and montane floras. Additionally, the high floral richness is a result of an extremely diverse topography, which supports a high diversity of polydominant forest formations. Many of the more important formations, from a conservation perspective, are mixed broadleaf and coniferous forest formations with extremely restricted distributions.

3.7.5 Medium montane forest (1,200-1,500 m)

The structure and composition of this habitat are broadly similar to those of lower montane forest, and the diversities of plant species and vegetation formations are almost as high. However, this habitat differs from the previous one by an increasing dominance of members of the Hamamelidaceae, Cupressaceae, Rhodoleiaceae, Mastixiaceae, Betulaceae and Rosaceae.

This habitat also supports a number of polydominant mixed broadleaf and coniferous forest formations of high conservation importance. Examples include forest dominated by *Dacrydium elatum*, and forest dominated by *Fokienia hodginsii*.

3.7.6 Upper montane forest (>1,500 m)

The transition between medium and upper montane forest takes place at different elevations at different sites, and, even within sites, varies in elevation due to edaphic factors. At Ngoc Linh (Quang Nam) proposed nature reserve, for instance, upper montane forest is mainly distributed above 1,700 m but extends to altitudes as low as 1,500 m along well drained ridge crests (Tordoff *et al.* 2000).

Upper montane forest is dominated by members of the Ericaceae, Magnoliaceae, Lauraceae, Pinaceae and Fagaceae. A number of species of high conservation importance are restricted to this habitat, including *Quercus platycarya*, *Keteleeria evelyniana*, *Panax vietnamensis* and *Pinus dalatensis*.

This habitat supports two distinct types of forest formation: forest on summits and ridge crests, and forest on slopes. Slopes support forest formations characterised by a mixture of broadleaf and coniferous species, and dominated by members of the Fagaceae, Lauraceae, Magnoliaceae and Pinaceae. Forest formations of high conservation importance in this category include forest dominated by *Pinus dalatensis*.

As a result of low temperatures, water and nutrient availability, summits and narrow ridges support specialised, edaphic forest formations, characterised by stunted growth and xerophytic morphology, and dominated by members of the Ericaceae (principally *Rhododendron* spp.), Fagaceae and Illiciaceae. Trees in these formations are covered in a thick layer of moss, and support a very limited diversity of epiphytic orchids.

Overall, upper montane forest is the least threatened primary habitat in Priority Landscape CA1. Of the 107,360 ha of the priority landscape above 1,500 m, 85,217 ha, or 79.4% is forested (Table 2), and a significant proportion of this is included within existing or proposed protected areas.

3.7.7 Secondary habitats

Priority Landscape CA1 supports a variety of secondary habitats, including scrub, grassland and bamboo. The vegetation of these habitats is characterised by the presence of members of the Poaceae, Melastomataceae, Euphorbiaceae and Theaceae. Secondary habitats have been formed as a result of numerous, primarily anthropogenic, factors, and are, therefore, associated with areas of human settlement. Consequently, secondary habitats are widespread at lower elevations and in easily accessible areas but are less so at higher elevations and in remote areas.

3.7.8 Rapids

Rapids are an aquatic habitat, characterised by high gradients, rocky substrates, high levels of dissolved oxygen and low temperatures (although these last two features may be less pronounced in lowland rapids). Due to their heterogeneity, rapids provide a wide variety of ecological niches, and support a number of specialised rheophilic species, which are only found in rapids. Large, complex rapids are believed to have more diverse and specialised fish faunas than small, temporary or isolated rapids (Kottelat unpublished).

The distribution of this habitat within Priority Landscape CA1 is poorly known, although it is presumed to be widespread but very localised, apart from along the upper Xe Kong river, which has extensive rapids over much of its length once it enters the Annamite foothills (R. Timmins pers. obs.). Although the invertebrate and fish diversity of this habitat in the priority landscape is little studied, the habitat is expected to support high levels of endemism.

The main threats to rapid communities are dam construction, particularly due to the development of small-scale hydropower schemes, and channelisation. One key consideration for the conservation of this habitat is that many specialised rapid species are known from only a few sites, and some only from a single site (Kottelat unpublished). Consequently, it may not be sufficient to conserve a few representative examples of this habitat. Rather, detailed studies are required of the diversity of specialised rapid species at each site, in order that a network of sites that supports the full diversity of rapid species within Priority Landscape CA1 can be identified.

3.7.9 Headwaters

Headwaters are an aquatic habitat, which, like rapids, is characterised by high gradients, high levels of dissolved oxygen, low temperatures and rocky substrates. As is the case with rapids, headwaters support a large number of fish species adapted to fast-flowing waters, many of which have restricted distributions. In general, fish species characteristic of this habitat inhabit a number of streams within a catchment, although some species may be restricted to a single stream (Kottelat unpublished).

This habitat is concentrated at higher elevations, which, within Priority Landscape CA1, are often forested. Deforestation can lead to a loss of aquatic diversity in this habitat, as a result of increased temperature and sediment load. In addition, deforestation can result in major hydrological changes, including increased seasonality in stream flow, which may have major implications for downstream water users. Another threat to this habitat is dam construction, especially as headwaters are often targeted for small-scale hydropower schemes.

3.7.10 Small forested streams in lowlands and foothills

Small forested streams in lowlands and foothills are an aquatic habitat characterised by low gradients, large amounts of leaf litter and other debris, and gravel or soil substrates. This habitat is distinguished from the following habitat in that, in forested areas, the forest canopy is unbroken above the watercourse (Kottelat unpublished).

This habitat is important for distinctive but little-known communities of small fish species. These communities are dominated by members of the Cyprinidae and Balitoridae but the species composition is largely unknown. This habitat is expected to support a number of fish species with geographical distributions restricted to a single basin. A small number of bird species are largely restricted to this habitat, for example black-backed kingfisher (*Ceyx erithacus*). However, none of these qualify as priority taxa.

The biggest threat to this habitat is deforestation, as a result of which, this habitat has been severely degraded in many lowland areas. Other threats include pollution, diversion of water for agriculture and over-fishing, especially using poison.

3.7.11 Middle reaches of main rivers

This aquatic habitat is characterised by very low gradients, low oxygen concentrations, high temperatures, high turbidity and fine to muddy substrates. This habitat is quite heterogeneous, consisting of a combination of deep-water stretches, shallows, rapids, waterfalls and gorges (Kottelat unpublished).

This habitat has potentially high importance for the conservation of a number of mammal taxa, not only specialised aquatic ones, such as otters (Timmins and Duckworth unpublished). It is also an important habitat for a number of priority bird taxa, including masked finfoot and grey-headed fish eagle (*Ichthyophaga ichthyaetus*). For mammal conservation, and presumably also for bird conservation, stretches of this habitat greater than 50 km in length, with intact vegetation along both banks and low levels of human activity, are the most important (Timmins and Duckworth unpublished). Kon Cha Rang Nature Reserve supports some important stretches of this habitat but these are relatively short. Elsewhere in the priority landscape, Song Thanh proposed nature reserve is potentially important for the conservation of this habitat, although this potential remains largely unassessed.

A number of fish species are restricted to the middle reaches of main rivers. Furthermore, some of these species are endemic to a single basin. These endemics are of particular concern because a single severe impact, such as construction of a dam, may eradicate the entire population (Kottelat unpublished). An additional threat to the fish communities of this habitat is that the effects of upstream impacts, such as pollution or deforestation, are concentrated in the middle reaches of main rivers.

It should be borne in mind that important stretches of this habitat may exist outside of forested areas, in the settled lowlands. Such stretches have yet to be identified, as sufficient data on aquatic fauna and levels of pollution and other forms of degradation or modification are not currently available. Further investigation of the significance of such stretches in each basin is, however, a high priority.

3.7.12 Man-made freshwater habitats

Man-made freshwater habitats include canals, reservoirs and paddy fields. These habitats usually support a low diversity of fish species, due to a lack of heterogeneity. These habitats often support a number of exotic species, and, in addition, the native species present tend to be more widespread, hardy species. Pollution levels in these habitats are frequently higher than in other aquatic habitats, and they are of lower importance from a conservation perspective (Kottelat unpublished).

PART IV: DEFINING THE CONSERVATION FOCI AND SETTING BIOLOGICAL TARGETS

4.1 Introduction

During the first stage of the biological assessment, 24 conservation foci were defined for Priority Landscape CA1. These comprised seven focal habitats, ten focal groups, four focal taxa and three focal landscape features. During the second stage of the biological assessment, biological targets were set for each conservation focus. In addition, five non-focal targets were set to cover any issues not adequately addressed by the targets set for the conservation foci.

4.2 Habitats

4.2.1 Lowland forest (0-700 m) in sub-landscape CA1a

This habitat has been extensively cleared and remaining areas have been heavily degraded. Consequently, some floral elements have probably already been lost. However, the remaining areas of this habitat are of the highest importance as they contain the last examples of vegetation formations that once covered the lowlands of Priority Landscape CA1. If these remaining areas of forest are lost, the restoration of natural forest cover in deforested lowland areas through the process of natural regeneration will be prevented. Therefore, the conservation of remaining areas of lowland forest is of the highest importance from social, economic and watershed protection, as well as biodiversity, perspectives. This is particularly true for lowland forest below 300 m, as this has been lost to a much greater extent than forest within any other elevation zone.

This habitat supports a number of vegetation formations of conservation concern, including forest dominated by *Parashorea stellata* and forest dominated by *Sindora tonkinensis*, both of which occur at Bach Ma National Park.

This habitat, together with lowland forest in sub-landscape CA1b, is of high importance for the conservation of mammal priority taxa. With the exception of a limited distribution in northern Quang Nam province, this is the only habitat in priority landscape CA1 known to support saola. Furthermore, should the occurrence of Annamite striped rabbit be confirmed in the priority landscape, it is likely to occur in this habitat.

This habitat was provisionally identified as the most important for priority bird taxa in Priority Landscape CA1 (combined priority score of 22). Several restricted-range species, including Edwards' pheasant and Annam partridge (*Arborophila merlini*), are found only in this habitat in the priority landscape. In addition, this habitat is important for crested argus.

Nine butterfly priority taxa are known from this habitat, of which five are known only from it. Two of these taxa, *Zeuxidia* sp. nov. and *Pintara capilloides*, are thought to be endemic to Priority Landscape CA1. In addition, this habitat supports a number of Amathusiidae taxa that are restricted to the understorey of primary forest, for example *Amathuxidia amythaon*. These taxa are extremely susceptible to logging, thus management activities should focus on preventing habitat degradation as well as habitat loss.

This habitat, together with lowland forest in sub-landscapes CA1b and CA1c, contains all stretches of small forested streams in lowlands and foothills in the priority landscape. In general, protection of lowland forest will also result in the protection of this aquatic habitat. However, special consideration should be given to this habitat if implementing sustainable forestry initiatives, to ensure that safeguards are introduced to maintain streamside buffer zones.

Short-term target 1 (high priority)

Within one year, at least 125,000 ha of habitat of high conservation importance below 700 m in sub-landscape CA1a will be included within priority 1 areas.

Short-term target 2 (high priority)

Within five years, the rate of loss of habitat of high conservation importance in all priority 1 areas in sub-landscape CA1a will be zero.

Short-term target 3 (high priority)

Within ten years, the rate of loss of habitat of high conservation importance in all priority 2 areas in sub-landscape CA1a will be zero.

Medium-term target 1 (high priority)

In 50 years time, there will be at least 175,000 ha of habitat of high conservation importance below 700 m in sub-landscape CA1a.

4.2.2 Lowland forest (0-700 m) in sub-landscape CA1b

As with lowland forest in sub-landscape CA1a, this habitat has been extensively cleared and remaining areas have been heavily degraded. Consequently, some floral elements have probably already been lost. However, the remaining areas of this habitat are of the highest importance, not only intrinsically for the elements of biodiversity that are represented only in these areas but because their loss will prevent the restoration of natural forest cover to deforested lowland areas in the sub-landscape. This habitat supports a number of important and highly localised vegetation formations, including forest dominated by *Dalbergia cochinchinensis*, which is found at Dak Huy Special-use Forest.

This habitat supports a high number of priority mammal taxa, including Sunda pangolin (*Manis javanica*), pig-tailed macaque (*Macaca nemestrina*) and ‘grey-shanked’ Douc langur, the former two being found in lowland forests elsewhere in the priority landscape, as well as at many other sites in South-East Asia. Although this habitat is also important for a range of priority bird taxa, it is probably less important than lowland forest in sub-landscape CA1a (combined priority score of 18). There has, however, been little ornithological study of lowland forest in sub-landscape CA1b, and the occurrence of taxa such as Edwards’ pheasant should not be discounted.

Only five butterfly priority taxa are known from this habitat, compared with nine known from lowland forest in sub-landscape CA1a. Furthermore, only one taxon is known only from this habitat: *Stichopthalma uemurai*.

This may, however, reflect disparities in survey effort between the two habitats rather than any underlying differences in numbers of butterfly priority taxa.

Short-term target 1 (high priority)

Within one year, at least 125,000 ha of habitat of high conservation importance below 700 m in sub-landscape CA1b will be included within priority 1 areas.

Short-term target 2 (high priority)

Within five years, the rate of loss of habitat of high conservation importance in all priority 1 areas in sub-landscape CA1b will be zero.

Short-term target 3 (high priority)

Within ten years, the rate of loss of habitat of high conservation importance in all priority 2 areas in sub-landscape CA1b will be zero.

Medium-term target 1 (high priority)

In 50 years time, there will be at least 225,000 ha of habitat of high conservation importance below 700 m in the Vietnamese component of sub-landscape CA1b.

4.2.3 Lower and medium montane forest (700-1,500 m)

This habitat supports the highest number of priority vascular plant species and vegetation formations of conservation concern in Priority Landscape CA1. Of particular importance in this habitat are a number of mixed broadleaf and coniferous forest formations, such as those dominated by *Fokienia hodginsii* at Kon Ka Kinh Nature Reserve and Song Thanh proposed nature reserve, and that dominated by *Dacrydium elatum* and *Dacrycarpus imbricatus* in the Kon Plong Forest Complex.

This is the second most important habitat for priority bird species (combined priority score of 20), and supports eight of the nine restricted-range bird species of the Kon Tum Plateau EBA: crested argus, yellow-billed nuthatch (*Sitta solangiae*), black-hooded laughingthrush, chestnut-eared laughingthrush, white-cheeked laughingthrush (*G. vassali*), short-tailed Scimitar babbler (*Jabouilleia danjoui*), black-crowned barwing and grey-faced Tit babbler (*Macronous kelleyi*).

This habitat supports the highest number of priority butterfly species, with 24 recorded to date. Eighteen of these species are not known from any other habitat in Priority Landscape CA1, and three are thought to be endemic to the priority landscape: *Delias vietnamensis*, *Lethe konkakini* and *Dodona katerina*.

Short-term target 1 (high priority)

Within one year, at least 350,000 ha of habitat of high conservation importance between 700 and 1,500 m will be included within priority 1 areas.

Short-term target 2 (high priority)

Within five years, rate of loss of habitat of high conservation importance in all priority 1 areas will be zero.

Short-term target 3 (high priority)

Within ten years, the rate of loss of habitat of high conservation importance in all priority 2 areas will be zero.

Medium-term target 1 (high priority)

In 50 years time, there will be at least 600,000 ha of habitat of high conservation importance between 700 and 1,500 m in Priority Landscape CA1.

4.2.4 Upper montane forest (>1,500 m)

Upper montane forest is almost entirely restricted to sub-landscapes CA1b and CA1c. Overall levels of plant and animal diversity and numbers of priority taxa in this habitat are lower than in other habitats. Furthermore, this is the least threatened primary habitat in Priority Landscape CA1. However, of the priority species that do occur, a large proportion are restricted to this habitat, for example golden-winged laughingthrush. This, coupled with its naturally small area, makes it important that this habitat is adequately represented within the conservation landscape.

An important consideration is that many of the priority species restricted to this habitat have very localised distributions. For example, the known global ranges of the plant species *Amentotaxus poilanei* and *Panax vietnamensis* are restricted to Mount Ngoc Linh. Therefore, consideration should be given to the distribution of priority species among sites, when selecting representative examples of this habitat for inclusion within the conservation landscape. The highest peaks and most extensive areas of this habitat are likely to support the highest levels of species richness and endemism, and these are largely encompassed in three blocks: the Ngoc Linh massif, the Phou Ahyon massif and Xe Sap NBCA. Less extensive, lower elevation areas of this habitat are found in Dong Ampham NBCA and Kon Ka Kinh Nature Reserve.

This habitat contains a number of important and localised vegetation formations, including forest dominated by *Rhododendron* spp., an edaphic formation distributed on summits and narrow ridges; and forest dominated by *Pinus dalatensis*.

This habitat supports a specialised montane bird community, with high levels of endemism, including three of the four bird species endemic to Priority Landscape CA1: black-crowned barwing, golden-winged laughingthrush and chestnut-eared laughingthrush. More information is needed about the ecology and distribution of these recently described species. Overall, however, this habitat is only of moderate importance for the conservation of priority bird species (combined priority score of 11).

The importance of this habitat for mammals is currently little known. However, it has been suggested that upper montane mammal communities are of conservation concern as they are intrinsically susceptible due to their restricted range and the difficulty of dispersal of taxa from other areas (Timmins and Duckworth unpublished).

This habitat is known to support 15 priority butterfly taxa, all but one of which are known only from it. Three of the taxa restricted to this habitat, *Aemona* sp. nov., *Dodona speciosa* and *Heliophorus emeraldus*, are endemic to Priority Landscape CA1. Because of their highly localised distributions, habitat loss is a potential threat to all butterfly taxa restricted to this habitat. In addition, trade is a potential threat to *Teinopalpus imperialis*, which is listed in CITES Appendix II (CITES 1998).

Short-term target 1 (high priority)

Within one year, at least 50,000 ha of habitat of high conservation importance between 700 and 1,500 m will be included within priority 1 areas.

Short-term Target 2 (high priority)

Within five years, the rate of loss of habitat of high conservation importance in all priority 1 areas will be zero.

Short-term target 3 (high priority)

Within ten years, the rate of loss of habitat of high conservation importance in all priority 2 areas will be zero.

Medium-term target 1 (high priority)

In 50 years time, there will be at least 100,000 ha of habitat of high conservation importance above 1,500 m in Priority Landscape CA1.

4.2.5 Rapids

Although little information is available about the distribution or species composition of this habitat in Priority Landscape CA1, it is almost certainly extremely important for the conservation of aquatic biodiversity. Stretches of rapids are predicted to support high levels of endemism in a limited area. Therefore, this habitat is highly susceptible to localised threats, such as hydropower development. Consequently, specific conservation action is required to determine the distribution of this habitat, evaluate the biodiversity value of each site, and mitigate the effects of any potential threats.

Short-term target 1 (high priority)

Within five years, all sets of rapids that support irreplaceable elements of aquatic biodiversity (taxa and communities) within Priority Landscape CA1 will have been identified and incorporated within priority 1 or priority 2 areas.

Medium-term target 1 (high priority)

In 50 years time, all sets of rapids that support irreplaceable elements of aquatic biodiversity within Priority Landscape CA1 will continue to support those elements.

4.2.6 Headwaters

Although little is known about the aquatic diversity of this habitat within Priority Landscape CA1, it is assumed to support high levels of endemism, with many species restricted to a single catchment. This habitat is thought to be important for the conservation of the globally endangered big-headed turtle (*Platysternon megacephalum*). In addition, this habitat is important in the context of entire hydrological systems, because impacts to headwaters also affect downstream habitats.

Deforestation is a major threat to the aquatic diversity of this habitat. However, this habitat is concentrated at higher elevations, where rates of deforestation are usually lower than at lower elevations; and conservation action to protect lower and upper montane forest will be sufficient to protect headwaters. Specific conservation action may, however, be required to mitigate the threat posed by small-scale hydropower developments, which often target this habitat.

Short-term target 1 (high priority)

Within one year, there will be at least 100 km of river bordered by habitat of high conservation importance in each catchment within priority 1 areas, with no stretch more than 5 km from another.

Short-term target 2 (high priority)

Within five years, all sub-catchments that support irreplaceable elements of aquatic biodiversity (taxa and communities) within Priority Landscape CA1 will have been identified and incorporated within priority 1 or priority 2 areas.

Medium-term target 1 (high priority)

In 50 years time, all sub-catchments that support irreplaceable elements of aquatic biodiversity within Priority Landscape CA1 will continue to support those elements.

Medium-term target 2 (low priority)

In 50 years time, there will be at least 500 km of river bordered by habitat of high conservation importance within each contiguous block of priority 1 and priority 2 areas, with no stretch more than 5 km from another.

Medium-term target 3 (low priority)

In 50 years time, at least 90% of the total length of headwaters within each priority 1 area will be bordered on both sides by habitat of high conservation importance.

Medium-term target 4 (low priority)

In 50 years time, at least 50% of the total length of headwaters within each priority 2 area will be bordered on both sides by habitat of high conservation importance.

4.2.7 Middle reaches of main rivers

With regard to aquatic diversity, this habitat is probably important for the conservation of a number of endemic fish species. In addition, the habitat supports a number of commercially important species. As with other focal aquatic habitats, dam construction is a major threat.

The middle reaches of main rivers are also important for certain priority mammal taxa, particularly otters, and several reptile species, possibly including Siamese crocodile.

Within Priority Landscape CA1, the middle reaches of main rivers are the most important wetland habitat for priority bird taxa. These include masked finfoot and grey-headed fish eagle, both of which occur on the Kon river in Kon Cha Rang Nature Reserve (Robson *et al.* 1989, Anon. 1999).

Short-term target 1 (low priority)

Within one year, there will be at least 100 km of river bordered by habitat of high conservation importance within each priority 1 area, with no stretch more than 5 km from another.

Short-term target 2 (high priority)

Within five years, all stretches of middle reaches of main rivers that support irreplaceable elements of aquatic biodiversity (taxa and communities) within Priority Landscape CA1 will have been identified and incorporated within priority 1 or priority 2 areas.

Medium-term target 1 (high priority)

In 50 years time, all stretches of middle reaches of main rivers that support irreplaceable elements of aquatic biodiversity within Priority Landscape CA1 will continue to support those elements.

Medium-term target 2 (low priority)

In 50 years time, at least 90% of the total length of middle reaches of main rivers within each priority 1 area will be bordered on both sides by habitat of high conservation importance.

Medium-term target 3 (low priority)

In 50 years time, at least 50% of the total length of middle reaches of main rivers within each priority 2 area will be bordered on both sides by habitat of high conservation importance.

4.3 Groups

4.3.1 All turtle species

This group contains a high proportion of globally threatened species, and the majority of the priority reptile and amphibian taxa in Priority Landscape CA1. These species are highly threatened by trade because of their high value as ingredients in traditional Chinese medicine. Another threat is exploitation for domestic consumption (Duckworth *et al.* 1999). One species of particular concern is the critically endangered Chinese three-striped box turtle, which is the most sought-after species, and which is provisionally recorded from the priority landscape.

Specific conservation action is required to tackle trade in all turtle species. In addition, captive breeding may be required in the case of three species, Chinese three-striped box turtle, Indochinese box turtle and keeled box turtle (*Pyxidea mouhotii*), which may soon be hunted out throughout their entire ranges (Duckworth *et al.* 1999). To date, however, none of these three species has been confirmed to occur within Priority Landscape CA1.

Short-term target 1 (medium priority)

Within ten years, at least one viable population of each priority turtle taxon in Priority Landscape CA1 will be identified and under effective conservation management.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each priority turtle taxon native to the priority landscape.

4.3.2 Wide-ranging large mammals

This group comprises those taxa that require large areas of habitat to support viable populations and, therefore, are not adequately protected within a network of small, isolated protected areas. This group comprises Asian elephant, tiger, leopard (*Panthera pardus*), dhole (*Cuon alpinus*) and gaur, together with a number of other ungulates. Timmins and Duckworth (unpublished) estimate that populations of tiger, and, probably, Asian elephant, wild cattle and leopard, are unlikely to survive except in areas exceeding 200,000 ha of largely contiguous habitat, while dhole requires areas of at least 100,000 ha.

For wide-ranging large mammals, large conservation landscapes, incorporating such elements as core areas, buffer zones and habitat corridors, must be designed. The optimum conservation landscape may differ among taxa, depending upon their ecology. Some species are particularly susceptible to habitat fragmentation, as they are unable to cross significant areas of non-forest habitat. Therefore, the conservation landscape must balance the requirements of each taxon.

Because a number of these taxa live at low population densities, they are particularly susceptible to hunting pressure. Therefore, specific measures to tackle hunting of these taxa are also required.

Short-term target 1 (low priority)

Within one year, at least 50,000 ha of habitat of high conservation importance, including at least 20,000 ha below 1,200 m, will be included within each priority 1 area.

Short-term target 2 (low priority)

Within ten years, at least one viable population of each priority wide-ranging large mammal taxon in Priority Landscape CA1 will be identified and under effective conservation management.

Medium-term target 1 (low priority)

In 50 years time, there will be at least 250,000 ha of habitat of high conservation importance, including at least 100,000 ha below 700 m, within each contiguous block of priority 1 and priority 2 areas.

Medium-term target 2 (low priority)

In 50 years time, at least 90% of the habitat of high conservation importance within each priority 1 area will be in a single contiguous block.

Medium-term target 3 (low priority)

In 50 years time, at least 50% of the habitat of high conservation importance within each priority 2 area will be in a single contiguous block.

Medium-term target 4 (low priority)

In 50 years time, a viable and intact large mammal community will occur in at least 70% of priority 1 areas.

Medium-term target 5 (low priority)

In 50 years time, Priority Landscape CA1 will support viable populations of Asian elephant, tiger, leopard, dhole and gaur.

4.3.3 All primates

All primate taxa occurring in Priority Landscape CA1 were provisionally identified as priority taxa. A significant number of these taxa are listed in the *2000 IUCN Red List of Threatened Species* (IUCN 2000). The priority landscape supports globally significant populations of a number of primate taxa, most notably ‘grey-shanked’ Douc langur, which is believed to be endemic or near-endemic to the priority landscape. However, the taxonomic relationships among douc langur taxa are currently unresolved and, while ‘grey-shanked’ Douc langur is considered by some authorities to be a distinct species (e.g. Roos and Nadler 2001), recent observations of douc langurs in eastern Cambodia suggest that the situation is more complex (Walston *et al.* 2001). Caution must, therefore, be exercised in adopting this taxon as a flagship for Priority Landscape CA1.

All primate taxa in Priority Landscape CA1 are severely threatened by hunting and trade, and specific conservation action is required to tackle these threats. Providing that hunting and trade can be controlled, primates are potentially conservable within a system of relatively small forest protected areas (Timmins and Duckworth unpublished).

Short-term target 1 (medium priority)

Within three years, at least one viable population of each priority primate taxon in Priority Landscape CA1 will be identified and under effective conservation management, with priority given to securing a population of ‘grey-shanked’ Douc langur.

Short-term target 2 (medium priority)

Within five years, there will be sufficient understanding of the distribution of gibbon and Douc langur taxa in Priority Landscape CA1 to assess whether the conservation landscape is appropriate for their conservation and to suggest refinements where necessary.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support viable populations of all primate priority taxa.

4.3.4 Lowland galliformes

This group is characterised by high levels of endemism and threat. Populations of several galliformes in Priority Landscape CA1 are thought to be globally significant, particularly those of Edwards' pheasant, Annam partridge and crested argus. However, the taxonomy of Annam partridge is currently unresolved, with some authorities not recognising it as a separate species (e.g. Inskipp *et al.* 1996).

The distributions of most lowland galliformes are concentrated in lowland forest, one of the most threatened habitats in the priority landscape. Priority conservation actions for this group include assessments of potential remaining habitat for each species, and surveys to assess the species' presence within each potential habitat block. However, habitat loss is not the only threat to this group, and specific conservation action is required to tackle indiscriminate snaring and trapping. This group also faces a possible threat from trade, the implications of which require further investigation.

Short-term target 1 (medium priority)

Within ten years, at least one viable population of each lowland galliform species in Priority Landscape CA1 will be identified and under effective conservation management, with priority given to securing a population of Edwards' pheasant.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each lowland galliform species.

4.3.5 Large, congregatory bird species (hornbills, green pigeons, parakeets, etc.)

Species in this group are particularly susceptible to hunting but also, in many cases, to selective logging, which may remove fruiting trees used for feeding and large trees used for nesting. Most of the species in this group are potential keystone species, with important ecological roles in seed dispersal. Consequently, they are in need of specific conservation measures. These may include promoting sustainable forestry practices, such as not felling large fruiting or nesting trees.

Short-term target 1 (low priority)

Within ten years, sustainable forest management practices that do not threaten populations of large, congregatory bird species will have been introduced into each priority 1 area.

Medium-term target 1 (low priority)

Within 50 years, sustainable forest management practices that do not threaten populations of large, congregatory bird species will have been introduced into each priority 2 area.

Medium-term target 2 (low priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each large, congregatory bird species.

4.3.6 Eels in the genus *Anguilla*

Several species in this genus occur in Priority Landscape CA1; these species are of high commercial value. However, they are catadromous species, which migrate to the sea to spawn. Consequently, they occur across a wide range of habitats during their life cycle, and site-based conservation projects will often be insufficient to adequately protect them. Instead, conservation approaches that consider hydrological systems in their entirety are in order. A second issue is that these are large-bodied species, occurring at low densities, making them particularly susceptible to over-exploitation.

Short-term target 1 (low priority)

Within five years, at least one catchment supporting each species in the genus *Anguilla* in Priority Landscape CA1 will be identified and effective conservation measures introduced.

Medium-term target 1 (low priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each species in the genus *Anguilla* native to the priority landscape.

4.3.7 Commercially valuable catfish

This group includes *Clarias batrachus*, *Hemibagrus elongatus*, *Cranoglanis sinensis* and *Bagarius bagarius*. In economic terms, this is possibly the most important group of freshwater fish in Priority Landscape CA1. However, because all species in this group are threatened by over-exploitation, and because they inhabit a wide range of habitats, specific conservation measures beyond habitat conservation are required.

Short-term target 1 (low priority)

Within ten years, at least one viable population of each commercially valuable catfish species in Priority Landscape CA1 will be identified and under effective conservation management.

Medium-term target 1 (low priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each commercially valuable catfish species.

4.3.8 Endemic and near-endemic animal taxa

The Greater Truong Son support a large number of endemic and near-endemic animal taxa, including saola, Heude's pig, large-antlered (giant) muntjac, endemic small muntjacs, 'grey-shanked', 'red-shanked' and 'black-shanked' Douc langurs, Annamite striped rabbit, black-crowned barwing, black-hooded laughingthrush and golden-winged laughingthrush. Many of these species have been confirmed to occur in Priority Landscape CA1, while most of the others have been provisionally recorded or are expected to occur. As the priority landscape supports a representative example of this community, it can be used to define the area, and act

as a flagship for its conservation. Further surveys to better understand the taxonomy, distribution, habitat requirements and global status of these taxa are a high priority if their conservation needs are to be adequately met.

Short-term target 1 (medium priority)

Within three years, and a research programme to study the ecology, status and distribution of all endemic and near-endemic animal taxa will be in place.

Short-term target 2 (medium priority)

Within five years, at least one viable population of each endemic and near-endemic animal taxon in Priority Landscape CA1 will be identified and under effective conservation management.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each endemic and near-endemic animal taxon.

4.3.9 Endemic and near-endemic plant taxa

In addition to endemic animal taxa, the Greater Truong Son support a large number of endemic and near-endemic plant taxa, including *Panax vietnamensis*, *Amentotaxus poilanei*, *Pinus dalatensis*, *Diplopanax vietnamensis* and *Bulbophyllum ngoclinhensis*. Many of these species have very restricted distributions, which makes them susceptible to habitat loss. This is, however, mitigated somewhat by the fact that many are found in montane habitats, where rates of habitat loss are relatively low. In order to ensure that the conservation landscape contains representative examples of each taxon, further surveys are required to better understand the distribution of these taxa, and to identify additional, as yet undiscovered, endemic taxa.

Short-term target 1 (medium priority)

Within five years, and a research programme to study the ecology, status and distribution of all endemic and near-endemic plant taxa will be in place.

Short-term target 2 (medium priority)

Within ten years, at least one viable population of each endemic and near-endemic plant taxon in Priority Landscape CA1 will be identified and under effective conservation management.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of each endemic and near-endemic plant taxon.

4.3.10 Taxa severely threatened by over-exploitation

This conservation focus comprises a heterogeneous selection of taxa, linked by a common threat: their continued survival in Priority Landscape CA1 is severely threatened by over-exploitation. For some of these taxa, conservation action will be required at levels higher than the site level, in order to secure their future. Turtles, lowland galliformes, wide-ranging large mammals, tiger, saola, 'Indochinese' hog deer, Siamese crocodile and some endemic and near-endemic animal taxa fall into this group but have also been considered as separate conservation foci as there are additional conservation issues that must be taken into account in each case. The first group threatened by over-exploitation comprises those that are in demand for the wild animal trade. This group includes pangolins, primates, bears, tiger, civets, cervid deer, wild cattle, Asian elephant, turtles, Tockay gecko and several species of snake. For some of these taxa, such as pangolins, the bulk of the demand comes from China, while, for taxa such as bears and Tockay gecko, domestic demand is also significant. For many taxa threatened by trade, it is the biggest threat to their survival in the priority landscape. A concerted programme of conservation action at the site, national and international levels is required to mitigate this threat.

Many taxa in this first group are threatened by snaring, which is very indiscriminate, and results in the capture of many other taxa with lower values and little international demand. Thus, the practice of snaring has potentially devastating consequences to the vertebrate ground fauna of a forest area, and needs to be addressed separately with its own specific targets and management actions.

The second group threatened by over-exploitation consists of plant species with high economic values. These include a number of medicinal plant species, such as *Aquilaria crassna*, which is the source of agarwood, and Ngoc Linh ginseng (*Panax vietnamensis*), which is used to produce a tonic. Both of these species are threatened with extinction in Priority Landscape CA1, as a result of over-exploitation. Specific action required to conserve medicinal plant species threatened by over-exploitation could include schemes to cultivate the species to provide an alternative source, such as is currently being implemented for Ngoc Linh ginseng.

Also included in this second group are timber species. Selective extraction of timber trees takes place in almost all forested areas in Priority Landscape CA1. However, a significant proportion of these trees are extracted to meet local demand for housing materials and tool manufacture, at levels that can be sustainable, and it is those species that are in demand from the commercial timber industry that are most seriously threatened by over-exploitation. In the priority landscape, these species include *Fokienia hodginsii*, *Erythrophleum fordii* and *Dalbergia cochinchinensis*.

Short-term target 1 (high priority)

Within five years, within priority 1 areas, NTFP exploitation will be reduced to levels where it no longer poses a threat to any animal or plant population.

Short-term target 2 (high priority)

Within seven years, within priority 1 areas, snaring will be reduced to levels where it no longer poses a threat to any animal population.

Short-term target 3 (high priority)

Within ten years, within priority 1 areas, hunting will be reduced to levels where it no longer poses a threat to any animal population.

Medium-term target 1 (high priority)

In 50 years time, hunting, trade, medicinal plant exploitation or timber extraction will not be a threat to any wildlife population within the priority area.

4.4 Taxa

4.4.1 Saola

Saola is a flagship species for Priority Landscape CA1, the Greater Truong Son and Indochina in general. Priority Landscape CA1 protects a significant proportion of the global population of this endangered species, which was one of only three mammal taxa confirmed to occur in the priority landscape to be assigned a priority score of 4. Although the ecology and habitat requirements of this species are still little understood, it is presumed to be threatened by habitat degradation and loss (particularly at lower elevations), hunting, indiscriminate snaring, and road construction (Robichaud 1997). While the habitat of saola (lowland forest in sub-landscape CA1a) is a conservation focus, the species should be the focus of specific conservation action to investigate its ecology and distribution, raise awareness of its importance and status, and develop and implement strategies to tackle hunting and snaring.

Priority Landscape CA1 is believed to support globally important populations of saola, a species only otherwise found within the Northern Truong Son. Although most work to date has concentrated on the latter area, it is possible that Priority Landscape CA1 might be equally important for the conservation of this species, even pivotal to its survival. The species' status remains enigmatic in all areas from which it is known, and there is no indication that it is numerous at any site.

Short-term target 1 (medium priority)

Within one year, at least 100,000 ha of habitat of high conservation importance below 1,200 m will be included within each priority 1 area where the species occurs.

Short-term target 2 (medium priority)

Within three years, there will be no hunting of saola within all priority 1 areas where the species occurs.

Short-term target 3 (medium priority)

Within three years, a research programme to study the ecology, status and distribution of saola will be in place.

Short-term target 4 (medium priority)

Within five years, all viable populations of saola within Priority Landscape CA1 will have been identified and included within priority 1 areas.

Medium-term target 1 (medium priority)

In 50 years time, there will be at least 100,000 ha of habitat of high conservation importance below 1,200 m within each contiguous block of priority 1 and priority 2 areas where saola occurs.

Medium-term target 2 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of saola.

4.4.2 Tiger

Tiger is another flagship taxon, although, unlike saola and ‘grey-shanked’ Douc langur, not one that is endemic to the Greater Truong Son. Tiger was assigned a priority score of 3.

Tiger is a potential keystone species, and its important ecological role means that, while larger populations exist elsewhere in South-East Asia, specific efforts must be made to maintain the population in Priority Landscape CA1. A major threat to tiger is hunting: both targeted, to supply the wild animal trade or in response to killing of livestock; and incidental, in pitfall traps set for wild pigs and other ungulates. Specific conservation action beyond habitat protection is required to mitigate this threat. A second major threat to tiger is habitat fragmentation, and this is covered under the conservation focus for wide-ranging large mammals.

Short-term target 1 (low priority)

Within one year, at least 50,000 ha of habitat of high conservation importance, including at least 20,000 ha below 1,200 m, will be included within each priority 1 area.

Short-term target 2 (low priority)

Within three years, there will be no hunting of tiger within all priority 1 areas where the species occurs.

Short-term target 3 (low priority)

Within five years, there will be no hunting of tiger within all priority 2 areas where the species occurs.

Medium-term target 1 (low priority)

In 50 years time, there will be at least 250,000 ha of habitat of high conservation importance, including at least 100,000 ha below 700 m, within each contiguous block of priority 1 and priority 2 areas where tiger occurs.

Medium-term target 2 (low priority)

In 50 years time, Priority Landscape CA1 will support a viable population of tiger.

4.4.3 'Indochinese' hog deer

The presence of this taxon in Priority Landscape CA1 is, as yet, unconfirmed. The taxon is associated with open habitats and lowland wetlands (Timmins and Duckworth unpublished), which are not well represented within the priority landscape. However, if a viable population were found, it would assume the highest priority for conservation, as the Indochinese race of hog deer is close to global extinction. The taxon was provisionally assigned a priority score of 4.

Immediate conservation priorities are surveys to locate remaining populations, and studies to understand the reasons for the taxon's current status and decline (Timmins and Duckworth unpublished). If a population were found, specific conservation measures might include protection, and, if feasible, restoration, of suitable habitat; conservation awareness; protected area extension/establishment; and development and implementation of strategies to control hunting.

Short-term target 1 (medium priority)

Within one year, the conservation status of 'Indochinese' hog deer within Priority Landscape CA1 will have been assessed, concentrating on the Kon Cha Rang-Kon Ka Kinh priority 1 area.

Short-term target 2 (medium priority)

Within two years, there will be no hunting of 'Indochinese' hog deer within all priority 1 areas where the taxon occurs.

Short-term target 3 (medium priority)

Within five years, all viable populations of 'Indochinese' hog deer within Priority Landscape CA1 will have been identified and included within priority 1 or priority 2 areas.

Medium-term target 1 (medium priority)

In 50 years time, Priority Landscape CA1 will support a viable population of 'Indochinese' hog deer, if it is currently extant in the priority landscape.

4.4.4 Siamese crocodile

As is the case with 'Indochinese' hog deer, the presence of this taxon in Priority Landscape CA1 is, as yet, unconfirmed. There are, however, provisional records of this species from the catchment of the Xe Kong river in sub-landscape CA1c (Salter 1993, Davidson *et al.* 1997, Showler *et al.* 1998). This critically endangered species is presumed to have undergone a drastic decline in Lao P.D.R. and Vietnam, as a result of habitat loss and over-exploitation (Duckworth *et al.* 1999, Platt and Ngo Van Tri 2000).

The priority action for this focal taxon is surveys to identify and evaluate remaining populations within Priority Landscape CA1. Should one or more viable populations be found, site-based conservation action could include conservation awareness programmes, development of strategies to tackle hunting, and community conservation initiatives. In addition, because trade in crocodile skins and live animals for stocking crocodile farms have been identified as major threats, measures would also need to be implemented to tackle trade.

Short-term target 1 (low priority)

Within three years, the conservation status of Siamese crocodile within Priority Landscape CA1 will have been assessed, concentrating on the upper catchments of the Xe Kong river.

Short-term target 2 (low priority)

Within five years, there will be no hunting of Siamese crocodile within all priority 1 areas where the species occurs.

Short-term target 3 (low priority)

Within ten years, all viable populations of Siamese crocodile within Priority Landscape CA1 will have been identified and included within priority 1 or priority 2 areas.

Medium-term target 1 (low priority)

In 50 years time, Priority Landscape CA1 will support a viable population of Siamese crocodile, if it is currently extant in the priority landscape.

4.5 Landscape features

4.5.1 Habitat corridors

Conservation of biodiversity in modified landscapes requires connectivity between patches of primary habitat, in order to maintain ecological processes, communities and populations. Habitat corridors are particularly important for the conservation of large, wide-ranging mammal species. However, although this is less well understood, they are probably also important for a wide range of other animal and plant taxa, particularly those that live at low densities or have low capacity to move through areas of secondary habitat.

Within Priority Landscape CA1, priority should be given to maintaining or creating three types of habitat corridor:

Habitat corridors within protected areas or other sites under conservation management.

Many protected areas in the priority landscape do not support contiguous areas of primary habitat but patches of primary forest, of greater or lesser connectivity, interspersed with areas of secondary habitat of varying degrees of disturbance. The management objectives of these protected areas should include, through the means of natural regeneration, consolidation of primary forest patches by connecting them and reducing edge-to-area ratios.

A number of protected areas in the priority landscape, most notably Ngoc Linh (Kon Tum) Nature Reserve, are bisected by roads. These sites are priorities for conservation action, which should focus on maintaining forest cover along the road, particularly through preventing human settlement.

Habitat corridors between protected areas or other sites under conservation management.

While many of the protected areas within Priority Landscape CA1 are not contiguous, they are often linked by forest corridors or areas with potential for habitat restoration. Maintaining and strengthening connectivity between protected areas is a key consideration for the conservation

landscape. Potential habitat corridors within the priority landscape include the following: the area between Kon Ka Kinh and Kon Cha Rang Nature Reserves, and the Kon Plong Forest Complex; the area between the Kon Plong Forest Complex and Ngoc Linh (Kon Tum) Nature Reserve; the area along the Vietnam-Lao P.D.R. border, between Song Thanh proposed nature reserve and Xe Sap NBCA; the "green corridor" between Xe Sap NBCA and Bach Ma National Park; and the area between Phong Dien proposed nature reserve and the "green corridor". The highest priority should be given to those potential habitat corridors that are bisected by an existing or planned road, particularly those where forest cover is still intact. Conservation action in these areas should concentrate on preventing human settlement along key stretches of road. Conservation action is also required for potential habitat corridors threatened by clearance for agriculture. Attempts should be made to ensuring that habitat corridors have continuous bands of forest at a range of elevations, because, for instance, a montane corridor is of little use to a lowland species.

When evaluating the potential of the above areas as habitat corridors, consideration should be given not only to existing forest corridors but also to areas with the potential for reforestation. In the context of Priority Landscape CA1, these include areas of scrub and grassland that are unused by local communities (i.e. excluding areas of fallow hill agriculture). Even where resources are not available or conditions not appropriate for immediate reforestation, these areas can be the focus of conservation action, such as seeking commitments from local authorities not to allow human settlement, agriculture or other activities that would preclude future reforestation within designated areas.

Habitat corridors between Priority Landscape CA1 and other priority landscapes.

In order to promote the long-term sustainability of the populations, communities and ecological processes of Priority Landscape CA1, consideration should be given to maintaining or creating habitat corridors with nearby priority landscapes. Priority should be given to assessing the potential for maintaining or creating habitat corridors in the following areas: across National Highway 19 between Quy Nhon and Plei Ku, which bisects the forest corridor between Priority Landscapes CA1 and SA1; and areas to the north and west of Dak Rong proposed nature reserve, which have the potential to link Priority Landscape CA1 with Survey Area NAS4.

In the context of the conservation landscape, it should be borne in mind that, in some case, the benefits of habitat corridors, in terms of increased capacity of animals to move through disturbed landscapes, greater opportunity for dispersal between isolated habitats and populations, and greater continuity of ecological processes, may be outweighed by the disadvantages, in terms of increased exposure of animals to predators, hunting or other threats, and reduced resources available for other conservation action (Bennett 1999). Therefore, the costs and benefits of maintaining or creating habitat corridors should be assessed on a case-by-case basis.

Medium-term target 1 (high priority)

In 50 years time, all blocks of habitat of high conservation importance greater than 10,000 ha in area within contiguous blocks of priority 1 and priority 2 areas will be linked by habitat corridors that allow the movement of all animal taxa occurring within the block.

4.5.2 Core areas

Because of edge effects and the requirement of some taxa for large areas of contiguous habitat, small areas of natural habitat, however well protected, are unable to support the full complement of taxa found in Priority Landscape CA1. Therefore, it is necessary to include within the conservation landscape a number of core areas: large areas of habitat, which provide the requirements of all taxa of that habitat. Although the requirement of large, wide-ranging mammals for large areas of contiguous habitat has been considered under a separate conservation focus, it will be necessary to include additional core areas within the conservation landscape, in order to represent the full range of major habitat types and taxa therein.

Short-term target 1 (high priority)

Within one year, at least 100,000 ha of habitat of high conservation importance below 300 m, 150,000 ha of habitat of high conservation importance between 300 and 700 m, 250,000 ha of habitat of high conservation importance between 700 and 1,200 m, 100,000 ha of habitat of high conservation importance between 1,200 and 1,500 m and 50,000 ha of habitat of high conservation importance above 1,500 m will be included within priority 1 areas.

Short-term target 2 (high priority)

Within five years, the conservation landscape will be refined by the identification and inclusion of additional priority 1 areas necessary to ensure the conservation of all priority taxa.

4.5.3 Ecological transitions

Ecological transitions refer to continuums of natural habitat types across ecological gradients, such as altitude, latitude or rainfall. Ecological transitions may involve transitions between different habitats, communities or taxa. Examples of ecological transitions in Priority Landscape CA1 include the continuum of natural forest between c.150 and 2,598 m at Ngoc Linh (Quang Nam) proposed nature reserve (Tordoff *et al.* 2000), and the continuous transect of natural forest between the main Annamite chain and the coast at the Hai Van pass.

Ecological transitions are particularly important for the conservation of species that make seasonal movements, for example altitudinal migratory bird species (Powell and Bjork 1994). For most taxa, however, these movements are poorly understood. Furthermore, in the long term, climate change may result in changes in the distribution of habitats within Priority Landscape CA1. Communities confined to isolated areas of a single habitat are more susceptible to the potential effects of habitat change than communities inhabiting areas with a transition of habitats, which are better able to 'track' changes in habitat distribution. Therefore, wherever possible, ecological transitions should be incorporated within the conservation landscape.

Short-term target 1 (high priority)

Within one year, each priority 1 area will support at least 5,000 ha of habitat of high conservation importance below 300 m, 5,000 ha of habitat of high conservation importance between 300 and 700 m, 10,000 ha of habitat of high conservation importance between 700 and 1,500 m, and 1,000 ha of habitat of high conservation importance above 1,500 m.

Medium-term target 1 (high priority)

In 50 years time, each contiguous block of priority 1 and priority 2 areas will support at least 50,000 ha of habitat of high conservation importance below 300 m, 50,000 ha of habitat of high conservation importance between 300 and 700 m, 100,000 ha of habitat of high conservation importance between 700 and 1,500 m, and 2,500 ha of habitat of high conservation importance above 1,500 m.

Medium-term target 2 (high priority)

In 50 years time, all blocks of habitat of high conservation importance greater than 10,000 ha in area within contiguous blocks of priority 1 and priority 2 areas will be linked by habitat corridors sufficient to maintain all biological processes occurring within the block.

4.6 Non-focal targets

In addition to the biological targets set for the conservation foci, a number of non-focal targets were set, to cover any measures that were considered to be essential to conserving the full complement of biodiversity and biological processes within Priority Landscape CA1 but were not adequately addressed by the targets set for the conservation foci.

Short-term target 1 (high priority)

Within one year, a mechanism will be in place to review the conservation landscape annually and introduce modifications where necessary.

Short-term target 2 (high priority)

Within one year, a monitoring and evaluation strategy for each biological target will be developed and put into effect.

Short-term target 3 (high priority)

Within two years, an appropriate methodology will be developed and implemented to monitor forest cover; wildlife (gibbons, crested argus, muntjacs, otters, large hornbills and selected fish species) populations; and disturbance (trap density, cut trees, campsites and forest fire) in each priority 1 area. This methodology will be applicable by staff with relatively low capacity, yet be robust and have good resolution for determining major changes. The methodology will be field tested, and peer reviewed by national and international scientists prior to adoption.

Short-term target 4 (high priority)

Within ten years, graduate and post-graduate courses will be established at one or more national universities, working collaboratively with international institutions, on the biodiversity and ecology of the Central Truong Son Landscape, with the aim of providing peer review of conservation projects, assistance with monitoring and evaluation, and further research into the biodiversity and ecological aspects of the landscape.

Short-term target 5 (high priority)

Within ten years, the management board of each protected area in Priority Landscape will have at least one member of scientific staff, who is supported by active links to academic institutions; and each protected area will have facilities to support field research.

PART V: MAPPING THE CONSERVATION FOCI

The third stage of the biological assessment process was to map the distribution of the conservation foci within the priority landscape. Four of the conservation foci were terrestrial forest habitats. Different data sets were used to map the distribution of these habitats in Vietnam and Lao P.D.R.. For Vietnam, 1999 land-cover data, collected by ground survey under the National Forest Statistics Programme of MARD, were used. For Lao P.D.R., 1997 land-cover data, derived from Landsat TM5 satellite images by the Forest Cover Monitoring Project of the Mekong River Commission/GTZ, were used. The land-cover data sets for Vietnam and Lao P.D.R. were available as vector coverages, which were then converted to raster format. Based on the personal experiences of the authors, these land-cover data sets were considered to be relatively accurate at the larger scale, compared with several other land-cover data sets in existence. It is acknowledged, however, that there may be inaccuracies at the smaller scale.

Table 3: Reclassification of land-cover categories for Vietnam into habitat categories

Land-cover category	Habitat category
Rich broadleaf evergreen forest	High conservation importance
Medium broadleaf evergreen forest	High conservation importance
Poor broadleaf evergreen forest	High conservation importance
Regenerating forest (closed canopy)	High conservation importance
Young forest (open canopy)	Medium conservation importance
Deciduous forest	High conservation importance
Semi-deciduous forest	High conservation importance
Bamboo forest	Medium conservation importance
Mixed broadleaf and bamboo forest	High conservation importance
Plantation forest	Low conservation importance
Scrub and grassland	Medium conservation importance
Rock outcrops	High conservation importance
Agricultural land and human settlement	Low conservation importance
Water bodies	Low conservation importance

Table 4: Reclassification of land-cover categories for Lao P.D.R. into habitat categories

Land-cover category	Habitat category
Rich forest	High conservation importance
Medium forest	High conservation importance
Forest mosaic	Medium conservation importance
Regrowth (includes some stunted forest)	Medium conservation importance
Wood and shrubland (includes bamboo)	Medium conservation importance
Grassland	Medium conservation importance
Mosaic of cropping (includes shifting cultivation)	Low conservation importance
Agricultural land	Low conservation importance
Urban / built-over areas	Low conservation importance
Water bodies / flooded areas	Low conservation importance
Rock outcrops	High conservation importance
Others	Low conservation importance

It was not considered appropriate to use the unmodified land-cover classifications for Vietnam and Lao P.D.R. to map the distribution of terrestrial forest habitats. This was because the large numbers of categories in the original classification were considered to be a hinderance to definition of a landscape at the large scale. In addition, the Lao and Vietnamese classifications were not compatible, and there was concern that not all categories in the Vietnamese classification were mutually exclusive. Finally, certain habitats classified as forest (e.g., plantation and bamboo forest) were considered to have lower biodiversity value and, therefore, to be of lower conservation importance, than other habitats classified as forest (for example rich broadleaf forest). Consequently, the land-cover categories for Vietnam and Lao P.D.R. were reclassified according to their importance for conserving biodiversity (Tables 3 and 4).

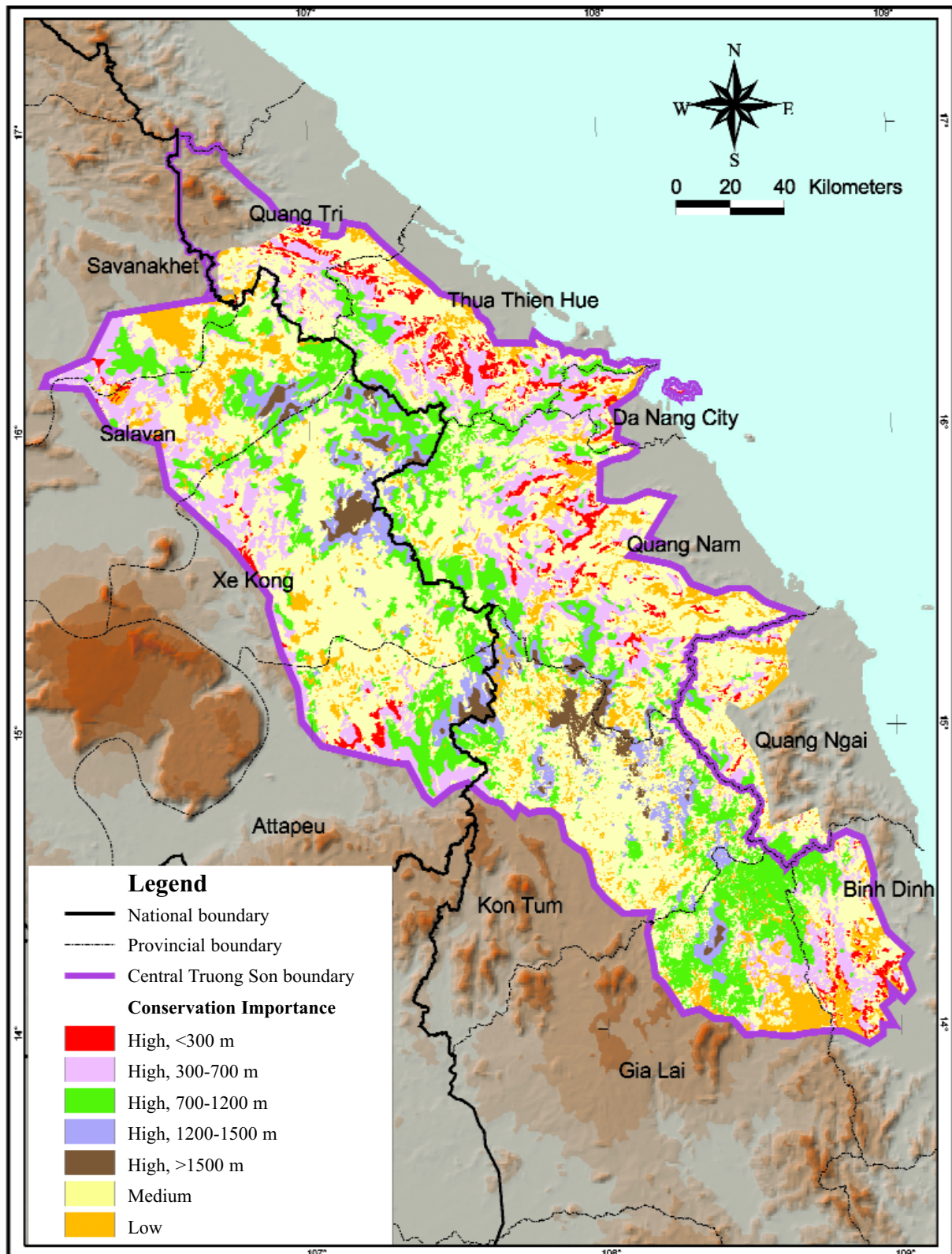
In order to distinguish habitats in different elevation zones, the habitat coverage was then overlaid on a Digital Elevation Model (DEM), which was derived from a GTOPO30 data set provided by the Eros Data Centre. The 1 km resolution of these data was increased to a 100 m resolution, using the bilinear option in the RESAMPLE module of Idrisi, and the DEM was reclassified into five elevation classes: 0-300 m, 300-700 m, 700-1,200 m, 1,200-1,500 m and >1,500 m (Map 3).

Three of the focal habitats identified during the first stage of the biological assessment were aquatic habitats. Maps of the distribution of these habitats were based on existing vector coverages of river systems in Lao P.D.R. and Vietnam. The coverage for Vietnam was obtained by digitising 1:100,000 scale topographical maps, while the one for Lao P.D.R. was obtained from the ADB Mekong Project. A comparison of the two coverages revealed that the coverage for Vietnam was more detailed than the one for Lao P.D.R., in terms of the proportion of the river system plotted. Consequently, the figures calculated during the analysis for lengths of rivers in Lao P.D.R. are likely to be underestimates of the actual lengths.

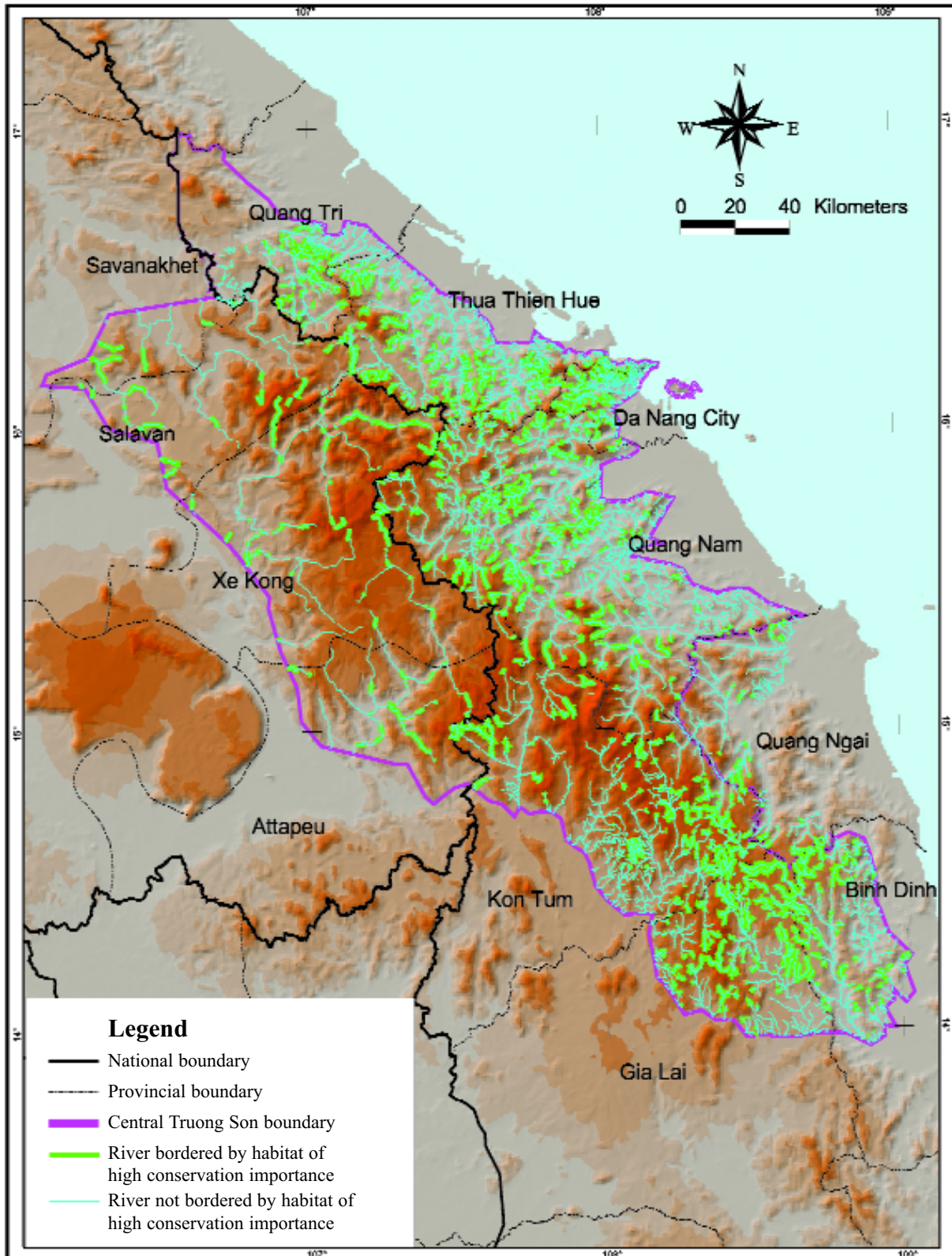
Action to conserve aquatic biodiversity needs to focus on individual catchments, since they are the major units of ecological and evolutionary processes. Therefore, individual catchments were distinguished by plotting the watershed of each catchment based on 1:250,000 scale topographical maps. Due to data limitations, it was not possible to distinguish middle reaches of main rivers from headwaters. In addition, because of very limited data on the location of major sets of rapids within the priority landscape, it was not possible to map this focal habitat completely. However, a preliminary map was produced, based on 1:250,000 scale topographical maps, combined with knowledge of scientists familiar with the area.

In the absence of detailed data on the biodiversity value of individual stretches of river, stretches bordered by habitat of high conservation importance were considered to have higher biodiversity value than stretches bordered by habitat of medium or low conservation importance, and this was the only criterion used to define conservation importance of aquatic habitat when designing the conservation landscape. Therefore, the river systems coverage was overlaid by the habitat coverage in order to identify stretches of river bordered on both sides by habitat of high conservation importance. It must be noted that, because the two coverages were not precisely aligned, there are likely to be inaccuracies in the figures calculated for lengths of river bordered by habitat of high conservation importance during the process to design the conservation landscape (Map 4).

Mapping the focal taxa and groups proved problematic, primarily because of limited availability and accuracy of data on taxa distributions within the priority landscape. For no plant or animal taxon in the priority landscape has survey coverage been sufficient to map its distribution with even a 75% accuracy. For many taxa, there are only one or two records from



Map 3 - Distribution of habitat of high conservation importance by elevation zone in Priority Landscape CA1



Map 4 - Stretches of river bordered by habitat of high conservation importance in Priority Landscape CA1

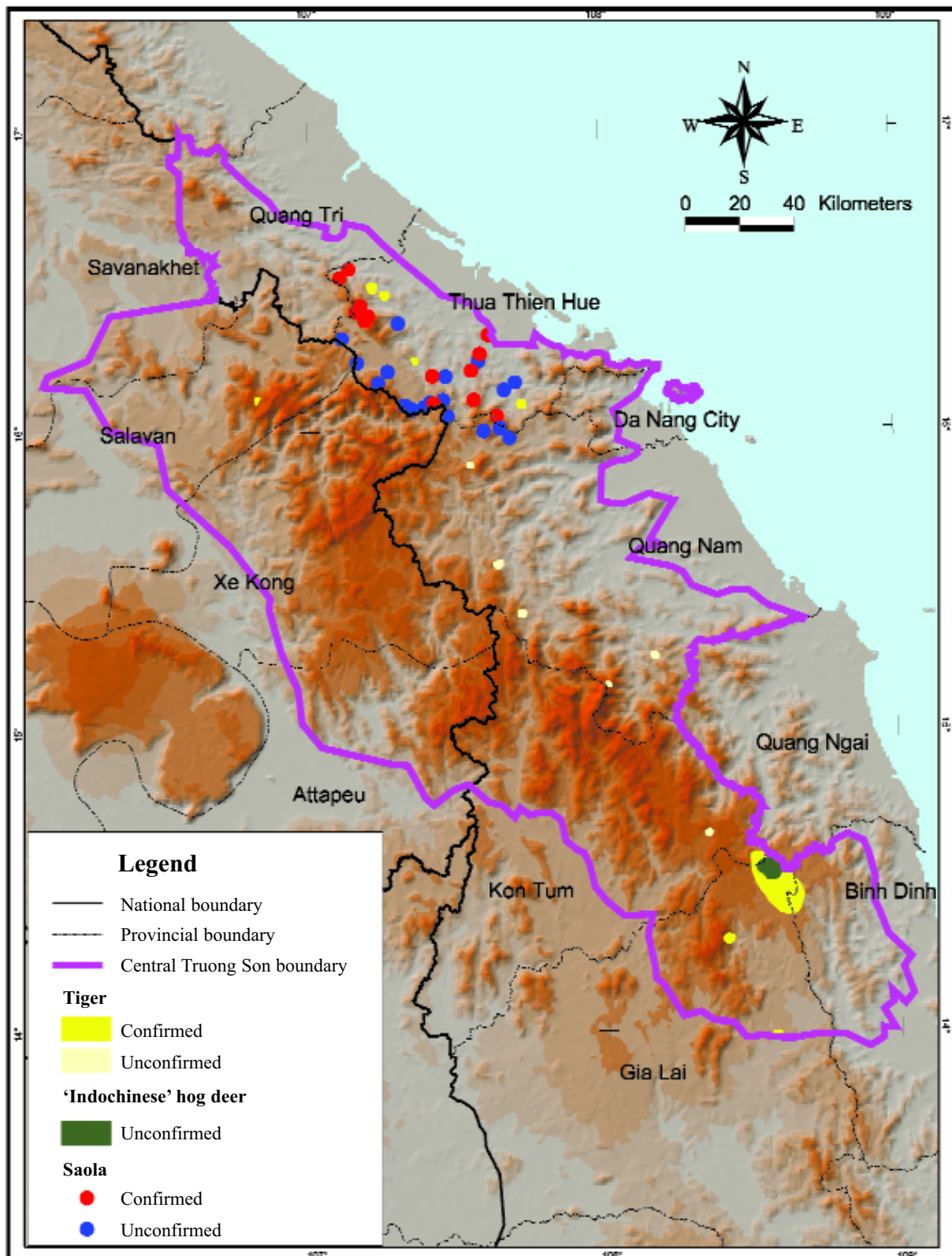
the priority landscape, yet many of these may be widespread and, in some cases, numerous within the priority landscape. Consequently, it was decided that the distributions of the majority of taxa were either impossible to predict, or, in the absence of direct distributional data, predictable only by the use of other factors, such as elevation, biogeographical unit, topography, habitat type and level of human impact.

For a few taxa, an attempt was made to plot distribution data. It must be borne in mind, however, that there are still many limitations to these data, and that they represent only current knowledge, not a taxon's full distribution. In addition, as there was insufficient time to carefully collate all existing data, the taxa distribution maps produced represent only preliminary interpretations. In particular, no attempt was made to map differences in population density, habitat suitability or probability of population/taxon extinction at different localities.

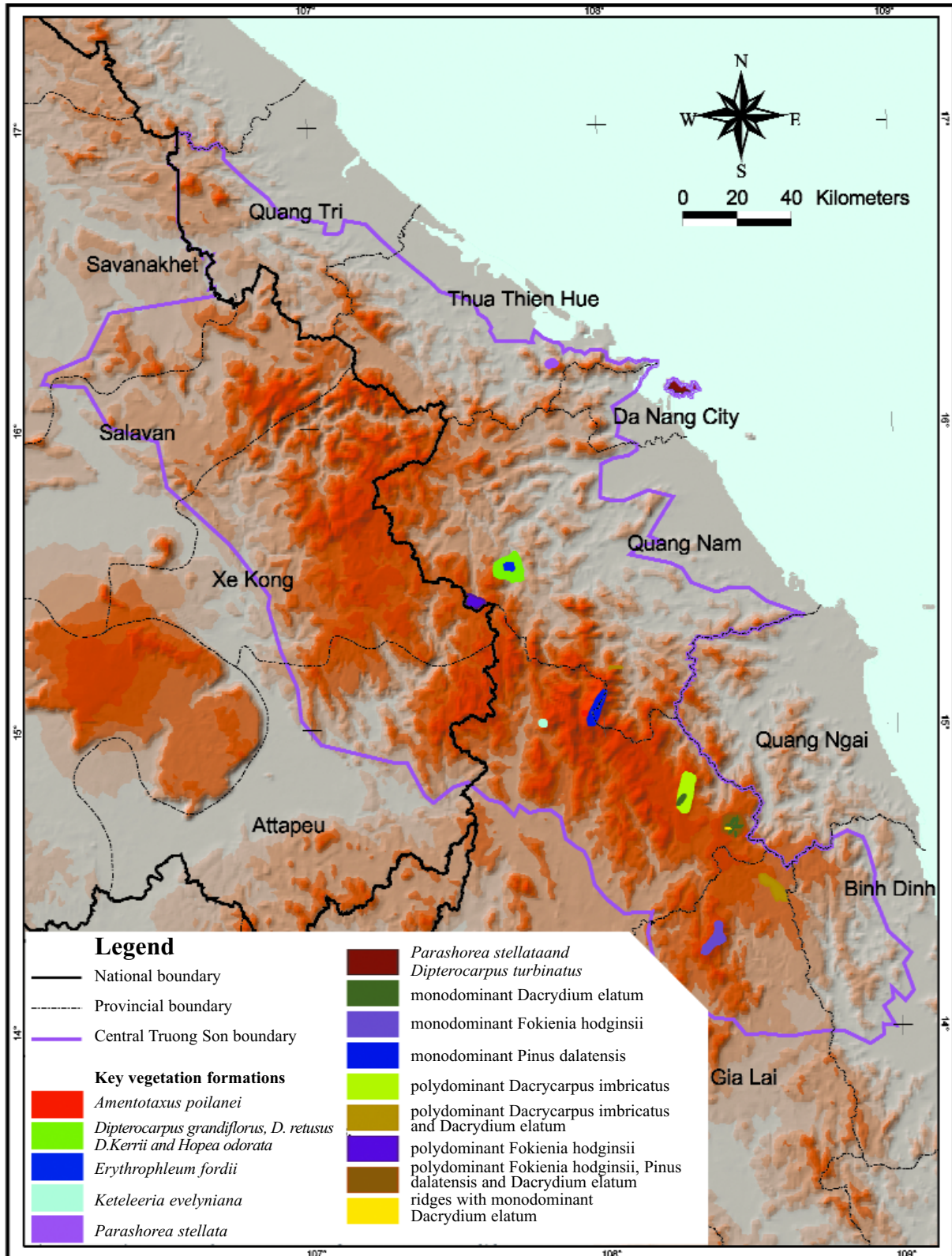
Four of the conservation foci defined during the first stage of the biological assessment were individual taxa. The distributions of three of these taxa (saola (*Pseudoryx nghetinhensis*), tiger (*Panthera tigris*) and 'Indochinese' hog deer (*Axis porcinus annamiticus*)) were marked on topographical maps, and this information was then captured digitally, using on-screen digitising, to produce vector coverages for each taxon. Data on the distribution of these taxa were collated from published and unpublished literature and consultations with members of the Vietnamese biological advisory group. For each taxon, both recent, confirmed records and unconfirmed records were shown (Map 5). Due to the lack of recent records within Priority Landscape CA1, it was not possible to map the distribution of the fourth focal taxon, Siamese crocodile (*Crocodylus siamensis*). Furthermore, there was not sufficient time to compile all existing data on the first two taxa, and only provisional maps were produced.

Ten of the conservation foci defined during the first stage of the biological assessment were groups. Seven of these groups, comprising wide-ranging large mammals, all primates, lowland galliformes, eels in the genus *Anguilla*, commercially valuable catfish, endemic and near-endemic animal taxa, and endemic and near-endemic plant taxa, were mapped in the same way as the focal taxa above. All of these groups, however, contained taxa that are distributed in suitable habitat throughout Priority Landscape CA1. It was not considered necessary to map these taxa, as their distributions could be predicted based on habitat alone. For taxa with distributions that could not be predicted based on habitat alone, provisional maps were made, showing those distribution data that could be collated within the time available. In the case of endemic and near-endemic plant taxa, vegetation formations with a restricted distribution within the priority landscape were mapped in addition to individual taxa (Map 6).

For the three remaining focal groups (all turtle species; large, congregatory bird species; and taxa threatened by over-exploitation), it was not considered appropriate to map the distributions of individual taxa within these groups, in some cases, because there were insufficient data available, and, in other cases, because taxa were distributed in suitable habitat throughout the priority landscape. Because all of the taxa within these three focal groups are susceptible to human disturbance, in the form of either over-exploitation or habitat degradation and loss, their relative densities can be considered to be directly correlated with distance from human settlement and distance from the edge of habitat of high conservation importance. Consequently, for these conservation foci, these two factors were mapped as partial surrogates, on the basis that areas of habitat of high conservation importance far from human settlement or the habitat edge could be expected to support higher densities of many taxa in these groups, taking into account differences in habitat/altitude utilisation, than areas close to human settlement or the habitat edge. It should be noted that these surrogate factors are useful not only for predicting the distribution of the three focal groups but also for predicting the distribution of intact biological communities and viable populations of other taxa susceptible to disturbance.



Map 5 - Confirmed and unconfirmed records of Saola, Tiger and 'Indochinese' hog deer in Priority Landscape CA1

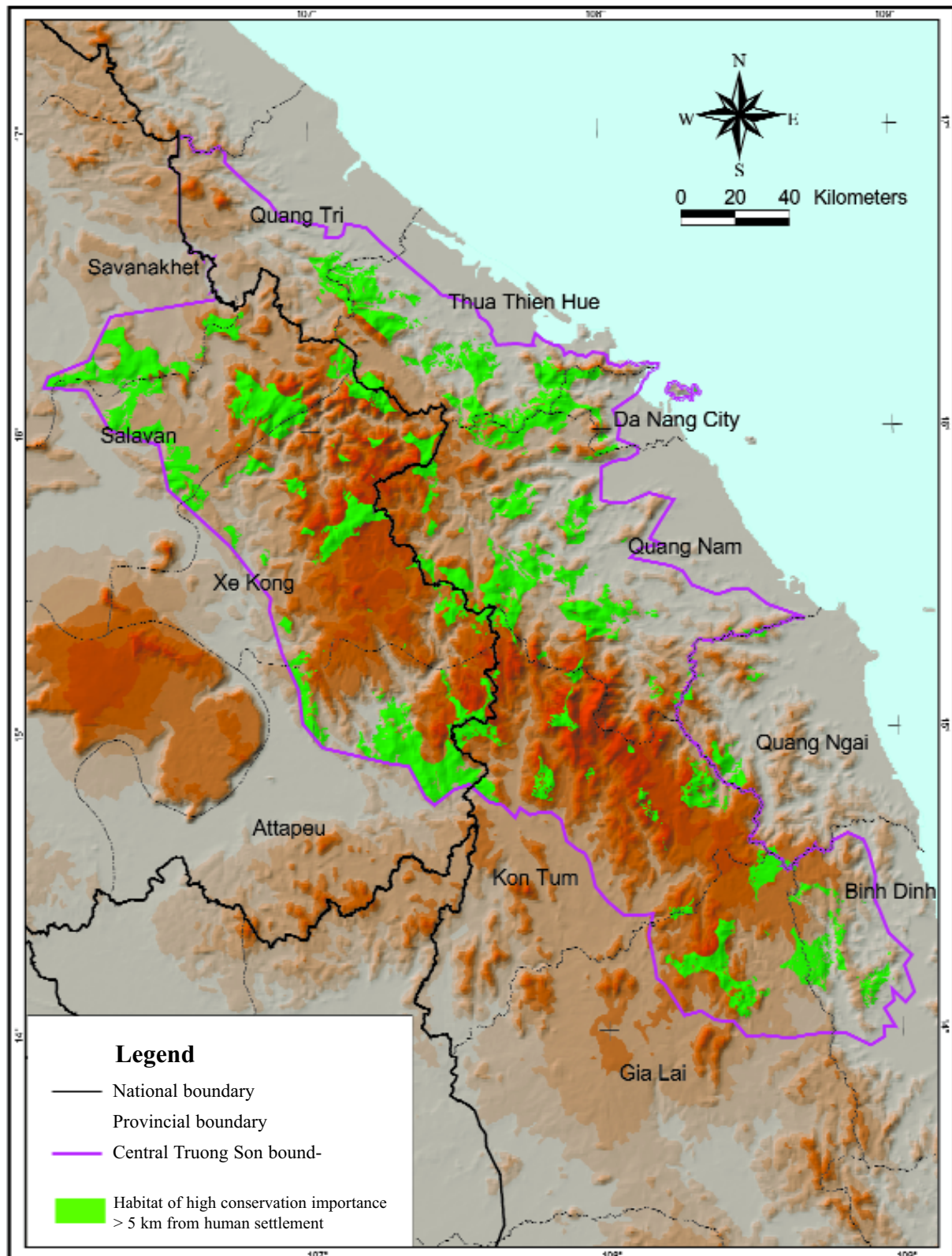


Map 6 - The distribution of key vegetation in Priority Landscape CA1

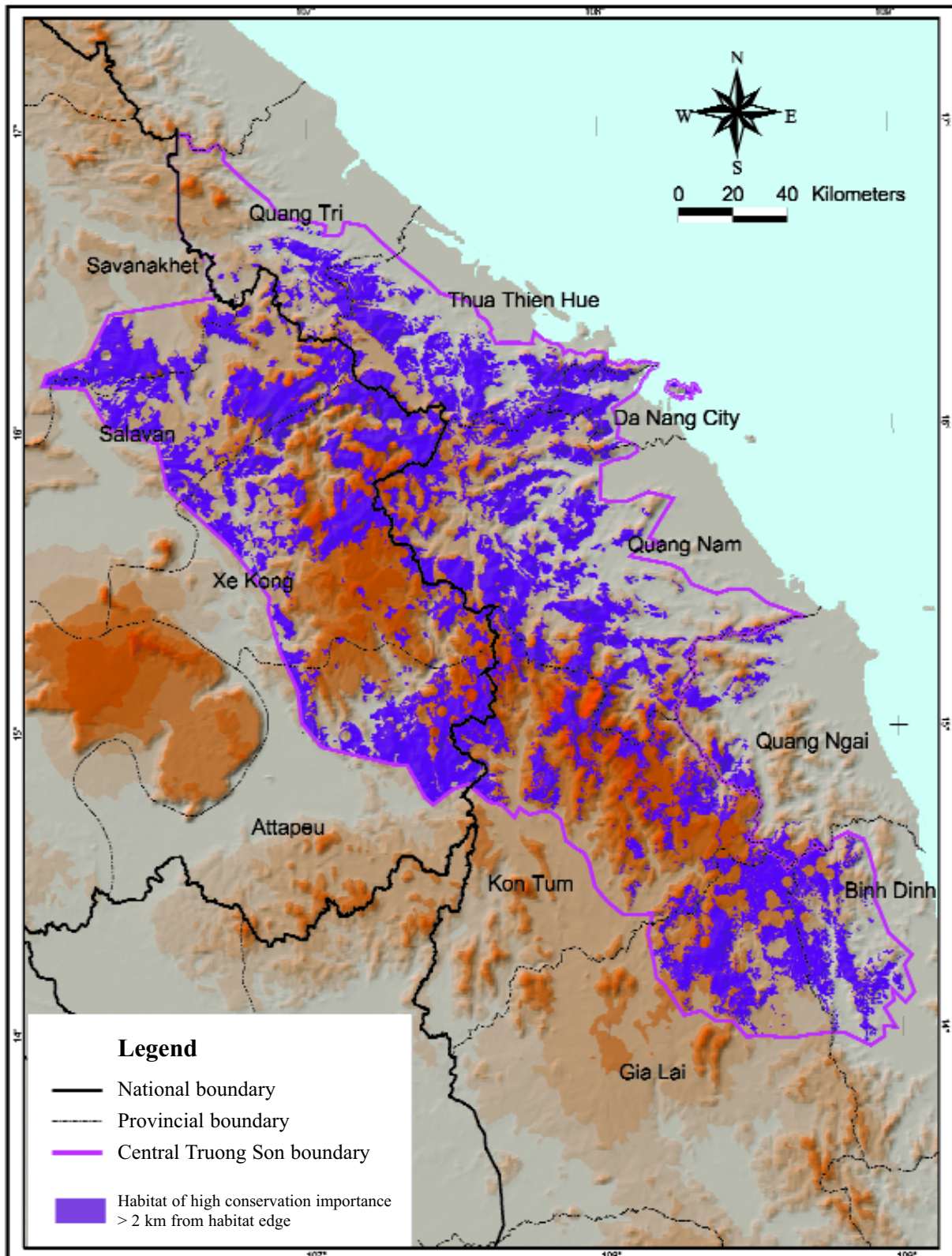
In order to map the first surrogate factor, human settlement data for Vietnam and Lao P.D.R. were used. For Vietnam, these data were provided by the National Institute of Agricultural Planning and Projection, while, for Lao P.D.R., they were obtained from the ADB Mekong Project. Unfortunately, the method of collection and resolution of these data were not available to the authors. In addition, data on human population density was not available at a fine enough resolution to predict the health of wildlife populations in specific areas. Furthermore, it is probable that some human settlements were missing from the data sets and that others were located inaccurately. However, it was considered, by scientists with prior knowledge of the area, that the data gave a relatively accurate view of the broad patterns of human distribution, particularly the main population centres.

The human settlement coverages for Vietnam and Lao P.D.R. were converted into raster format and then combined to produce a distance from human settlement coverage. This was then reclassified to produce a Boolean coverage, where all areas further than 5 km from human settlement were given a value of 1 and the rest given a value of 0. This was then multiplied by the land-cover coverage and reclassified to show only areas of habitat of high conservation importance that were further than 5 km from human settlement (Map 7). The same method was then used to produce an additional coverage for areas of habitat of high conservation importance that were further than 2 km from human settlement.

In order to map the second surrogate factor, the land-cover coverage was reclassified to only show areas of habitat of high conservation importance, and this was converted to vector format using the POLYVEC module of Idrisi. The vector coverage was then imported into ArcView and the Buffer function was used to produce polygons that showed all areas of habitat of high conservation importance more than 2 km from the edge of the habitat patch (Map 8). In this analysis, there were obvious problems with incomparability of data sets. In particular, the land-cover data for Lao P.D.R. appeared to be at a coarser scale than the majority of the data for Vietnam. In general, it was felt that the habitat edge was mapped with a higher level of detail in the data for Vietnam, and, thus, that the areas of habitat of high conservation importance further than 2 km from the edge of the habitat patch would be smaller. A particular problem was the presence of small enclosures of habitat of medium or low conservation importance within large blocks of habitat of high conservation importance. These small enclosures were only present in certain parts of the priority landscape, particularly in Gia Lai province, Vietnam. In an attempt to make the data more uniform, small enclosures of less than 100 ha in area were not buffered.



Map 7 - Habitat of high conservation importance further than 5 km from human settlement in Priority Landscape CA1



Map 8 - Habitat of high conservation importance further than 2 km from the habitat edge in Priority Landscape CA1

PART VI: DESIGNING THE CONSERVATION LANDSCAPE

6.1 Introduction

After the conservation foci for Priority Landscape CA1 had been defined and mapped, and biological targets had been set, the final stage of the biological assessment was to design the conservation landscape: the final part of the biological vision.

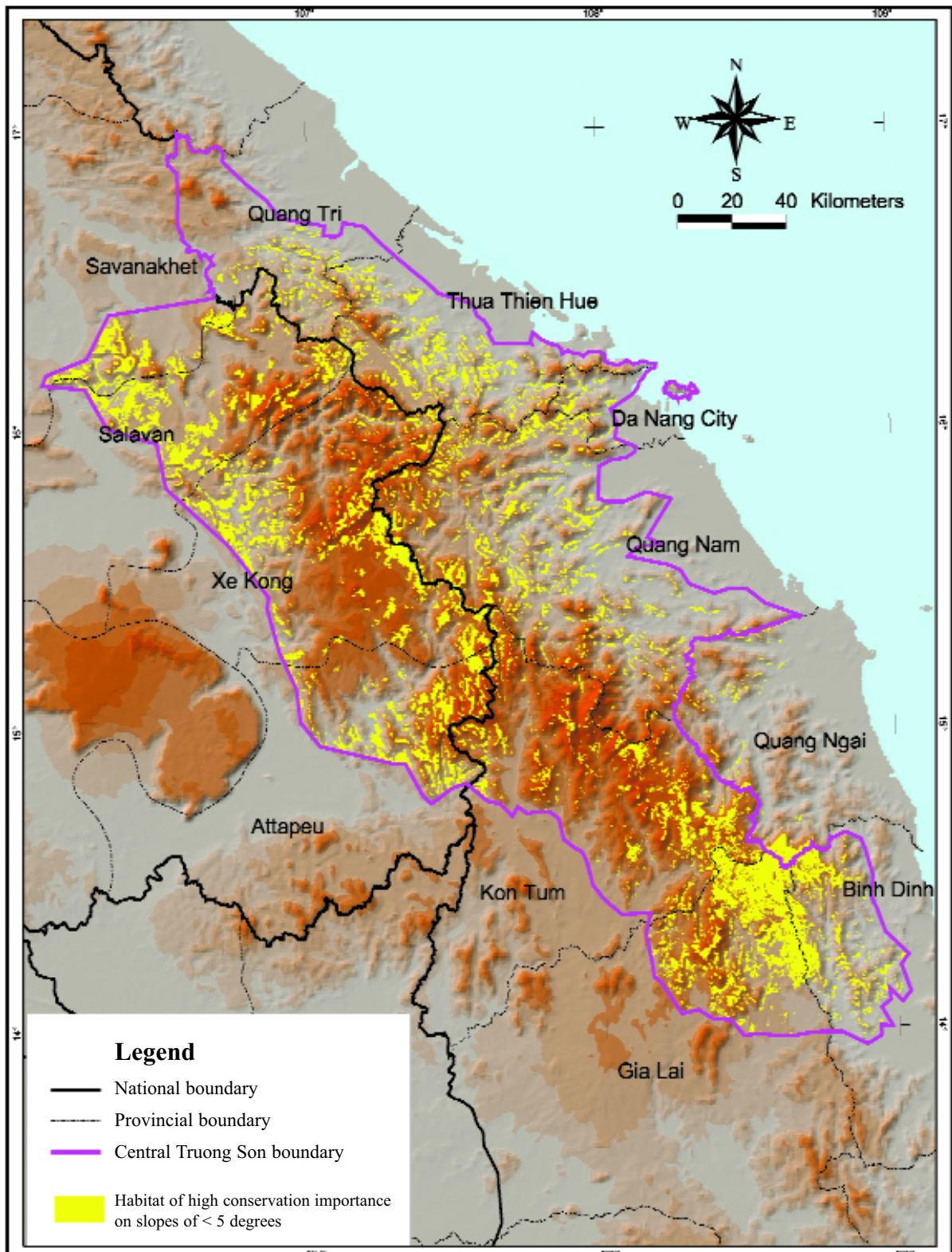
6.1.1 Ensuring representation

In order to ensure that the full range of biodiversity present in the priority landscape was represented in the conservation landscape, it was necessary for all taxa, communities and habitats to be adequately represented. During stage three of the biological assessment, focal habitats were mapped. In order to adequately conserve each focal habitat, however, it was necessary to account for variation within them with regard to community composition. Therefore, GIS coverages were created for the major factors determining the composition of biological communities. Although the major determinants of biological communities (land-cover and elevation) had already been mapped during stage three of the biological assessment, two additional determinants were mapped at this stage: gradient and biogeographical unit.

The distributions of certain vegetation formations are restricted to areas of low gradient, while those of certain others are restricted to areas of high gradient. By implication, the distributions of communities associated with these vegetation formations are also correlated with gradient. Similarly, the distributions of aquatic communities are also correlated with gradient, because steep, fast-flowing stretches of river support different communities than low-gradient, slow-flowing stretches. Therefore, in order to represent the full range of communities within each habitat type, it is necessary to include representative examples of areas of each gradient. Because areas of low gradient are typically the most suitable for cultivation and concentrated at lower elevations, habitats of high conservation importance are most likely to have been lost from these areas. Attention was, thus, given to adequately representing remaining areas of habitat of high conservation importance on low gradients.

In order to create a GIS coverage for low gradient areas, the DEM was used to produce a slope map, which was then reclassified to identify those areas where the slope was less than 5°. This was then combined with the land-cover coverage, using the OVERLAY module of Idrisi, to produce a coverage that only showed areas of high conservation importance on slopes less than 5° (Map 9). The process was then repeated to produce a coverage for areas of high conservation importance on slopes less than 2°.

Many taxa are distributed in areas of suitable habitat throughout Priority Landscape CA1. As a result of variation in aspect, climate, latitude or other factors, however, a number of taxa are restricted to part of the priority landscape. The first major biogeographical boundary within Priority Landscape CA1 is formed by the Hai Van pass. A number of taxa, such as Edwards' pheasant (*Lophura edwardsi*), appear to be largely or fully restricted to areas north of the Hai Van pass, while other taxa, such as great-eared nightjar (*Eurostopodus macrotis*) and wire-tailed swallow (*Hirundo smithii*), appear to be largely or fully restricted to areas to the south. The second biogeographical boundary within Priority Landscape CA1 is formed by the main ridge of the Annamite chain, which, in large part, forms the border between Vietnam and Lao P.D.R..



Map 9 - Habitat of high conservation importance on slopes of less than 5 degrees in Priority Landscape CA1

Areas on the western flanks of the Annamite chain are sheltered from the north-eastern monsoon, and tend, therefore, to be drier than areas on the eastern flanks. This may partly explain why the distributions of a number of endemic and near-endemic animal taxa, such as saola and crested argus (*Rheinardia ocellata*), appear to be largely restricted to the eastern flanks of the Annamite chain in Priority Landscape CA1. Although the main Annamite chain runs away from the Vietnam-Lao P.D.R. border in northern Kon Tum province, so little is known of the affinities and communities of the western flanks of the Annamite chain in the Vietnamese component of the priority landscape that it was decided that, for the purposes of the biological assessment, the political boundary would provide a more useful division. In fact, the international border in this southern section does follow a secondary Annamite ridge, which is likely to form a significant biogeographical boundary.

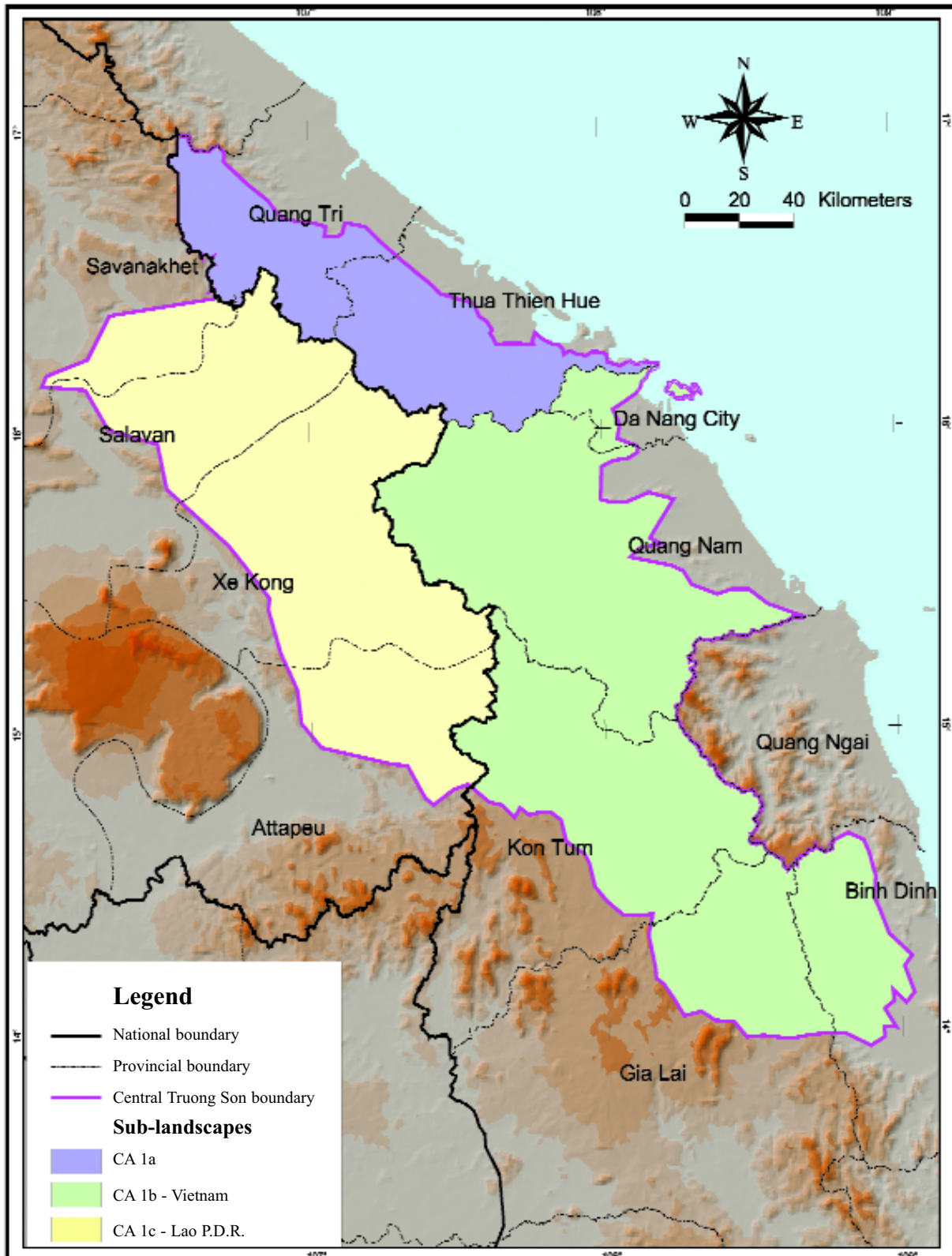
For the purposes of the biological assessment, therefore, priority landscape CA1 was divided, along the Hai Van pass and the Vietnam-Lao P.D.R. border, into three sub-landscapes (Map 10). In order to account for biogeographical variation in the composition of biological communities, it was necessary to equitably represent all three sub-landscapes within the conservation landscape.

6.1.2 Zoning the conservation landscape into areas of different conservation priority

In order for the objectives of a conservation landscape to be met, the highest priority is to ensure the integrity of core areas that can support the full range of biodiversity and biological processes within the priority landscape in the short term (5-10 years). The second priority is to ensure the integrity of a network of natural areas that can support the full range of biodiversity and biological processes in the medium term (10-50 years). The third priority is to ensure connectivity between the priority landscape and neighbouring priority landscapes, in order to support the full range of biodiversity and biological processes in the long term (50-200 years). To this end, the conservation landscape was zoned into priority 1 areas, the conservation of all of which could potentially support the full range of biodiversity and biological processes in the short term; priority 2 areas, the conservation of all of which, together with that of all priority 1 areas, could potentially support the full range of biodiversity and biological processes in the medium term; and priority 3 areas, the conservation of all of which, together with that of all priority 1 and priority 2 areas, could potentially make a significant contribution to the long-term conservation of the full range of biodiversity and biological processes in the landscape.

6.1.3 Setting quantitative goals

The next step was to set quantitative goals for the conservation landscape, in order to support the full range of biodiversity and biological processes within the priority landscape in the short, medium and long term. The first step towards this was to explore ideas of minimum areas required to support viable populations. Due to time constraints, there was no time to review relevant international literature, which is very substantial and very complex, or to hold consultations with authorities in this field. Furthermore, there are essentially no data originating from either Lao P.D.R. or Vietnam pertaining directly to minimum area requirements, viable area and population estimation, temporal population/community modelling, resource partitioning, and other related factors inherently essential to indefinite support of biodiversity. Instead, a conservative view relevant to the situation in Priority Landscape CA1 was agreed upon by the participants in the process. Looking back to interpret how biodiversity has persisted to the present was the primary tool used to predict the best way to conserve biodiversity in the future. While this method is likely to provide reasonable resolution for sustaining biodiversity in the short term, it becomes progressively less



Map 10 - The three major biogeographical units of Priority Landscape CA1

appropriate for longer-term planning. Consequently, further review and redesign of the conservation landscape where necessary should be an integral part of the process to conserve Priority Landscape CA1.

The quantitative goals for the conservation landscape were based upon the biological targets set for the conservation foci during stage two of the biological assessment. Predicting minimum area requirements for taxa is, however, a difficult and evolving science, and considerable uncertainty shadows any landscape designed to conserve the full range of biodiversity and biological processes. Because of this limitation, a cautious, conservative approach was followed in setting the quantitative goals for the conservation landscape.

For terrestrial focal habitats, four sets of goals were set. The first set specified the minimum area of habitat of high conservation importance within each elevation zone for inclusion within an individual priority 1 area. The second set specified the minimum area of habitat of high conservation importance within each elevation zone for inclusion within the whole network of priority 1 areas. The third set specified the minimum area of habitat of high conservation importance within each elevation zone for inclusion within a single contiguous block of priority 1 and priority 2 areas. The fourth set specified the minimum area of habitat of high conservation importance within each elevation zone for inclusion within the whole network of priority 1 and priority 2 areas (Table 5). The first and third sets of goals were based on the principal that, wherever possible, each priority 1 area and each contiguous block of priority 1 and priority 2 areas should support representative examples of habitat of high conservation importance within each elevation zone, in order to support the full range of terrestrial forest habitats and associated communities in that area, and to maintain ecological transitions and other biological processes.

Table 5: Goals for the minimum area of habitat of high conservation importance to be included within each elevation zone

Elevation zone (m)	Priority 1 area (ha)		Priority 1 and 2 areas (ha)	
	Individual area	Whole network	Individual block	Whole network
0-300	5,000	100,000	50,000	150,000
300-700	5,000	150,000	50,000	250,000
700-1,200	10,000 combined	250,000	100,000	400,000
1,200-1,500		100,000	combined	200,000
>1,500	1,000	50,000	2,500	100,000

When meeting the third and fourth sets of goals, priority was given to habitat restoration within priority areas over definition of additional areas. The advantages of this approach are that it maximises the integrity of contiguous blocks of priority areas while minimising the size of the conservation landscape. For the purposes of this analysis, habitat of medium conservation importance was considered to have potential for rehabilitation into habitat of high conservation importance, whereas habitat of low conservation importance was not. Therefore, both habitat of high conservation importance and habitat of medium conservation importance automatically contributed to meeting the third and fourth sets of goals.

In order to account for biogeographical variation in the composition of biological communities within Priority Landscape CA1, the goals for the minimum area of habitat of high conservation importance to be included within the whole network of priority 1 areas and the whole network of priority 1 and priority 2 areas were broken down by biogeographical unit (Table 6). Goals were not set for habitat of high conservation importance below 700 m in sub-landscape CA1c,

Table 6: Goals for the minimum area of habitat of high conservation importance to be included within each elevation zone within each biogeographical unit

Network	Elevation zone (m)	Sub-landscape CA1a (ha)	Sub-landscape CA1b (ha)	Sub-landscape CA1c (ha)
Priority 1 areas	0-300	50,000	50,000	0
	300-700	75,000	75,000	0
	700-1,200	25,000	125,000	100,000
	1,200-1,500	4,000	50,000	46,000
	>1,500	0	25,000	25,000
Priority 1 and priority 2 areas	0-300	75,000	75,000	0
	300-700	100,000	150,000	0
	700-1,200	40,000	200,000	160,000
	1,200-1,500	4,000	105,000	91,000
	>1,500	0	55,000	45,000

because this habitat was considered to have a significant semi-evergreen component, and, therefore, to be unrepresentative of Priority Landscape CA1, the habitats of which are predominantly evergreen in nature. In addition, this habitat is well represented within other priority landscapes outside of Priority Landscape CA1.

For aquatic focal habitats, there were three goals. The first goal was, for each catchment, to include within priority 1 areas at least 100 km of river bordered by habitat of high conservation importance, with no stretch greater than 5 km from another. The second goal was to include within each priority 1 area, at least 100 km of river bordered by habitat of high conservation importance, with no stretch greater than 5 km from another. The third goal was to include within each contiguous block of priority 1 and priority 2 areas, at least 500 km of river bordered by habitat of high conservation importance, with no stretch greater than 5 km from another (Table 7).

Table 7: Goals for taxa and groups with large area requirements

Taxon/group	Priority 1 area	Priority 1 and priority 2 areas
Species restricted to middle reaches of main rivers: masked finfoot, grey-headed fish eagle, etc.	100 km of river bordered by habitat of high conservation importance, with no stretch more than 5 km from another	500 km of river bordered by habitat of high conservation importance, with no stretch more than 5 km from another
Wide-ranging large mammals	50,000 ha of contiguous habitat of high conservation importance, including at least 20,000 ha below 700 m	250,000 ha of contiguous habitat of high conservation importance, including at least 100,000 ha below 700 m
saola	For priority 1 areas where saola occurs, 20,000 ha of contiguous habitat of high conservation importance below 1,200m, preferably below 700 m	For priority 1 and priority 2 areas where saola occurs, 100,000 ha of contiguous habitat of high conservation importance below 1,200 m, preferably below 700 m

The above goals for aquatic focal habitats are, however, only appropriate because of the absence of detailed information about the distribution of aquatic biodiversity within Priority Landscape CA1. There remains an urgent requirement to conduct detailed biological surveys of each catchment within the priority landscape, to collate data that will help predict stretches and catchments with the highest conservation potential, and to revise the conservation landscape based on the results.

Goals were only set for those focal taxa and groups that were considered unlikely to be adequately conserved in a conservation landscape based only on the above goals for focal habitats. These comprised wide-ranging large mammals and saola, which occur at low densities and, therefore, have large area requirements. For both conservation foci, one goal was set for minimum areas to be included within individual priority 1 areas, and a second goal was set for minimum areas or lengths to be included within contiguous blocks of priority 1 and priority 2 areas (Table 7).

When meeting the goals for contiguous blocks of priority 1 and priority 2 areas, priority was given to habitat restoration within priority areas over definition of additional areas. Therefore, both habitat of high conservation importance and habitat of medium conservation importance automatically contributed to meeting these goals.

6.1.4 Setting secondary criteria

In addition to quantitative goals, a series of secondary selection criteria was employed to guide the selection of priority 1, priority 2 and priority 3 areas. These criteria were formulated at a meeting attended by members of the Vietnamese biological advisory group. The first criterion was that preference should be given to areas that support focal taxa or groups, particularly those with a restricted distribution within Priority Landscape CA1 that cannot be predicted based on habitat distribution alone. The second criterion was that preference should be given to areas of habitat of high conservation importance that are more than 5 km from human settlement. The third criterion was that preference should be given to areas of habitat of high conservation importance that are more than 2 km from the habitat edge. The fourth criterion was that preference should be given to stretches of river upstream of all human settlement, which were considered to have lower disturbance as a result of pollution or over-fishing. The final criterion was that preference should be given to areas already designated as production forest or watershed protection forest, on the basis that such land-use designations can meet conservation goals if managed appropriately. Data on current land-use within the Vietnamese component of Priority Landscape CA1 were provided by the National Institute of Agricultural Planning and Projection.

6.1.5 Designing the conservation landscape

The conservation landscape was designed by an iterative process. First, the ability of existing protected areas to meet the quantitative goals for the conservation landscape was assessed. Then, wherever possible, existing protected areas were consolidated into priority 1 areas by the addition of contiguous areas. Next, additional priority 1 areas were identified to meet outstanding goals for the network of priority 1 areas as a whole. Next, each priority 1 area was consolidated by the addition of priority 2 areas, so that it met the goals for a contiguous block of priority 1 and priority 2 areas. Next, additional priority 2 areas were identified to meet outstanding goals for the network of priority 1 and priority 2 areas as a whole. Finally, a number of priority 3 areas were identified to ensure connectivity between the priority landscape and neighbouring priority landscapes. At each stage of the process, a number of principles were used in the selection of additional priority areas, including minimising the edge-to-area ratio, selecting the least fragmented and most contiguous areas, and selecting areas of known significance for biodiversity conservation. All additional areas require further evaluation to determine their biodiversity value, and based on the results, it may be necessary to make revisions to the conservation landscape.

6.2 Evaluation of existing protected areas

Existing protected areas were selected as the starting point for designing the conservation landscape, in order to build on existing conservation action in these areas, and, by limiting the additional area that would need to be brought under conservation management, to make the most efficient use of resources available for conservation.

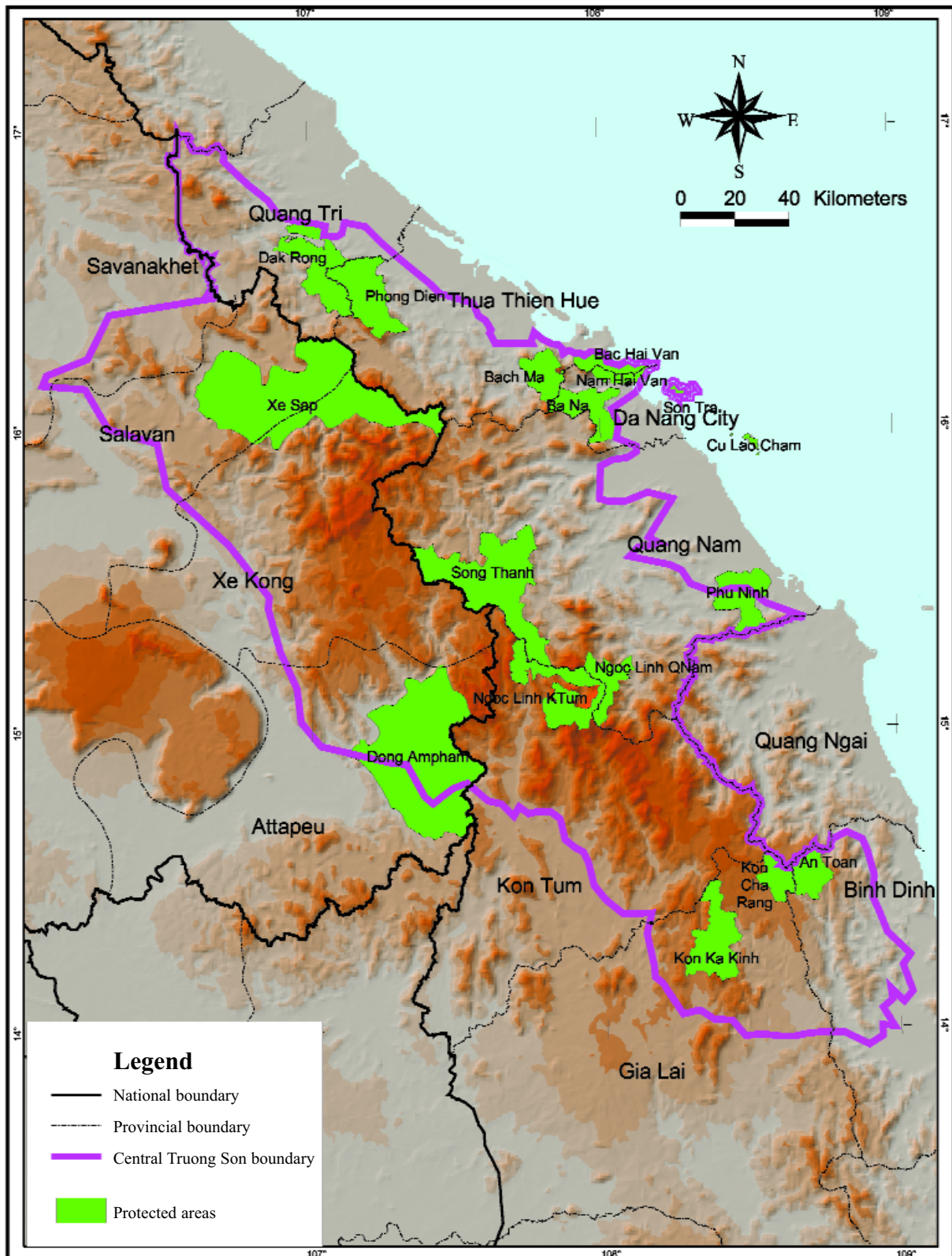
Because the protected areas systems of both Lao P.D.R. and Vietnam are still evolving in terms of coverage and institutional arrangements, there exist a range of sites that may be considered as "protected areas", including protected areas decreed at the national level, protected areas established at the provincial level, and protected areas that exist only as proposals. For the purpose of this analysis, for Lao P.D.R., existing protected areas were taken to comprise the 20 NBCAs decreed by the central government to date (Robichaud in prep.), while, for Vietnam, they were taken to comprise the 107 sites included on the revised list of Special-use Forests currently awaiting approval by the central government (FPD and FIPI unpublished). Consequently, for the purposes of this analysis, a number of sites within Priority Landscape CA1 were not considered to be existing protected areas. These sites comprised Phou Khathong, Phou Ahyon and Phou Theung in Lao P.D.R., and A Vuong, Sao La and Nui Thanh in Vietnam.

In addition, although Priority Landscape CA1, as defined in this document, contains a small portion of Dong Phou Vieng NBCA, this existing protected area is included within Priority Landscape CA2 (Dong Phou Vieng) and was not, therefore, included in the analysis. As mentioned in Section 1.4, there may be a need to redefine the north-western boundary of Priority Landscape CA1, following the precise definition of the boundary of Priority Landscape CA2.

The ability of existing protected areas to meet the quantitative goals for the conservation landscape was evaluated. As Figures 1 to 5 illustrate, the existing protected areas do not support sufficient habitat of high conservation importance in any elevation zone to meet even the goal for the area to be included within the network of priority 1 areas. Moreover, for all elevation zones, the existing protected areas fall well short of the goal for the area of habitat of high conservation importance to be included within the network of priority 1 area and priority 2 areas. Therefore, a network of priority 1 areas based solely on existing protected areas would be insufficient to support the full range of biodiversity and biological processes in Priority Landscape CA1 in the short or medium term. In particular, the existing protected areas support only a small proportion of the area of habitat of high conservation importance in the 0-300 m elevation zone necessary to meet the goals for this zone.

6.3 Consolidation of existing protected areas

There are 16 existing protected areas in Priority Landscape CA1 (Map 11), two of which lie partly outside of the priority landscape: Dong Ampham and Phu Ninh. An additional protected area, Cu Lao Cham, is situated off the Vietnamese coast, to the east of the priority landscape. For the purpose of this analysis, these 17 protected areas were considered as 11 combined protected areas. The contiguous protected areas combined together were Phong Dien and Dak Rong; Bach Ma and Ba Na; Bac Hai Van and Nam Hai Van; Ngoc Linh (Kon Tum), Ngoc Linh (Quang Nam) and Song Thanh; and Kon Cha Rang and An Toan.



Map 11 - Protected areas in Priority Landscape CA1

Each combined protected area was reviewed against the goals for a single priority 1 area (Tables 5 and 7), and all protected areas that met all these goals were zoned as priority 1 areas. Then, wherever possible, additional, contiguous areas were added to the remaining protected areas until they also met all the goals for a single priority 1 area. Any protected area for which it was not possible to meet all of the goals for a single priority 1 area in this manner was not included in the conservation landscape at this stage. Exception was made for protected areas that failed to meet goals for which there was no possibility of meeting due to the wider area being below a certain elevation or due to there being insufficient length of river bordered by habitat of high conservation importance in the wider area.

Table 8 gives the areas of habitat of high conservation importance within each elevation zone included in each combined protected area, together with the goals for the minimum area to be included in a single priority 1 area. Only Dong Ampham met the goals for all elevation zones.

Table 8: Evaluation of combined protected areas against the goals for habitat of high conservation importance in each elevation zone (in hectares) for a single priority 1 area

Combined protected area	0-300 m		300-700 m		700-1,200 m		1,200-1,500 m		> 1,500 m	
	Area	Gap	Area	Gap	Area	Gap	Area	Gap	Area	Gap
Phong Dien/Dak Rong	13,007	0	25,365	0	14,150	1,487	0	0	1,000	0
Xe Sap	22	4,978	9,475	0	67,543	28,628	0	9,980	0	0
Bac Hai Van/Nam Hai Van	1,020	3,980	4,057	943	4,042	0	5,958	0	1,000	0
Bach Ma/Ba Na	6,544	0	20,732	0	6,943	245	2,812	0	1,000	0
Son Tra	2,128	2,872	663	4,337	0	0	10,000	0	1,000	0
Cu Lao Cham	462	4,538	98	4,902	0	0	10,000	0	1,000	0
Ngoc Linh/Song Thanh	2,754	2,246	21,049	0	50,055	11,978	0	19,140	0	0
Phu Ninh	24	4,976	1,453	3,547	725	0	9,275	0	1,000	0
Dong Ampham	5,637	0	36,001	0	41,583	9,672	0	2,295	0	0
Kon Cha Rang/An Toan	0	5,000	1,629	3,371	29,801	0	0	0	1,000	0
Kon Ka Kinh	0	5,000	284	4,716	18,298	11,386	0	2,570	0	0
Goal	5,000		5,000		10,000 combined				1,000	

Table 9 shows the degree to which each combined protected area met the goals for taxa and groups with large area requirements for a single priority 1 area. The only combined protected areas to meet all the goals were Phong Dien/Dak Rong and Ngoc Linh/Song Thanh.

Table 9: Evaluation of combined protected areas against the goals for taxa and groups with large area requirements for a single priority 1 area

Combined protected area	Area of habitat of high conservation importance (ha)						River bordered by habitat of high conservation importance (km)	
	<700 m	Gap	<1,200 m	Gap	Total	Gap	Total	Gap
Phong Dien/Dak Rong	38,372	0	52,522	0	54,009	0	167.2	0
Xe Sap	9,497	10,503	77,040	0	115,648	0	100.4	0
Bac Hai Van/Nam Hai Van	5,077	14,923	9,119	10,881	9,119	40,881	81.7	18.3
Bach Ma/Ba Na	27,276	0	34,219	0	34,464	15,536	168.6	0
Son Tra	2,791	17,209	2,791	17,209	2,791	47,209	0.0	100.0
Cu Lao Cham	560	19,440	560	19,440	560	49,440	0.0	100.0
Ngoc Linh/Song Thanh	23,803	0	73,858	0	104,976	0	189.7	0
Phu Ninh	1,477	18,523	2,202	17,798	2,202	47,798	0.2	99.8
Dong Ampham	41,638	0	83,221	0	95,188	0	45.8	54.2
Kon Cha Rang/An Toan	1,629	18,371	31,430	0	31,430	18,570	100.3	0
Kon Ka Kinh	284	19,716	18,582	1,418	32,538	17,462	83.3	16.7
Goal	20,000		20,000		50,000		100.0	

6.3.1 Phong Dien/Dak Rong

Phong Dien/Dak Rong is an important area for the conservation of lowland galliformes, especially Edwards' pheasant and Annam partridge, which are currently only known from sub-landscape CA1a. The combined protected area is also important for the conservation of saola, although possibly less so than areas to the south, and there are confirmed records of tiger from the area.

The combined protected area met the terrestrial habitat goals for all elevation zones, apart from that for the >1,500 m zone, which there was no possibility of meeting, due to the whole area being below 1,500 m. The combined protected area also met all the goals for taxa and groups with large area requirements. Consequently, it was not necessary to add any additional areas to Phong Dien/Dak Rong for it to be zoned as a priority 1 area.

6.3.2 Xe Sap

This combined protected area met the terrestrial habitat goals for all elevation zones, apart from that for the 0-300 m zone. The combined protected area also met most of the goals for taxa and groups with large area requirements, apart from the goal to include at least 20,000 ha below 700 m for wide-ranging species, and the goal to include at least 100 km of river bordered by habitat of high conservation importance, with no stretch more than 5 km from another. Of all the existing protected areas, Xe Sap supports the largest area of habitat of high conservation importance, and, on the basis of current wildlife populations, is probably the most important protected area in Priority Landscape CA1 for the conservation of wide-ranging large mammals.

No area contiguous with Xe Sap supports a significant area of habitat of high conservation importance below 700 m. To the east, in Thua Thien Hue province, there are significant areas of habitat of high conservation importance below this elevation. However, these areas are not contiguous with the habitat of high conservation importance within Xe Sap, and, in the short term at least, it is unrealistic to expect that incorporating these areas could make a significant contribution to maintaining biodiversity and biological processes within Xe Sap. In the medium and long term, however, provided intervening areas of habitat medium conservation importance were rehabilitated to habitat of high conservation importance, it is possible that the contiguity between Xe Sap and nearby areas of high conservation could be restored.

Although Xe Sap supports 100.4 km of river bordered by habitat of high conservation importance, this is in stretches more than 5 km from one another. However, due to the low level of detail of the data on aquatic habitats in Lao P.D.R., this figure is likely to be an underestimate of the actual length, and it was felt, therefore, that Xe Sap probably met this goal in reality. Consequently, although Xe Sap did not meet all the goals for a single priority 1 area, it was felt appropriate to zone it as such.

6.3.3 Bac Hai Van/Nam Hai Van

Bac Hai Van/Nam Hai Van supports a narrow belt of habitat of high conservation importance along the boundary between sub-landscapes CA1a and CA1b. Although the habitat of high conservation importance is not fragmented, the narrowness of the belt and its small area mean that very little is more than 2 km from the habitat edge.

Bac Hai Van/Nam Hai Van did not meet any of the goals for a single priority 1 area. However, because of the proximity of Bac Hai Van/Nam Hai Van to Bach Ma/Ba Na, a combined protected area to the west, it was possible to link the two areas, and, thereby, consolidate them into a single priority 1 area. Therefore, a 9,773 ha area linking Bac Hai Van/Nam Hai Van to Bach Ma/Ba Na was defined. This area included 1,727 ha of habitat of high conservation importance in the 0-300 m elevation zone, 4,651 ha in the 300-700 m zone, 1,812 ha in the 700-1,200 m zone and 104 ha in the 1,200-1,500 m zone (area 1 on Map 12).

6.3.4 Bach Ma/Ba Na

Bach Ma/Ba Na supports two relatively well consolidated blocks of habitat of high conservation importance, much of which is more than 5 km from human settlement. Although these blocks are separated by a narrow belt of habitat of medium conservation importance, which bisects southern Bach Ma, there exists the potential to rehabilitate this area in the medium term.

Bach Ma/Ba Na only met the goals for habitat of high conservation importance in the 0-300 m and 300-700 m elevation zones. Although the combined protected area met the goals for saola, there are no confirmed records of this species from the area. In addition, while the combined protected area failed to meet the goal for wide-ranging taxa, the area is of no real significance for the conservation of these taxa, and it was, therefore, considered unnecessary to meet this goal. Furthermore, there was no possibility of meeting the goal for habitat of high conservation importance in the >1,500 m elevation zone, due to the whole area being below 1,500 m.

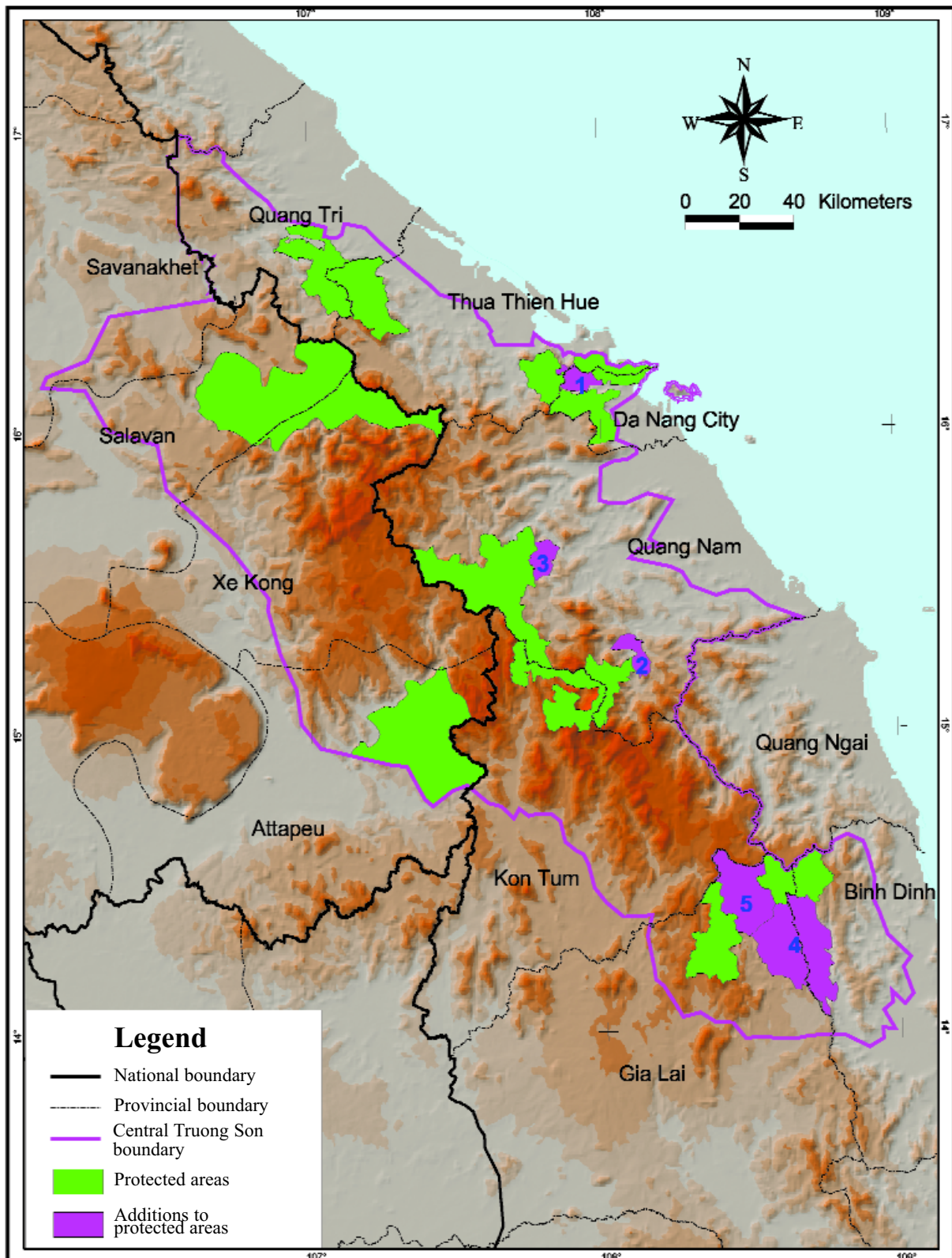
Consequently, in order to consolidate Bach Ma/Ba Na into a priority 1 area, it was only necessary to add 2,812 ha of habitat of high conservation importance between 700 and 1,500 m. This goal was met by the addition of the area between Bach Ma/Ba Na and Bac Hai Van/Nam Hai Van (see Section 6.3.3).

6.3.5 Son Tra

Son Tra failed to meet any of the goals for a single priority 1 area. Although this protected area supports nearly 3,000 ha of habitat of high conservation importance, it is isolated from other areas of high conservation importance by the urban area of Da Nang city, and there exists no potential to establish a habitat corridor to these areas. Similarly, although this protected area supports a few priority taxa, such as 'red-shanked' Douc langur, it is unlikely that these populations will be viable in the long term, due to their isolation. For these reasons, Son Tra was not zoned as a priority 1 area.

6.3.6 Cu Lao Cham

Cu Lao Cham, which comprises an archipelago of small islands off the Vietnamese coast, is peripheral to Priority Landscape CA1. Despite the shortage of biodiversity survey data from this protected area, it is not expected to have strong faunal and floral affinities with sites in the Central Truong Son Landscape, or to support significant numbers of endemic and near-endemic taxa. Cu Lao Cham failed to meet any of the goals for a single priority 1 area, and was not, therefore, zoned as a priority 1 area.



Map 12 - The consolidation of existing protected areas into priority 1 areas

6.3.7 Ngoc Linh/Song Thanh

Ngoc Linh/Song Thanh supports 104,976 ha of habitat of high conservation importance. However, the overall integrity of this habitat appears somewhat low, as few areas are more than 2 km from the habitat edge. Due to the large area of habitat of high conservation importance, Ngoc Linh/Song Thanh met all of the goals for taxa and groups with large area requirements.

Ngoc Linh/Song Thanh supports a larger area of habitat of high conservation importance above 2,000 m than any other combined protected area, and supports the widest altitudinal transition of habitat of high conservation importance in Priority Landscape CA1. The upper montane habitats in the combined protected area support many endemic and near-endemic taxa, including some that are not known from any other site. Despite the good coverage of habitat of high conservation importance at higher elevations, Ngoc Linh/Song Thanh only supports 2,754 ha in the 0-300 m elevation zone: 2,246 ha less than the goal for a single priority 1 area.

In order to meet the goal for habitat of high conservation importance in the 0-300 m elevation zone, two additional areas were defined. The first area, to the north-east of Ngoc Linh (Quang Nam), was defined with a total area of 9,844 ha, including 1,857 ha of habitat of high conservation importance in the 0-300 m elevation zone, 6,285 ha in the 300-700 m zone and 493 ha in the 700-1,200 m zone (area 2 on Map 12). The second area, to the east of Song Thanh, was defined with a total area of 10,221 ha, including 1,702 ha of habitat of high conservation importance in the 0-300 m elevation zone, 4,047 ha in the 300-700 m zone and 353 ha in the 700-1,200 m zone (area 3 on Map 12).

6.3.8 Phu Ninh

Phu Ninh failed to meet any of the goals for a single priority 1 area. As there is only a small amount of contiguous habitat of high conservation importance outside of Phu Ninh, the potential for expanding the protected area to meet these goals was low. Inclusion of additional areas of habitat of high conservation importance between 300 and 700 m would have only barely met the minimum area requirement for a single elevation zone. In addition, Phu Ninh is relatively isolated from other protected areas and potential priority 1 areas, and was, therefore, considered unsuitable for inclusion within a contiguous block of priority 1 and priority 2 areas. Furthermore, there were no grounds for considering that Phu Ninh harbours any significant elements of biodiversity that are not better represented in other priority 1 areas. For these reasons, Phu Ninh was not zoned as a priority 1 area.

6.3.9 Dong Ampham

Of the existing protected areas, Dong Ampham supports one of the widest altitudinal transitions of habitat of high conservation importance, despite supporting only a relatively small area above 1,500 m. Relative to other areas within Priority Landscape CA1, Dong Ampham should be considered important for the conservation of wide-ranging large mammals, although its position on the western flank of the Annamite chain suggests that it might be of only secondary importance for the conservation of endemic and near-endemic taxa.

Dong Ampham met all of the goals for a single priority 1 area, except the goal for river bordered by habitat of high conservation importance. However, as noted in Section 2.2, due to the low level of detail of the data on aquatic habitats in Lao P.D.R., this figure is likely to be

an underestimate of the actual length. In addition, those parts of Dong Ampham outside of Priority Landscape CA1 support significant, additional lengths of river bordered by habitat of high conservation importance. For these reasons, it was not considered necessary to add any additional areas to Dong Ampham for it to be zoned as a priority 1 area.

6.3.10 Kon Cha Rang/An Toan

Kon Cha Rang/An Toan supports a significant block of habitat of high conservation importance, most of which is more than 5 km from human settlement and more than 2 km from the habitat edge. There are confirmed records of tiger from the combined protected area, and it is, perhaps, the site with greatest potential to support a viable population of 'Indochinese' hog deer in Priority Landscape CA1. By itself, however, Kon Cha Rang/An Toan supports only 31,430 ha of habitat of high conservation importance, including only 1,629 ha below 700 m, far less than the minimum required to support populations of wide-ranging taxa in the short term. Fortunately, Kon Cha Rang/An Toan is part of a large, well consolidated area of habitat of high conservation importance, and there is high potential to include Kon Cha Rang/An Toan within a larger priority 1 area. In addition to failing to meet the goals for wide-ranging taxa, Kon Cha Rang/An Toan failed to meet the goals for habitat of high conservation importance within all except the 700-1,200 m elevation zone. This is because the combined protected area covers a relatively narrow elevation range.

Consequently, in order to consolidate Kon Cha Rang/An Toan into a priority 1 area, it was necessary to add at least 1,000 ha of habitat of high conservation importance in the >1,500 m elevation zone, and at least 18,371 ha below 700 m, including at least 5,000 ha in the 0-300 m elevation zone and 3,371 ha in the 300-700 m elevation zone.

In order to address the under-representation of habitat of high conservation importance below 700 m, it was necessary to add an additional area to the south of Kon Cha Rang, along the border between Gia Lai and Binh Dinh provinces (area 4 on Map 12). Of the areas contiguous with Kon Cha Rang/An Toan that support habitat of high conservation importance below 700 m, this area is the most consolidated, and includes significant areas of habitat of high conservation importance more than 5 km from human settlement and more than 2 km from the habitat edge. Furthermore, the area supports large areas of habitat of high conservation importance in the 300-700 m and 700-1,200 m elevation zones on slopes less than 5°.

The area to the south of Kon Cha Rang has a total area of 75,857 ha, including 3,277 ha of habitat of high conservation importance in the 0-300 m elevation zone, 23,979 ha in the 300-700 m zone and 24,993 ha in the 700-1,200 m zone. Even with this addition, the goal for habitat of high conservation importance in the 0-300 m zone was not quite met, and the priority 1 area still did not include any habitat of high conservation importance in the >1,500 m zone. This second goal was, however, met by the addition of a corridor between Kon Cha Rang/An Toan and Kon Ka Kinh (see Section 6.3.11).

6.3.11 Kon Ka Kinh

Kon Ka Kinh supports significant areas of habitat of high conservation importance above 1,200 m on slopes less than 5°. These areas support a number of vegetation formations that are believed to have very restricted distributions within Priority Landscape CA1. Although, there are recent confirmed records of tiger and other wide-ranging taxa from the protected area, it does not, by itself, meet the goals for these taxa. In particular, Kon Ka Kinh only supports 284

ha of habitat of high conservation importance below 700 m. Furthermore, the protected area only supports 83.3 km of river bordered by habitat of high conservation importance, which is mostly in stretches more than 5 km from one another.

Consequently, in order to consolidate Kon Ka Kinh into a priority 1 area, it was necessary to add at least 19,748 ha of habitat of high conservation importance below 700 m, including at least 5,000 ha in the 0-300 m elevation zone and at least 4,716 ha in the 300-700 m zone. Also, it was necessary to add at least 16.7 km of river bordered by habitat of high conservation importance.

Within the contiguous block of habitat of high conservation importance containing Kon Ka Kinh, the only significant areas below 700 m are to the south and south-east of Kon Cha Rang/An Toan. Therefore, an area was identified that linked Kon Ka Kinh to Kon Cha Rang/An Toan. This area has a total area of 42,777 ha, including 266 ha of habitat of high conservation importance in the 300-700 m elevation zone, 29,188 ha in the 700-1,200 m zone and 3,876 in the 1,200-1,500 m zone (area 5 on Map 12). Furthermore, a significant proportion of the habitat of high conservation importance in this area is on slopes less than 5°.

6.4 Identification of additional priority 1 areas

After the existing protected areas had been consolidated into priority 1 areas, a gap analysis was conducted to assess the degree to which these priority 1 areas met the goals for the network of priority 1 areas as a whole (Table 6). Next, complimentarity was used to assess the extent to which each significant area of habitat of high conservation importance outside of the priority 1 areas already identified met outstanding goals for the network of priority 1 areas as a whole. The area that made the biggest contribution to meeting these goals was designated as a priority 1 area, then the figures were recalculated and the process was repeated until all goals had been met. The additional priority 1 areas could have been either extensions to the priority 1 areas already identified or new areas. New areas would have had to meet all the goals for a single priority 1 area. However, because no such areas could be identified, only extensions to existing priority 1 areas were defined.

Table 10: Gap analysis for habitat of high conservation importance within the network of priority 1 areas

Elevation zone		Sub-landscape CA1a (ha)	Sub-landscape CA1b (ha)	Sub-landscape CA1c (ha)
0-300 m	Goal	50,000	50,000	0
	Already met	16,722	15,166	5,659
	Gap	33,278	34,834	0
300-700 m	Goal	75,000	75,000	0
	Already met	35,106	77,236	45,476
	Gap	39,894	0	0
700-1,200 m	Goal	25,000	125,000	100,000
	Already met	21,072	159,055	109,126
	Gap	3,928	0	0
1,200-1,500 m	Goal	4,000	50,000	46,000
	Already met	1,591	27,485	38,300
	Gap	2,409	22,515	7,700
>1,500 m	Goal	0	25,000	25,000
	Already met	0	21,710	12,275
	Gap	0	3,290	12,725

The results of the gap analysis are shown in Tables 10 and 11. In Table 10, the additional areas of habitat of high conservation importance within each elevation zone within each biogeographical unit that needed to be added to the network of priority 1 areas in order for the goals to be met are shown in bold. Similarly, in Table 11, the additional lengths of river bordered by habitat of high conservation importance within each catchment that needed to be added to the network of priority 1 areas in order for the goals to be met are shown in bold.

Table 11: Gap analysis for river bordered by habitat of high conservation importance within the network of priority 1 areas

Catchment	Length of river bordered by habitat of high conservation importance (km)		
	Goal	Already met	Gap
Ba	100.0	225.7	0
Bo	100.0	27.6	72.4
Ca De	100.0	161.0	0
Con (Say)	100.0	216.9	0
Huong	100.0	58.2	41.8
Lai Giang	100.0	0.5	99.5
O Lau	100.0	51.8	48.2
Quang Tri	100.0	85.3	14.7
Thu Bon	100.0	251.9	0
Tra Bong	100.0	0.0	100.0
Tra Khuc	100.0	0.0	100.0
Ve	100.0	0.0	100.0
Xe Bang Hieng	100.0	23.1	76.9
Xe Kong	100.0	152.9	0
Xe San	100.0	15.1	84.9

6.4.1 Sub-landscape CA1a

In order for the full range of biodiversity and biological processes in sub-landscape CA1a to be supported in the short term, the network of priority 1 areas based on consolidated protected areas needed to be extended to include additional habitat of high conservation importance in the 0-300 m, 300-700 m, 700-1,200 m and 1,200-1,500 m elevation zones. In addition, there was a need to include additional stretches of river bordered by habitat of high conservation importance in the Bo, Huong, O Lau and Quang Tri catchments. However, there was no possibility of meeting the goal for the O Lau catchment because only 53.9 km of river in this catchment is bordered by habitat of high conservation importance, of which 51.8 km was already included within priority 1 areas. Similarly, only 76.0 km of river in the Bo catchment is bordered by habitat of high conservation importance, of which 27.6 km was already included within priority 1 areas.

The additional area that met the most goals for sub-landscape CA1a was an area in A Luoi, Nam Dong, Huong Thuy and Huong Tra districts, Thua Thien Hue province. This area is the most consolidated block of habitat of high conservation importance outside of existing protected areas in sub-landscape CA1a, although the eastern part, in Nam Dong and Huong Thuy districts, is more consolidated than the western part, in A Luoi and Huong Tra districts. The area contains significant areas of habitat of high conservation importance more than 5 km from human settlement and more than 2 km from the habitat edge. In addition, the area supports the largest blocks of habitat of high conservation importance in the 0-300 m elevation

zone on slopes less than 5° in Priority Landscape CA1. Importantly, the area appears to comprise a significant proportion of the known range of saola in Priority Landscape CA1, and may be the single most important area for the conservation of this species in the priority landscape.

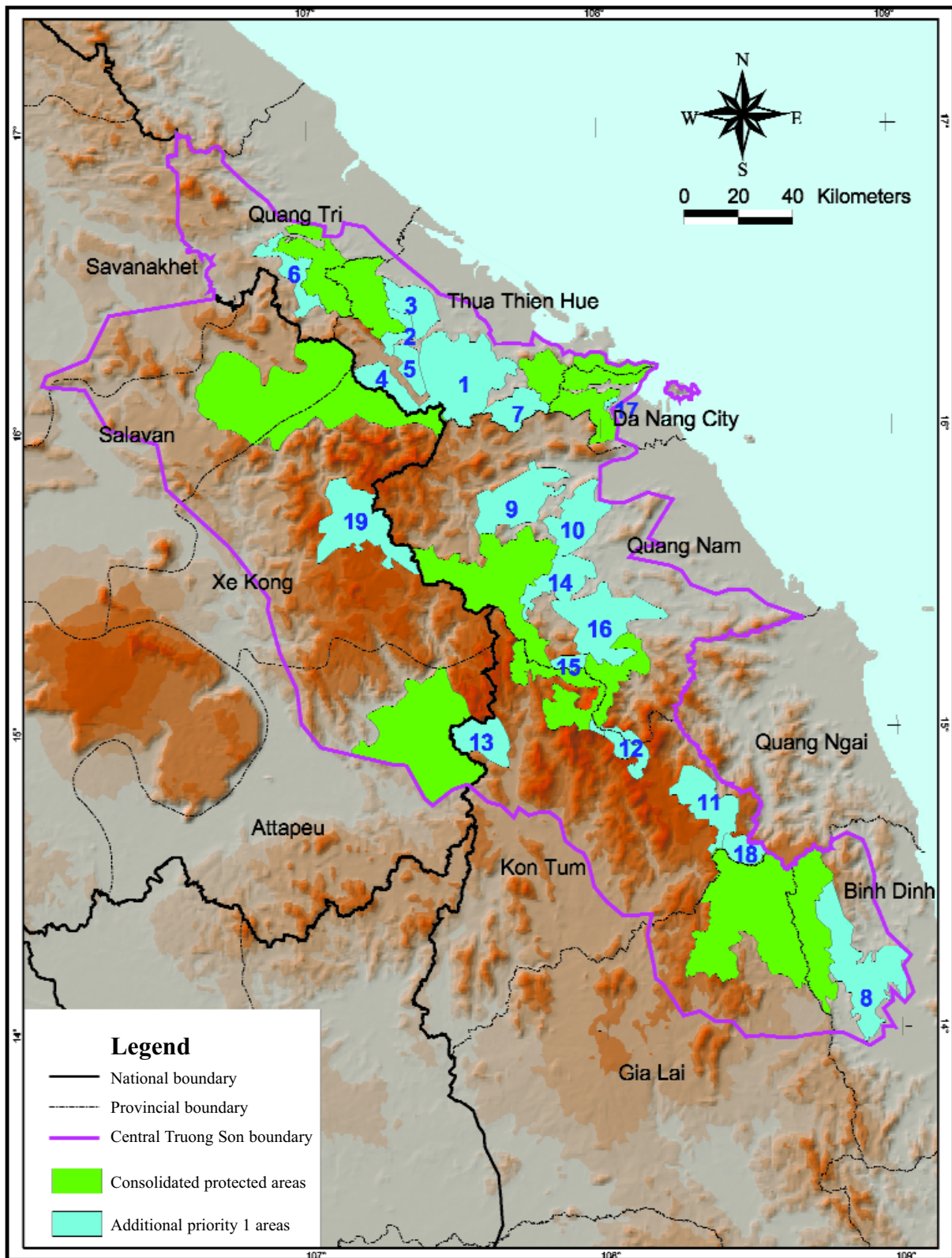
Therefore, an area of 80,808 ha was defined, including 20,147 ha of habitat of high conservation importance in the 0-300 m elevation zone, 26,156 ha in the 300-700 m zone and 6,540 ha in the 700-1,200 m zone (area 1 on Map 13). The addition of this area met the goal for the 700-1,200 m zone. Furthermore, this area contains 132.1 km of river bordered by habitat of high conservation importance in the catchment of the Huong river, most of which is in stretches within 5 km of each other. Therefore, the goal for this catchment was met. The addition of this area also added 12.4 km of river bordered by habitat of high conservation importance in the catchment of the Bo river, although this comprises stretches located more than 5 km from other stretches bordered by habitat of high conservation importance.

The next area to be added was an area to the south-east of Phong Dien, in A Luoi district, Thua Thien Hue province (area 2 on Map 13). This area covers 9,049 ha, including 1,806 ha of habitat of high conservation importance in the 0-300 m elevation zone, 3,345 ha in the 300-700 m zone and 1,161 ha in the 700-1,200 m zone. In addition, the area includes 16.1 km of river bordered by habitat of high conservation importance in the Bo catchment. Furthermore, the area gives good consolidation to Phong Dien/Dak Rong, with which it is contiguous, as a significant proportion of the habitat of high conservation value is more than 5 km from human settlement. Finally, the area is potentially important for both saola and lowland galliformes.

The next area to be added was an area to the east of Phong Dien, in Phong Dien and Huong Tra districts, Thua Thien Hue province (area 3 on Map 13). This area covers 24,086 ha, including 5,739 ha of habitat of high conservation importance in the 0-300 m elevation zone and 446 ha in the 300-700 m zone. In addition, the area includes 15.0 km of river bordered by habitat of high conservation importance in the Bo catchment, and 2.1 km in the O Lau catchment, thus meeting, as far as possible, the goal for the latter catchment. Furthermore, the area contains a significant area of habitat of high conservation importance in the 0-300 m elevation zone on slopes less than 5°. However, the area has low integrity, and does not help to consolidate Phong Dien/Dak Rong.

The next area to be added was an area to the east of Xe Sap, in A Luoi district, Thua Thien Hue province (area 4 on Map 13). This area covers 18,728 ha, including 1,146 ha of habitat of high conservation importance in the 300-700 m elevation zone, 8,177 ha in the 700-1,200 m zone, 2,216 ha in the 1,200-1,500 m zone and 644 ha in the >1,500 m zone. The area has high integrity, and gives good consolidation to Xe Sap. In addition, the area is potentially important for saola, although only a small proportion of the habitat of high conservation importance is below 700 m.

The next area to be added was an area in central A Luoi district, Thue Thien Hue province (area 5 on Map 13). This area covers 12,230 ha, including 698 ha of habitat of high conservation importance in the 0-300 m elevation zone, 6,921 ha in the 300-700 m zone and 204 ha in the 700-1,200 m zone. The area is potentially important for saola and lowland galliformes, and supports a significant area of habitat of high conservation importance in the 300-700 m elevation zone on slopes less than 5°. In addition, the area includes 4.9 km of river bordered by habitat of high conservation importance in the Bo catchment, thus meeting, as far as possible, the goal for this catchment.



Map 13 - Identification of additional priority 1 areas to meet the goals for the network as a whole

The next area to be added was an area to the west of Dak Rong, in Dak Rong district, Quang Tri province (area 6 on Map 13). This area covers 21,101 ha, including 3,342 ha of habitat of high conservation importance in the 0-300 m elevation zone and 5,418 ha in the 300-700 m zone, thus meeting the goal for the 300-700 m zone. In addition, the area includes 16.0 km of river bordered by habitat of high conservation importance in the Quang Tri catchment, thus meeting the goal for this catchment. The integrity of the area is low, although it helps to consolidate Phong Dien/Dak Rong.

The next area to be added was an area to the south-west of Bach Ma/Ba Na, in Nam Dong district, Thua Thien Hue province (area 7 on Map 13). This area covers 21,327 ha, including 1,681 ha of habitat of high conservation importance in the 0-300 m elevation zone, 6,734 ha in the 300-700 m zone, 5,684 ha in the 700-1,200 m zone and 174 ha in the 1,200-1,500 m zone. The addition of this area met the goals for the 0-300 m and 1,200-1,500 m zones. The area is potentially important for the conservation of saola and lowland galliformes.

6.4.2 Sub-landscape CA1b

In order for the full range of biodiversity and biological processes in sub-landscape CA1b to be supported in the short term, the network of priority 1 areas based on consolidated protected areas had to be extended to include additional habitat of high conservation importance in the 0-300 m, 1,200-1,500 m and >1,500 m elevation zones. In addition, there was a need to include additional stretches of river bordered by habitat of high conservation importance in the Lai Giang, Xe San, Tra Bong, Tra Khuc and Ve catchments. There was, however, no possibility of meeting the goals for the Lai Giang, Tra Bong and Ve catchments, as these catchments only contain 28.6, 9.3 and 37.9 km of river bordered by habitat of high conservation importance, respectively.

The additional area that met the most goals for sub-landscape CA1a was an area to the south of An Toan, in Vinh Thanh, Hoai An, Tay Son and Phu Cat districts, Binh Dinh province (area 8 on Map 13). This area covers 74,018 ha, including 13,268 ha of habitat of high conservation importance in the 0-300 m elevation zone, 21,397 ha in the 300-700 m zone and 1,596 ha in the 700-1,200 m zone. A large proportion of the habitat of high conservation importance in this area is more than 5 km from human settlement, indicating that it may support relatively intact biological communities. The addition of this area made the biggest single contribution to meeting the goal for habitat of high conservation importance in the 0-300 m zone.

The next area to be added was an area to the north of Song Thanh, in Giang and Hien districts, Quang Nam province (area 9 on Map 13). This area covers 47,818 ha, including 5,372 ha of habitat of high conservation importance in the 0-300 m elevation zone, 20,426 ha in the 300-700 m zone and 3,548 ha in the 700-1,200 m zone. The area supports one of the most consolidated blocks of habitat of high conservation importance below 700 m outside of the priority 1 areas already defined, including significant areas on slopes less than 5°. However, the block of habitat of high conservation importance is not contiguous with habitat of high conservation importance within Song Thanh.

The next area to be added was an area to the north-east of Song Thanh, in Que Son, Dai Loc and Giang districts, Quang Nam province (area 10 on Map 13). This area covers 35,057 ha, including 9,169 ha of habitat of high conservation importance in the 0-300 m elevation zone, 11,748 ha in the 300-700 m zone and 1,562 ha in the 700-1,200 m zone. This area has similar attributes to the previous area, except that it has less integrity; the two areas could be considered as alternatives.

The next area to be added was an area in Kon Plong district, to the north of the corridor linking Kon Ka Kinh and Kon Cha Rang/An Toan (area 11 on Map 13). This area covers 36,502 ha, including 2,235 ha of habitat of high conservation importance in the 300-700 m elevation zone, 13,635 ha in the 700-1,200 m zone, 8,424 ha in the 1,200-1,500 m zone and 708 ha in the >1,500 m zone. The area includes 57.5 km of river bordered by habitat of high conservation importance in the Tra Khuc catchment. While there are an additional 47.5 km of river bordered by habitat of high conservation importance in the Tra Khuc catchment, sufficient to meet the goal for this catchment, these stretches are found within isolated blocks of habitat of high conservation importance in western Quang Ngai province. Consequently, it was not possible to include these stretches within a priority 1 area. In addition, the area includes 7.3 km of river bordered by habitat of high conservation importance in the Xe San catchment. The area has low integrity, with almost no habitat of high conservation importance more than 2 km from the habitat edge. However, the area supports a number of vegetation formations that are not known from elsewhere in Priority Landscape CA1.

The next area to be added was an area to the south-east of Ngoc Linh (Quang Nam), in Dak To district, Kon Tum province (area 12 on Map 13). This area covers 17,619 ha, including 218 ha of habitat of high conservation importance in the 700-1,200 m elevation zone, 5,281 ha in the 1,200-1,500 m zone and 6,793 ha in the >1,500 m zone. The addition of this area met the goal for the >1,500 m zone. In addition, the area includes 7.3 km of river bordered by habitat of high conservation importance in the Xe San catchment.

The next area to be added was an area to the east of Dong Ampham, in south-western Dak Glei district, Kon Tum province (area 13 on Map 13). This area covers 26,630 ha, including 10,065 ha of habitat of high conservation importance in the 700-1,200 m elevation zone, 7,461 ha in the 1,200-1,500 m zone and 929 ha in the >1,500 m zone. In addition, the area includes 54.7 km of river bordered by habitat of high conservation importance in the Xe San catchment; a major contribution to meeting the goal for this catchment. Furthermore, the area helps to consolidate Dong Ampham.

The next area to be added was an area centred on Thu Bon Forest Enterprise, to the east of Song Thanh, in Phuoc Son district (area 14 on Map 13). This area covers 28,612 ha, including 3,262 ha of habitat of high conservation importance in the 0-300 m elevation zone, 10,278 ha in the 300-700 m zone and 184 ha in the 700-1,200 m zone. The addition of this area met the goal for the 0-300 m zone. In addition, a significant proportion of the habitat of high conservation importance in this area is more than 5 km from human settlement.

The next area to be added was the intervening area between Song Thanh and Ngoc Linh (Quang Nam), in southern Phuoc Son district, Quang Nam province (area 15 on Map 13). This area covers 6,002 ha, including 1,252 ha of habitat of high conservation importance in the 700-1,200 m elevation zone, 1,571 ha in the 1,200-1,500 m zone and 1,719 ha in the >1,500 m zone, thus meeting the goal for the 1,200-1,500 m zone. The addition of this area helps to consolidate Ngoc Linh/Song Thanh.

The next area to be added was an area centred on Tra My Forest Enterprise, in Phuoc Son and Tra My districts, Quang Nam province. This area has a total area of 59,460 ha, including 2,408 ha of habitat of high and medium conservation importance in the 0-300 m elevation zone, 15,529 ha in the 300-700 m zone, 14,492 ha in the 700-1,200 m zone and 3,152 ha in the 1,200-1,500 m zone (area 16 on Map 13). The area supports significant areas of habitat of high conservation importance more than 5 km from human settlement and more than 2 km from the habitat edge, and can, therefore, be expected to support relatively intact biological communities.

The next area to be added was an area to the east of Ba Na Nature Reserve (area 17 on Map 13). This area covers 1,097 ha, including 936 ha of habitat of high conservation importance in the 0-300 m elevation zone and 50 ha in the 300-700 m zone.

The final area to be added was an area centred on Mang La Forest Enterprise, to the north-west of Kon Cha Rang (area 18 on Map 13). This area covers 12,537 ha, including 131 ha of habitat of high conservation importance in the 300-700 m elevation zone, 5,381 ha in the 700-1,200 m zone and 815 ha in the 1,200-1,500 m zone. In addition, the area includes 14.4 km of river bordered by habitat of high conservation importance in the Ve catchment. Finally, the area helps to consolidate Kon Cha Rang/An Toan.

6.4.3 Sub-landscape CA1c

In order for the full range of biodiversity and biological processes in sub-landscape CA1c to be supported in the short term, the network of priority 1 areas based on consolidated protected areas had to be extended to include additional habitat of high conservation importance in the 1,200-1,500 m and >1,500 m elevation zones. In addition, there was a need to include additional stretches of river bordered by habitat of high conservation importance in the Xe Bang Hieng catchment. No attempt was made to meet this last goal, because, firstly, the length of river bordered by habitat of high conservation importance within Xe Sap was considered to be an under-estimate, and, secondly, because Priority Landscape CA1 contains only a small proportion of the Xe Bang Hieng catchment, with larger proportions being contained within neighbouring priority landscapes.

In order to meet the goals for habitat of high conservation importance within sub-landscape CA1c, it was only necessary to add one additional area: an area centred on the Phou Ahyon massif, in Xe Kong province (area 19 on Map 13). This area covers 60,063 ha, including 4 ha of habitat of high conservation importance in the 300-700 m elevation zone, 9,475 ha in the 700-1,200 m zone, 23,158 ha in the 1,200-1,500 m zone and 16,217 ha in the >1,500 m zone. This area is centred on the highest mountain in southern Lao P.D.R., and supports an extensive area of habitat of high conservation importance above 1,200 m, a significant proportion of which is on slopes less than 5°.

6.5 Consolidation of contiguous blocks of priority 1 areas

During the first two steps of the GIS analysis, a network of priority 1 areas was defined, which, if adequately protected, would hopefully be sufficient to support all biodiversity and biological processes in Priority Landscape CA1 in the short term (Appendix 7). However, in order to potentially support all biodiversity and biological processes in the priority landscape in the medium term, it was necessary to increase the coverage of the conservation landscape by the addition of a number of priority 2 areas. The next step in the GIS analysis was, therefore, to consolidate each priority 1 area by adding contiguous areas, or by joining it to a separate priority 1 areas by the addition of intervening areas, so that it met the goals for a contiguous block of priority 1 and priority 2 areas (Tables 5 and 7). These additional areas were designated as priority 2 areas.

When meeting the goals for contiguous blocks of priority 1 and priority 2 areas, priority was given to habitat restoration within priority areas over definition of additional areas.

Consequently, both habitat of high conservation importance and habitat of medium conservation importance contributed to meeting the goals. When defining priority 2 areas, however, priority was given to areas supporting a high proportion of habitat of high conservation importance over areas supporting a high proportion of habitat of medium conservation importance.

Table 12 gives the area of habitat of high and medium conservation importance within each elevation zone in each priority 1 area, together with the goals for a contiguous block of priority 1 and priority 2 areas. Only the Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area met the goals for all elevation zones.

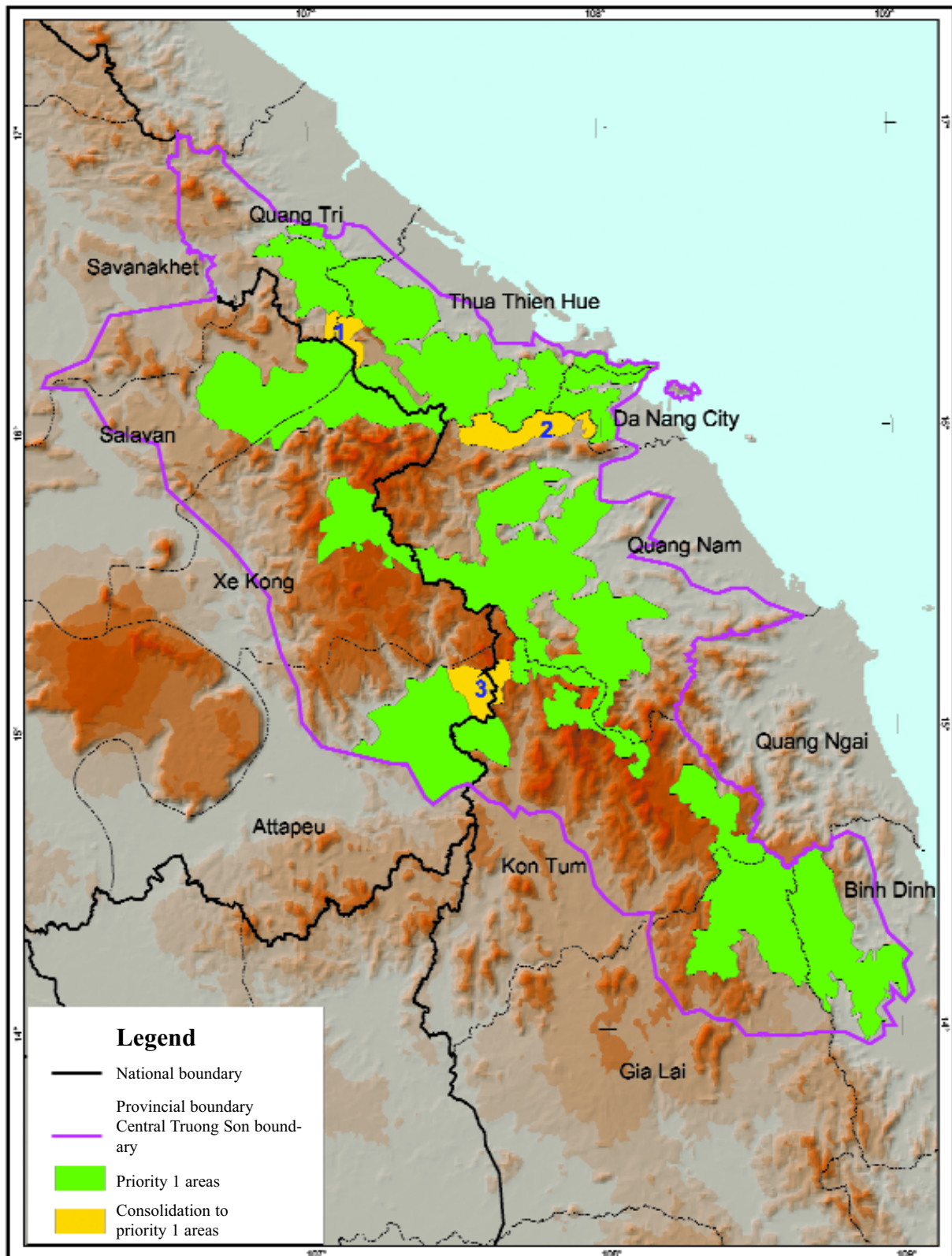
Table 12: Evaluation of priority 1 areas against the goals for habitat of high and medium conservation importance in each elevation zone (in hectares) for a contiguous block of priority 1 and priority 2 areas

Priority 1 area	Area of habitat of high and medium conservation importance (ha)						Length of river bordered by habitat of high or medium conservation importance (km)		
	0-300 m	Gap	300-700 m	Gap	700-1,200 m	1,200-1,500 m	Gap	> 1,500 m	Gap
Phong Dien/Dak Rong	66,829	0	52,281	0	16,812	1,488	81,700	0	2,500
Xe Sap/Nam Thua Thien Hue	41,651	8,349	76,176	0	116,151	33,507	0	11,041	0
Bach Ma/Ba Na/Hai Van	24,087	25,913	46,464	3,536	20,693	638	78,669	0	2,500
Ngoc Linh/Song Thanh/Phou Ahyon	59,096	0	142,943	0	109,782	58,348	0	53,706	0
Dong Ampham	7,201	42,799	45,446	4,554	67,552	19,638	12,810	3,448	0
Kon Ka Kinh/Kon Cha Rang	38,417	11,583	81,824	0	152,039	29,583	0	3,646	0
Goal	50,000		50,000		100,000 combined		2,500		

Table 13 shows the degree to which each priority 1 area met the goals for taxa and groups with large area requirements for a contiguous block of priority 1 and priority 2 areas, assuming that all areas of habitat of medium conservation importance were rehabilitated into habitat of high conservation importance.

Table 13: Evaluation of priority 1 areas against the goals for taxa and groups with large area requirements for a contiguous block of priority 1 and 2 areas

Priority 1 area	Area of habitat of high and medium conservation importance (ha)						Length of river bordered by habitat of high or medium conservation importance (km)	
	<700 m	Gap	<1,200 m	Gap	Total	Gap	Total	Gap
Phong Dien/Dak Rong	119,110	0	135,922	0	137,410	112,590	773.2	0
Xe Sap/Nam Thua Thien Hue	117,827	0	233,978	0	278,526	0	763.5	0
Bach Ma/Ba Na/Hai Van	70,551	29,449	91,244	8,756	91,882	8,118	775.3	0
Ngoc Linh/Song Thanh/Phou Ahyon	202,039	0	311,821	0	423,875	0	1,445.4	0
Dong Ampham	52,647	47,353	120,199	0	143,285	106,715	221.9	278.1
Kon Ka Kinh/Kon Cha Rang	120,241	0	272,280	0	305,509	0	564.4	0
Goal	100,000		100,000		250,000		500.0	



Map 14 - The consolidation of priority 1 areas by the addition of priority 2 areas

6.5.1 Phong Dien/Dak Rong

In order to meet the goals for a contiguous block of priority 1 and priority 2 areas, a priority 2 area was defined, linking the Phong Dien/Dak Rong priority 1 area with the Xe Sap/Nam Thua Thien Hue priority 1 area. This priority 2 area has a total area of 16,254 ha, including 16,217 ha of habitat of high and medium conservation importance (area 1 on Map 14). This area was labeled the A Luoi priority 2 area (Appendix 7).

6.5.2 Xe Sap/Nam Thua Thien Hue

As described in Section 6.5.1, in order to meet the goals for a contiguous block of priority 1 and priority 2 areas, a priority 2 area was defined, linking the Xe Sap/Nam Thua Thien Hue priority 1 area with the Phong Dien/Dak Rong priority 1 area.

6.5.3 Bach Ma/Ba Na/Hai Van

In order to meet the goals for a contiguous block of priority 1 and priority 2 areas, a priority 2 area was defined, linking the Bach Ma/Ba Na/Hai Van priority 1 area to the Xe Sap/Nam Thua Thien Hue priority 1 area. This priority 2 area is situated in northern Hien district, Quang Nam province, and has a total area of 40,945 ha (area 2 on Map 14).

6.5.4 Ngoc Linh/Song Thanh/Phou Ahyon

By itself, the Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area met all the goals for a contiguous block of priority 1 and priority 2 areas. Therefore, it was not necessary to define any contiguous priority 2 areas.

6.5.5 Dong Ampham

In order to meet the goals for a contiguous block of priority 1 and priority 2 areas, a priority 2 area was defined, linking the Dong Ampham priority 1 area with the Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area. This priority 2 area has a total area of 30,999 ha, including 27,312 ha of habitat of high and medium conservation importance (area 3 on Map 14). This area was labeled the East Dong Ampham priority 2 area (Appendix 7).

6.5.6 Kon Ka Kinh/Kon Cha Rang

The Kon Ka Kinh/Kon Cha Rang priority 1 area met all the goals for a contiguous block of priority 1 and priority 2 areas, except the goal for habitat of high and medium conservation importance in the 0-300 m elevation zone. Because most contiguous areas of habitat of high and medium conservation importance below 300 m were already included within the priority 1 area, it was not possible to meet this goal by defining a contiguous priority 2 area.

6.6 Identification of additional priority 2 areas

During the first three steps of the GIS analysis, six priority 1 areas and three priority 2 areas were defined. The next step was to add additional priority 2 areas, to meet the goals for the network of priority 1 and priority 2 areas as a whole (Table 6). Once again, emphasis was placed on consolidation of existing blocks of contiguous priority areas.

In order to identify additional priority 2 areas, a gap analysis was carried out to determine which of the goals for the network of priority 1 and priority 2 areas were met by the priority 1 and priority 2 areas already defined. Again, this analysis used complementarity to assess the extent to which each significant area of habitat of high and medium conservation importance outside of the priority 1 and priority 2 areas already identified met outstanding goals for the network of priority 1 and priority 2 areas as a whole. The area that made the biggest contribution to meeting these goals was designated as a priority 2 area, then the figures were recalculated and the process was repeated until all goals had been met. The additional priority 2 areas could have been either contiguous with the priority 1 and priority 2 areas already identified or new areas. However, no new areas that met all the goals for a contiguous block of priority 1 and priority 2 areas could be identified.

When selecting priority 2 areas, priority was given to selecting areas of habitat of high conservation importance. Within some elevation zones, however, there was insufficient habitat of high conservation importance available for the minimum area goals to be met (Tables 2 and 5). In these cases, the goals for priority 2 areas were met through the selection of areas of habitat of medium conservation importance, which were considered to have the potential for rehabilitation into areas of habitat of high conservation importance in the medium term.

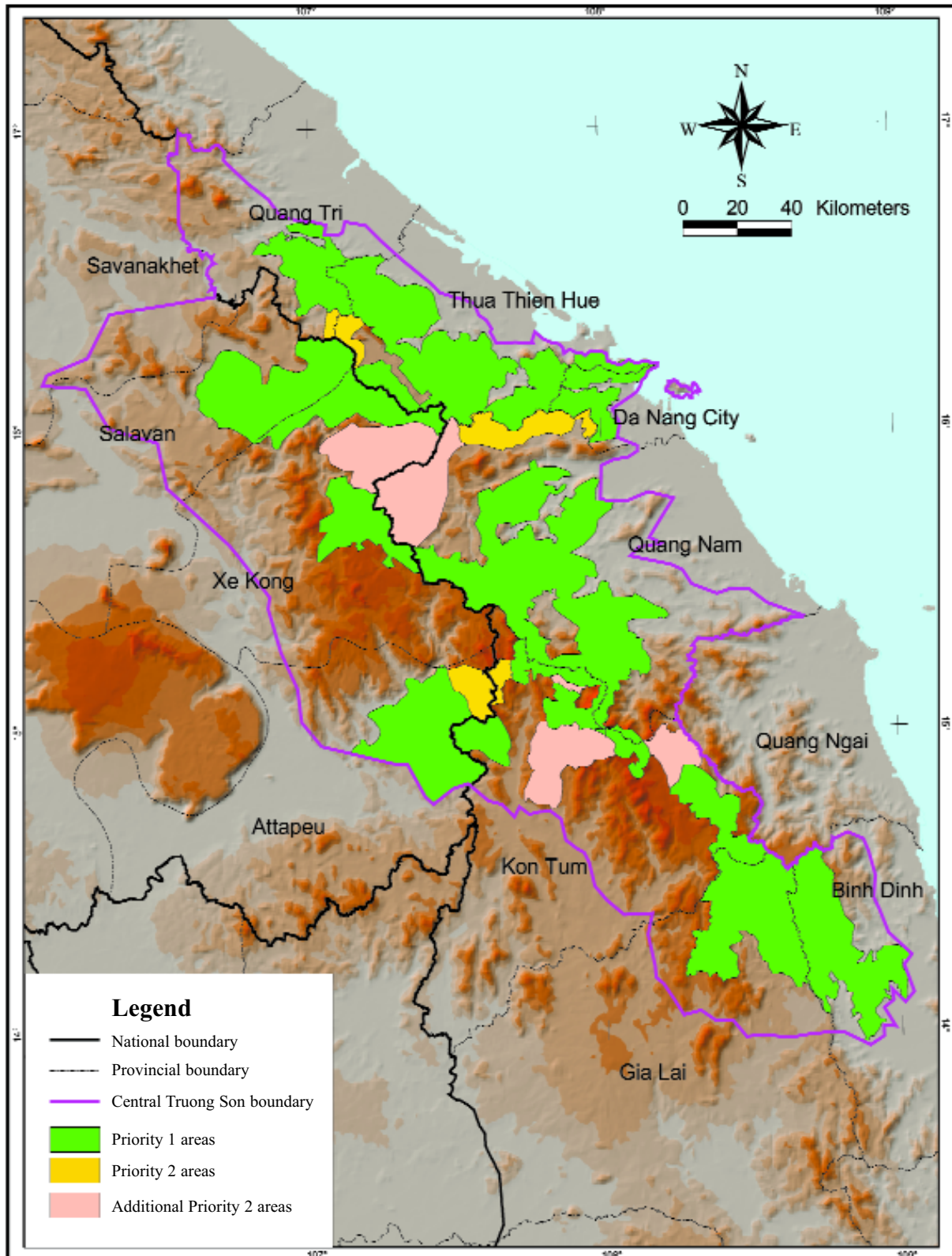
Table 14: Gap analysis for habitat of high and medium conservation importance within the network of priority 1 and priority 2 areas

Elevation zone		Sub-landscape CA1a (ha)	Sub-landscape CA1b (ha)	Sub-landscape CA1c (ha)
0-300 m	Goal	75,000	75,000	0
	Already met	120,524	109,534	7,223
	Gap	0	0	0
300-700 m	Goal	100,000	150,000	0
	Already met	134,612	269,232	71,273
	Gap	0	0	0
700-1,200 m	Goal	40,000	200,000	160,000
	Already met	57,122	289,302	166,241
	Gap	0	0	0
1,200-1,500 m	Goal	4,000	105,000	91,000
	Already met	4,116	71,692	83,809
	Gap	884	33,308	7,191
>1,500 m	Goal	0	55,000	45,000
	Already met	664	40,324	38,050
	Gap	0	14,676	6,950

The results of this gap analysis are shown in Table 14, with the additional area of habitat of high and medium conservation importance within each elevation zone within each biogeographical unit that needed to be added shown in bold.

6.6.1 Sub-landscape CA1a

As all the goals for the whole network of priority 1 and priority 2 areas were already met, it was not necessary to add any additional priority 2 areas in sub-landscape CA1a, in order for the full range of biodiversity and biological processes to be supported in the medium term.



Map 15 - Identification of additional priority 2 areas to meet the goals for the network as a whole

6.6.2 Sub-landscape CA1b

The additional area that met the most goals for sub-landscape CA1b was an area centred on Dak To Forest Enterprise, in Dak To district, Kon Tum province. This area has a total area of 58,275 ha, including 22,588 ha of habitat of high and medium conservation importance in the 700-1,200 m elevation zone, 22,897 ha in the 1,200-1,500 m zone and 11,303 ha in the >1,500 m zone (area 1 on Map 15). This area supports a significant area of habitat of high conservation importance more than 5 km from human settlement, although the largest block is isolated from other areas of habitat of high conservation importance, and habitat rehabilitation is necessary in the intervening area. In addition, the area supports a number of endemic plant taxa that are currently not known from any other site. This area was labeled the Dak To priority 2 area (Appendix 7).

The next area to be added was an area in western Quang Nam province (area 2 on Map 15). This area has a total area of 71,723 ha, including 3,793 ha of habitat of high and medium conservation importance in the 300-700 m elevation zone, 53,798 ha in the 700-1,200 m zone, 11,418 ha in the 1,200-1,500 m zone and 329 ha in the >1,500 m zone. Providing areas of habitat of medium conservation importance are rehabilitated, this priority 2 area could form a habitat corridor between the Xe Sap/Nam Thua Thien Hue and Ngoc Linh/Song Thanh/Phou Ahyon priority 1 areas.

The next area to be added was an area centred on Thach Nham Watershed Protection Forest (area 3 on Map 15). This area has a total area of 25,263 ha, including 24,294 ha of habitat of high and medium conservation importance. This area, which was labeled the Thach Nham priority 2 area, could form a habitat corridor between the Kon Ka Kinh/Kon Cha Rang and Ngoc Linh/Song Thanh/Phou Ahyon priority 1 areas (Appendix 7).

The final area to be added was an area in the buffer zone of Ngoc Linh (Kon Tum), which links the northern and southern parts of the protected area. This area has a total area of only 3,189 ha, including 1,482 ha of habitat of high and medium conservation importance in the 700-1,200 m elevation zone, 853 ha in the 1,200-1,500 m zone and 316 ha in the >1,500 m zone (area 4 on Map 15). Although this area supports very little habitat of high conservation importance, with rehabilitation of areas of habitat of medium conservation importance, it could help to consolidate the Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area. This area was labeled the Dak Choong priority 2 area (Appendix 7).

6.6.3 Sub-landscape CA1c

In order for the full range of biodiversity and biological processes in sub-landscape CA1c to be supported in the medium term, the network of priority 1 and priority 2 areas needed to be extended to include an additional 7,191 ha of habitat of high and medium conservation importance in the 1,200-1,500 m elevation zone and 6,950 ha in the >1,500 m zone.

In order to meet the above goals, a single priority 2 area was added in eastern Xe Kong province, between the Xe Sap/Nam Thua Thien Hue and Ngoc Linh/Song Thanh/Phou Ahyon priority 1 areas (area 5 on Map 15). This area has a total area of 69,623 ha, including 1,153 ha of habitat of high and medium conservation importance in the 300-700 m elevation zone, 31,884 ha in the 700-1,200 m zone, 29,452 ha in the 1,200-1,500 m zone and 5,323 ha in the >1,500 m zone. This priority 2 area was combined with the priority 2 areas in northern Hien district and western Quang Nam province (area 2 on Map 14 and area 2 on Map 15), to form the Xe Kong/Quang Nam priority 2 area (Appendix 7).

Even with the addition of the above priority 2 area, only 43,373 ha of habitat of high and medium conservation importance in the >1,500 m elevation zone were included within priority 1 and priority 2 areas in sub-landscape CA1c. However, as there are only 45,370 ha of habitat of high and medium conservation importance in this elevation zone, meeting the goal of including 45,000 ha would have required the inclusion of large additional areas of sub-landscape CA1c.

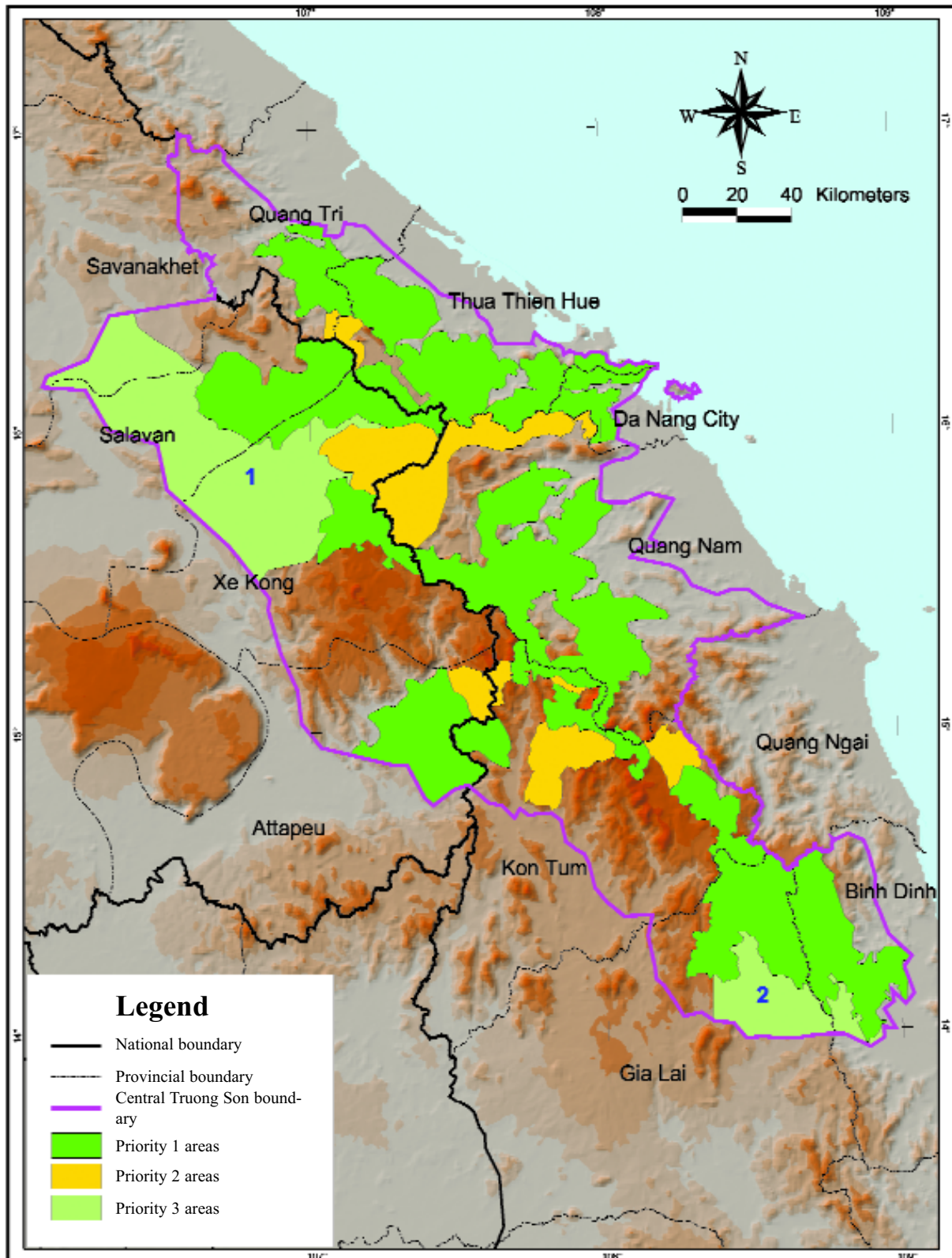
6.7 Identification of priority 3 areas

In order for the full range of biodiversity and biological processes in Priority Landscape CA1 to be supported in the long term, it was necessary to identify a number of priority 3 areas, to ensure connectivity within the priority landscape and between it and neighbouring priority landscapes. Long-term conservation planning is difficult, particularly as the future political and socio-economic climate for habitat restoration efforts cannot be predicted. Therefore, priority 3 areas are areas, which, on the basis of current land use, might be included in short and medium-term conservation plans, in order to significantly aid conservation activities in the future. It is certainly possible that future long-term conservation efforts will require the addition of considerable areas to the conservation landscape, although these cannot be precisely identified at this stage. Therefore, only two priority 3 areas were roughly defined.

The first priority 3 (area 1 on Map 16) area links Priority Landscape CA1 with Priority Landscape CA2 (Dong Phou Vieng). Although there is no contiguity between areas of habitat of high conservation importance in the two priority landscapes, opportunities exist to create habitat corridors through rehabilitation of habitat of medium conservation importance to the west of Xe Sap NBCA.

The second priority 3 (area 2 on Map 16) area links Priority Landscape CA1 with Survey Area CAS2 (Central Annamite Southern Extension). Areas of habitat of high conservation importance within the two areas are only linked by very narrow corridors of habitat of high and medium conservation importance. In the short and medium term, there is limited potential to consolidate these corridors as they are bordered by extensive areas of habitat of low conservation importance.

Finally, it was not necessary to define a priority 3 area to ensure connectivity between Priority Landscape CA1 and Priority Landscape LM8 (Cambodia/Lao P.D.R./Vietnam Tri-border Forests), because these areas are already linked via Dong Ampham NBCA.



Map 16 - The final conservation landscape

PART VII: CONSTRAINTS TO ACHIEVING THE BIOLOGICAL VISION

The constraints to achieving the biological vision for the Central Truong Son Landscape were outlined at a meeting of the Vietnamese biological advisory group. The major constraints outlined at this meeting were as follows:

- Currently, insufficient information is available about the biodiversity of the Central Truong Son Landscape, and much of the information that is available is unreliable and imprecise.
- There is a particularly urgent need to conduct a thorough analysis of river catchments, specifically to identify gaps in coverage of the conservation landscape designed in this document, to set more objective targets for the conservation of aquatic conservation foci, to more accurately identify stretches of high conservation importance, and to collect more comprehensive field data to underpin the aforementioned objectives.
- Due to a lack of funding, many protected areas do not yet have a management board. At those protected areas that do have a management board, staff typically have low capacity, a low level of training and little knowledge about conservation.
- In many areas, local people are very poor and their livelihoods are dependent - to one degree or another - on natural resources. Often, there is a conflict between their needs and the objectives of biodiversity conservation. The present legislative and institutional framework is not conducive to the sustainable use of natural resources by local communities, while the conditions to enforce strict management regulations do not exist in most areas.
- Regulations and plans regarding land-use planning are not understood by all people, particularly local communities.
- There is insufficient capacity to enforce laws relating to forest management, biodiversity conservation and environmental protection at all levels, with the result that the illegal exploitation of natural resources is widespread.
- Awareness of environmental issues is low among local people, and environmental management staff at all levels.
- Significant areas of the Central Truong Son Landscape are affected by dioxin and other pollutants, with serious implications for human health and biodiversity.
- There is insufficient cooperation between central and local level institutions in biodiversity survey, capacity building and environmental management.
- There is a lack of a centralised information management system for biodiversity data, with the result that only a small proportion of data are easily accessible to environmental managers and policy makers.

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APPENDIX I: PROVISIONAL LIST OF PRIORITY VASCULAR PLANT TAXA IN PRIORITY LANDSCAPE CA1

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
Polypodiophyta														
Aspleniaceae														
<i>Diplazium platyklamys</i>						X							EC	
Cyatheaceae														
<i>Cyathea salletii</i>					X								EV	
Dennstaedtiaceae														
<i>Lindsaea dissectiformis</i>										X			EV	
Dryopteridaceae														
<i>Tectaria triglossa</i>					X								EV	
Pinophyta														
Amentotaxaceae														
<i>Amentotaxus poilanei</i>						X					VU	T	EC	W
Cephalotaxaceae														
<i>Cephalotaxus mannii</i>		X				X	X	X			VU	R		W
Cupressaceae														
<i>Fokienia hodginsii</i>		X		X		X		X		X	NT	K		W, M
Cycadaceae														
<i>Cycas chevalieri</i>	X													O
<i>C. inermis</i>		X	X											O
<i>C. micholitzii</i>										X		V		O
<i>C. pectinata</i>		X	X			X						V		O
<i>C. simplicipinna</i>	X													O
Gnetaceae														
<i>Gnetum formosum</i>						X							EV	
Pinaceae														
<i>Keteleeria evelyniana</i>		X				X						V		
<i>Pinus dalatensis</i>					X	X		X		X	VU	R	EI	W, M
<i>P. merkusii</i>		X					X			X	VU			W
<i>P. wangii</i>		X									EN			
Podocarpaceae														
<i>Nageia fleuryi</i>		X		X	X	X		X	X			V		W

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
<i>Podocarpus neriifolius</i>	X	X		X	X	X	X	X	X		DD			W
Magnoliophyta														
<i>Magnoliopsida</i>														
Acanthaceae														
<i>Justicia vagabunda</i>					X								EV	
<i>Phlogacanthus annamensis</i>										X			EV	
Aceraceae														
* <i>Acer erythranthum</i>									X		NT		EV	W
Anacardiaceae														
<i>Semecarpus annamensis</i>						X							EC	
Annonaceae														
<i>Artabotrys aeneus</i>										X			EC	
<i>Cyathocalyx annamensis</i>						X							EV	
<i>Goniothalamus albiflorus</i>										X			EV	
<i>Melodorum kontumense</i>										X			EC	
<i>Polyalthia corticosa</i>										X			EV	
<i>P. luensis</i>										X			EV	
Apocynaceae														
<i>Tabernaemontana buffalina</i>					X								EV	
Araliaceae														
<i>Panax vietnamensis</i>					X	X						E	EC	M
<i>Schefflera kontumensis</i>						X		X			EN		EC	M
Campanulaceae														
<i>Codonopsis javanica</i>					X	X						V		
Dipterocarpaceae														
* <i>Dipterocarpus baudii</i>					X				X		CR			W
<i>D. grandiflorus</i>		X									CR	R		W
* <i>D. hasseltii</i>		X									CR			W
* <i>D. kerrii</i>	X										CR			W
* <i>D. retusus</i>				X							VU			W
* <i>D. turbinatus</i>		X	X	X							CR			W
<i>Hopea hainanensis</i>				X					X		CR	K		W
* <i>H. odorata</i>				X							VU			W

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
<i>*H. pierrei</i>		X									EN	K		W
<i>*H. siamensis</i>		X		X							CR			W
<i>*Shorea roxburghii</i>		X						X			EN			W
<i>Vatica mangachapoi</i>		X									EN			W
Elaeocarpaceae														
<i>Elaeocarpus darlacensis</i>					X		X						EV	W
<i>E. kontumensis</i>					X		X	X					EV	W
Ericaceae														
<i>Craibiodendron scleranthum</i>								X	X		VU	R	EV	W
Euphorbiaceae														
<i>Alchornea annamica</i>						X	X	X					EV	
<i>Baccaurea silvestris</i>	X	X		X		X		X	X				EV	W
<i>Breynia septata</i>	X	X											EV	
<i>Croton maieuticus</i>										X			EV	
<i>*Deutzianthus tonkinensis</i>	X										NT			
<i>Macaranga eberhardtii</i>	X												EV	W
Fabaceae														
<i>Afzelia xylocarpa</i>								X			EN	V	EV	W
<i>Albizia poilanei</i>										X			EV	
<i>Archidendron dalatensis</i>										X			EV	
<i>A. pellitum</i>						X							EV	
<i>*Dalbergia balansae</i>	X			X							VU			W
<i>D. cochinchinensis</i>		X						X	X		VU	K	EV	W
<i>D. oliveri (D. bariaensis)</i>		X									EN	V		W
<i>Dialium cochinchinensis</i>								X	X		NT	K		W
<i>Erythrophleum fordii</i>	X	X									EN			W
<i>Pterocarpus macrocarpus</i>								X					K	
<i>Sindora siamensis</i>	X												K	
<i>S. tonkinensis</i>	X			X							DD	V		W
<i>Zenia insignis</i>				X							NT	R		
Fagaceae														
<i>Castanopsis echinophora</i>						X							EV	
<i>C. harmandii</i>						X							EV	

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
<i>Lithocarpus annamitorum</i>										X			EV	
<i>L. gagnepainianus</i>					X					X			EC	
<i>L. toumorangensis</i>										X			EC	
<i>Quercus augustinii</i>						X							EC	
<i>Q. fructiseptum</i>						X							EC	
<i>Q. kontumensis</i>										X			EC	
<i>Trigonobalanus cheloni</i>										X				W
Lamiaceae														
<i>Orthosiphon velterii</i>										X			EV	
Lauraceae														
<i>Cinnamomum balansae</i>						X					EN	R	EV	W
<i>C. songcaurianum</i>							X						EV	W
<i>C. parthenoxylon</i>	X			X				X	X		DD	K		W
Matixiaceae														
<i>Diplopanax vietnamensis</i>					X	X	X						EC	
Melastomataceae														
<i>Medinilla honbaensis</i>						X							EV	
<i>Melastoma osbeckioides</i>										X			EV	
Meliaceae														
<i>Aglaia silvestris</i>							X				NT			W
Myristicaceae														
<i>Horsfieldia longiflora</i>		X									VU			
<i>Knema pachycarpa</i>				X	X		X				VU			W
* <i>K. pierrei</i>	X			X			X				VU			W
<i>K. saxatilis</i>		X		X	X						VU			W
<i>K. sessiflora</i>		X			X						VU			W
<i>K. squamulosa</i>							X				VU			W
Nepenthaceae														
<i>Nepenthes annamensis</i>		X									DD	R	EV	
Proteaceae														
<i>Helicia stenophylla</i>						X							EV	
Rubiaceae														
<i>Lasianthus baviensis</i>						X							EV	

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
<i>L. caerulens</i>					X								EV	
Sabiaceae														
<i>Meliosma cinerea</i>						X							EC	
<i>M. kontumensis</i>										X			EC	
<i>Sabia kontumensis</i>						X							EC	
Sapindaceae														
<i>Amesiodendron chinense</i>			X	X							NT	T		
Sapotaceae														
<i>Madhuca pasquieri</i>	X	X		X		X					VU	K		W, M
Scrophulariaceae														
<i>Paulownia</i> sp. (sp. nova ?)							X						EC?	W
<i>Torenia scandens</i>										X			EV	
Styracaceae														
* <i>Rehderodendron macrocarpon</i>		X				X		X	X		NT			W
Symplocaceae														
<i>Symplocus banaensis</i>										X			EV	
Thymeleaceae														
<i>Aquilaria banaensis</i>		X									VU	T	EC	M
<i>A. crassna</i>	X	X		X	X	X	X	X	X		CR	E		M
<i>Liliopsida</i>														
Areaceae														
<i>Calamus poilanei</i>	X			X		X		X	X			K	EV	
Cyperaceae														
<i>Carex khei</i>						X							EV	
Orchidaceae														
<i>Anoetochilus lylei</i>						X	X	X	X					M, O
<i>A. roxburghii</i>								X	X			E		M, O
<i>Arachis annamensis</i>						X	X						EV	O
<i>Bulbophyllum hiepii</i>							X	X	X			R	EC	O
<i>B. evrardii</i>						X						R	EV	O
<i>B. ngoclinhensis</i>						X							EC	O
<i>B. tixieri</i>						X						R	EV	O
<i>Cleisocentron klossii</i>							X						EV	O

Species	Phong Dien & Dakrong	Bach Ma	Ban Dao Son Tra	West Quang Nam	Ngoc Linh (QN)	Ngoc Linh (KT)	Kon Plong	Kon Ka Kinh	Kon Cha Rang	Other sites in CA1	Global threat status	Vietnam threat status	Endemism	Economic Value
<i>Cymbidium schroederi</i>						X							EV	O
<i>Dendrobium amabile</i>	X	X					X					R	EV	O
<i>D. dentata</i>						X							EV	O
<i>D. ochraceum</i>								X	X			R	EC	O
<i>Epigeneium boniana</i>						X							EV	O
<i>E. chapaensis</i>		X				X		X					EV	O
<i>E. gagnepainii</i>						X							EV	O
<i>E. globulifera</i>						X							EV	O
<i>Eria spirodela</i>							X						EV	O
<i>Monomeria dichroma</i>						X						R	EV	O
<i>Otochilus fuscus</i>						X							EV	O
<i>Paphiopedilum appletonianum</i>		X				X	X					R		O
<i>Pholidota chinensis</i>					X	X		X					EI	O
<i>Renanthera annamensis</i>					X									O
<i>R. coccinea</i>		X		X										O
<i>R. imschootiana</i>								X						O
<i>Schoenorchis eberhardtii</i>						X							EV	O
<i>Vanda pumila</i>						X								O

Global threat status: CR = Critical; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient as per IUCN (2000). Species marked with an asterisk (*) are listed in IUCN (2000) but are common and widespread in Vietnam; the global threat status of these species may be in need of review.

Vietnam threat status: E = Endangered; V = Vulnerable; R = Rare; T = Threatened; K = Insufficiently known as per Anon. (1996).

Endemism: EI = endemic to Indochina; EV = endemic to Vietnam; EC = endemic to the Central Annamites Priority Landscape.

Economic Value: W = Wood; M = Medicine; O = Ornament.

References:

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 West Quang Nam Wikramanayake *et al.* (1997)
 Ngoc Linh (Quang Nam) Tordoff *et al.* (2000)
 Ngoc Linh (Kon Tum) Le Trong Trai *et al.* (1999a)
 Kon Plong Eames *et al.* (in press)
 Kon Ka Kinh Le Trong Trai *et al.* (2000)
 Kon Cha Rang Anon. (1999)

Additional data on vascular plant distributions within Priority Landscape CA1 were provided by Nguyen Tien Hiep, Phan Ke Loc, Vu Van Dung and Andrey Kuznetsov (pers. comm.)

APPENDIX II: PROVISIONAL LIST OF PRIORITY MAMMAL TAXA IN PRIORITY LANDSCAPE CA1

Common Name	Scientific Name	PD	BN	WQ	QN	KT	KP	KK	KC	XS	PA	DP	DA	No.	FLMEC	Status	VN	End.	Intrin.	Signif.	Priority
Chinese pangolin	<i>Manis pentadactyla</i>	S		S										2	1	NT	V		a,b	2a	1
Sunda pangolin	<i>M. javanica</i>	S	[X]	S		S	S	S	S		X	[X]		9	2	NT			a,b	2a	1
northern slow loris	<i>Nycticebus bengalensis</i>	S		S		S	[I]		S	[X]				6	Ind	[NT]	V		a,b	2a	2
lesser slow loris	<i>N. pygmaeus</i>		[X]	[I]			[I]			[X]	[X]	X		6	Ind	VU	V		a,b	1b	3
pig-tailed macaque	<i>Macaca nemestrina</i>	O		S		S	S	S	O		[X]		X	8	3	VU	V		a,b	2a	2
[Assamese macaque] ¹	[<i>M. assamensis</i>]									[X]	[X]			2	3	VU	V		a,b	2a	2
Rhesus macaque	<i>M. mulatta</i>	S	[X]	S	O	S				[X]	[X]			7	2	NT			a,b	2a	1
[long-tailed macaque] ²	[<i>M. fascicularis</i>]			[I]						[X]			[X]	3	3	NT			a,b	2a	1
bear macaque	<i>M. arctoides</i>	O	[X]	S	P	S	S	S	O		X		[X]	10	2/3	VU	V		a,b	2a	2
[silvered langur] ³	[<i>Semnopithecus cristatus</i>]									[X]		[X]	[X]	3	3/Ind	[VU]			a,b,f	2a	2
'red-shanked' Douc langur	<i>Pygathrix nemaeus nemaeus</i>	S	[X]	[I]						[X]	[X]	[X]	[X]	7	1	EN	E	EI	a,b,f	1a	4
['black-shanked' Douc langur] ⁴	[<i>P. n. nigripes</i>]								[X]					1	1	EN	V	EI	a,b,f	1a	4
'grey-shanked' Douc langur	<i>P. n. cinerea</i>				[O]		S	S	[S]					4	1	[EN]	n/e	EC?	a,b,f	1a	4
[white-cheeked crested gibbon (southern)] ⁵	[<i>Hylobates leucogenys siki</i>]	[H]		[H]		[H]				[X]	[X]		[X]	6	2	[EN]	E	EI	a,b,f	1a	4
yellow-cheeked crested gibbon	<i>Hylobates gabriellae</i>	[H]		[H]		[H]	O	H	H	[X]	[X]		[X]	9	2	VU		EI	a,b,f	1a	3
dhole	<i>Cuon alpinus</i>	[I]	[X]	[I]	S	[H]			[I]	[X]		[X]	[X]	9	1	VU	E		b,c,e	2a	2
Asiatic black bear	<i>Ursus thibetanus</i>	S	[X]	O	[T]	[I]	[I]	[I]	[I]	X	[X]	[X]	[X]	12	1	VU	E		a,b	2a	2
sun bear	<i>U. malayanus</i>	S		[I]		[I]	S			[X]	X		X	7	1	[VU]	E		a,b	2a	2
Eurasian otter	<i>Lutra lutra</i>	S		O	O	S			[T]					5	2	VU	T		b,d	2a	2
[smooth-coated otter] ⁶	[<i>Lutrogale perspicillata</i>]													0	2	VU	V		b,d	3a	1
Oriental small-clawed otter	<i>Aonyx cinerea</i>											[X]	X	2	2/3	NT	V		b,d	2a	1
[Taynguyen civet] ⁷	[<i>Viverra zibethica</i>]													0	Ind	[DD]	n/e	EV		1a	1
Owston's civet ⁸	<i>Hemigalus owstoni</i>													0	1/2	VU	R		f	1a	3
[Lowe's otter civet] ⁹	[<i>Cynogale lowei</i>]													0	1	EN	E	EV	b,d	1a	4
fishing cat	<i>Prionailurus viverrinus</i>												X	1	3	NT	R		d	2b	1
Asian golden cat	<i>Catopuma temminckii</i>	S	[X]	S	[T]	[I]	[I]						[X]	7	3/Ind	NT	V		a	2a	1
marbled cat	<i>Pardofelis marmorata</i>			S		S			S					3	3	[VU]	V		a	2a	2
clouded leopard	<i>P. nebulosa</i>	S		[I]	[T]	[I]	[I]		S	[X]			X	8	2	VU	V		a,e	2a	2
tiger	<i>P. tigris</i>	[I]		[I]	[I]	[I]		[T]	[T]	[X]		X	X	9	1	EN	E		a,c,e	2a	3
Asian elephant	<i>Elephas maximus</i>			[I]						[X]		X	X	4	1	EN	E		a,b,c	2a	3
[Heude's pig] ¹⁰	[<i>S. bucculentus</i>]									[X]				1	Ind	[DD]	n/e			1a	1

Common Name	Scientific Name	PD	BN	WQ	QN	KT	KP	KK	KC	XS	PA	DP	DA	No.	FLMEC	Status	VN	End.	Intrin.	Signif.	Priority
['Indochinese' greater Oriental chevrotain] ¹¹	[<i>Tragulus napu versicolor</i>]			[S]										1	2	[DD]	E	EI?		1a	1
['Indochinese' hog deer] ¹²	[<i>Axis porcinus annamiticus</i>]			[I]					[S]					2	1	[EN]	E	EI?	c,d,f	1a	4
large-antlered muntjac	<i>Muntiacus vuquangensis</i>	S		S		S			S	X	X	X	X	8	2	[VU]	n/e	EI	c,f	1a	3
<i>Muntiacus</i> 'taxon undetermined'	<i>Muntiacus</i> sp.								[X]	X		X		3	2	[DD]	n/e	EI	f	1a	2
Annamite muntjac	<i>M. truongsoneensis</i>			S	S	S	S	S			X			6	2	[VU]	n/e	EI	f	1a	3
gaur	<i>Bos gaurus</i>	[I]							[X]		[X]	X		4	1	VU	E		a,b,c	2a	2
southern serow	<i>Naemorhedus sumatraensis</i>	[T]		S	S	[I]	S	S	S	X	X	X	X	11	2	VU	V			2a	1
saola	<i>Pseudoryx nghetinhensis</i>	S		S								[X]		3	1	EN	n/e	EI	b,c,f	1a	4
[particolored flying squirrel] ¹³	[<i>H. alboniger</i>]								[O]					1	Ind	EN	R			2b	2
[Annamite striped rabbit] ¹⁴	[<i>Nesolagus timminsi</i>]													0	2/Ind	[DD]	n/e	EI		1a	1
Total number of priority taxa recorded at site to date		19	8	22	11	17	13	9	14	14	12	12	17								

Taxonomy follows the desk study (Timmins and Duckworth unpublished), apart from northern slow loris (*Nycticebus bengalensis*), lesser slow loris (*N. pygmaeus*) and Annamite striped rabbit (*Nesolagus timminsi*).

The list of priority mammal taxa only includes those species that received priority score 1 or higher in the analysis in this report. In addition, the list only includes those taxa for which Priority Landscape CA1 supports, or theoretically could support, a significant proportion of their population in the Forests of the Lower Mekong Ecoregional Complex; taxa that are suspected of having only marginal occurrence in relatively insignificant populations are excluded from the list. Taxa for which Priority Landscape CA1 is expected to support a significant population, but for which there are no confirmed records to date, are placed in square brackets, with an explanation given in the notes below.

Species in square brackets are not confirmed from Priority Landscape CA1 but are either provisionally recorded or predicted to occur based on known range and habitat requirements. If they are confirmed to occur to one or more sites in CA1, their priority level should be adjusted accordingly.

Site: PD = Phong Dien and Dak Rong; BN = Ba Na; WQ = western Quang Nam province; QN = Ngoc Linh (Quang Nam); KT = Ngoc Linh (Kon Tum); KP = Kon Plong; KK = Kon Ka Kinh; KC = Kon Cha Rang; XS = Xe Sap; PA = Phou Ahyon; DP = Dakchung Plateau; DA = Dong Ampham.

Data source: S = specimen; O = observation; P = phototrap picture; T = tracks or traces; H = heard; I = interview; X = unspecified record. Provisional records are placed in square brackets.

No. = Number of sites from which there are recent records (confirmed or provisional).

FLMEC = Priority level for the taxon within the Forests of the Lower Mekong Ecoregion Complex, as defined in the desk study: 1 = high priority; 2 = medium priority; 3 = low priority; 0 = no priority Ind = indeterminate priority.

Status: CR = Critical; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient; lc = least concern as per IUCN (2000). For species, the global threat status for the species as a whole is given; for subspecies, the global threat status for the subspecies is given; for taxa not assessed by IUCN or listed as Data Deficient, an assessment of their status is given in square brackets, based upon the opinion of the authors of the mammal desk study and the members of the Vietnamese biological advisory group.

VN (Threat status in Vietnam): E = Endangered; V = Vulnerable; R = Rare; T = Threatened as per the *Red Data Book of Vietnam* (Anon. 1992); n/e = not evaluated. For all taxa, the threat status in Vietnam refers to the species, apart from *Pygathrix nemaeus nemaeus* and *P. n. nigripes*, where it refers to the subspecies.

End. (Endemism): EI = endemic to Indochina; EV = endemic to Vietnam; EC = endemic to Priority Landscape CA1.

Intr. = Intrinsic susceptibility: a = trade; b = susceptible to hunting; c = wide-ranging species living at low densities; d = lowland wetland association; e = dependence on adequate prey base; f = susceptible to habitat degradation/fragmentation.

Significance of CA1 population:

1. Globally significant, if
 - a. endemic or near-endemic to FLMEC as per the desk study
 - or b. CA1 supports more than 10% of global population/range size of taxon
2. Regionally significant, if
 - a. not globally significant and recorded at at least two sites within CA1
 - or b. not globally significant and recorded at only one site within CA1 but believed to have been seriously under-recorded and presumed to be more widespread within CA1 than records suggest
3. Marginal, if
 - a. not globally significant and recorded at only one site within CA1

Priority score:

	Intrinsically susceptible	CR	EN	VU	NT/DD	lc	
	Not intrinsically susceptible		CR	EN	VU	NT/DD	lc
Globally significant population		5	4	3	2	1	0
Regionally significant population		4	3	2	1	0	0
Marginal occurrence		3	2	1	0	0	0

References:

- Phong Dien and Dak Rong Le Trong Trai *et al.* (1999a)
 Ba Na Le Vu Khoi (2000)
 West Quang Nam Wikramanayake *et al.* (1997)
 Ngoc Linh (Quang Nam) Tordoff *et al.* (2000)
 Ngoc Linh (Kon Tum) Le Trong Trai *et al.* (1999b)
 Kon Plong Eames *et al.* (in press)
 Kon Ka Kinh Le Trong Trai *et al.* (2000)
 Kon Cha Rang Robson *et al.* (1989), Anon. (1999)
 Xe Sap Duckworth *et al.* (1999), Steinmetz *et al.* (1999)
 Phou Ahyon Duckworth *et al.* (1999)
 Dakchung Plateau Duckworth *et al.* (1999)
 Dong Ampham Duckworth *et al.* (1999)

Notes:

1. Macaques observed at Xe Sap NBCA by Steinmetz *et al.* (1999) were provisionally identified as this species. Bergmans (1995) collected two macaque skulls from the Kaleum area, south of Xe Sap NBCA, which were identified as belonging to Assamese macaque. However, Bergmans (1995) quotes a personal communication with Dr J. Fooden, who states that “the evidence [for the identification] is somewhat ambiguous”. Consequently, this identification is best considered provisional. However, the occurrence of this species within Priority Landscape CA1 is to be expected (R. Timmins *in litt.* 2001).
2. Much of Priority Landscape CA1 lies within the hybrid zone of Rhesus and long-tailed macaques. Within the hybrid zone, however, only a small proportion of macaques are believed to be hybrids: most animals are identifiable either as Rhesus or long-tailed macaque (Fooden 1997). To date, there are no confirmed records of long-tailed macaque from Priority Landscape CA1, only provisional records from Dong Ampham NBCA and the area south of Xe Sap NBCA (Bergmans 1995, Davidson *et al.* 1997).
3. This species is provisionally listed as occurring at Xe Sap and Dong Ampham NBCAs and on the Dakchung plateau (Duckworth *et al.* 1999).
4. The only records of this taxon from Priority Landscape CA1 are from Kon Cha Rang Nature Reserve (Lippold 1995, 1998). However, the same author also reported the occurrence of Hatinh langur (*Semnopithecus francoisi hatinhensis*) and Phayre’s langur (*Semnopithecus phayrei*) from this site (Lippold and Vu Ngoc Thanh 1995), which is extremely doubtful given current knowledge about the ranges and habitat requirements of these species. Furthermore, the photograph labelled as *Pygathrix nemaesus nigripes* in Lippold (1998), is actually grey-shanked Douc langur (*P. n. cinerea*) (Nadler 1997). Consequently, doubt is cast upon Lippold’s records of black-shanked Douc langur (which may have been misidentifications of grey-shanked Douc langur), and further surveys are required to clarify the taxon’s status at the site.
5. The southern limit of *Hylobates leucogenys siki* in Vietnam and Lao P.D.R. is currently unknown. Data on vocalisations and skin colouration collected over a large area between the ranges of typical *H. l. siki* and *H. gabriellae* suggest a more complex situation than a simple boundary or limited hybrid zone between the two taxa (Geissmann *et al.* 2000). Geissmann *et al.* (2000) consider that all gibbon records from Dak Rong proposed nature reserve south to Ngoc Linh (Kon Tum) Nature Reserve could refer to either *H. l. siki* or *H. gabriellae*.
6. Although this species is mapped as occurring within Priority Landscape CA1 by Corbet and Hill (1992), there are no recent confirmed records.
7. There is considerable doubt over the validity of this species, which may be synonymous with large Indian civet (*Viverra zibetha*) (Walston and Veron 2001).
8. Although this species is not mapped as occurring within Priority Landscape CA1 by Corbet and Hill (1992), there are confirmed records from the southern part of the priority Landscape: Rozhnov *et al.* (1991) collected two specimens from the Kon Ha Nung area in north-eastern Gia Lai province.
9. There are no records of this species from the Forests of the Lower Mekong Ecoregion Complex. The species is, however, predicted to occur considering its Sudaic affinities (Timmins and Duckworth unpublished), and may occur within Priority Landscape CA1.
10. The only record of this species from Priority Landscape CA1 to date is an unconfirmed interview record from the southern border of Xe Sap NBCA (Showler *et al.* 1998). This species is, however, known to occur at Nam Theun Extension PNBCA to the north (Duckworth *et al.* 1999), and, if the localities for the original type material are correct, it is also known historically from the southern Annamites (R. Timmins *in litt.* 2001). Given the lack of information about the identification, distribution and habitat requirements of this species, its occurrence within Priority Landscape CA1 would not be surprising.
11. There are no recent confirmed records of this species from Priority Landscape CA1. There is, however, a provisional record of this species from western Quang Nam province (Wikramanayake *et al.* 1997).
12. This species is mapped as occurring within Priority Landscape CA1 by Corbet and Hill (1992) and Dang Huy Huynh *et al.* (1994), and there is an unconfirmed record from Kon Cha Rang Nature Reserve based on two specimens and reports from local hunters; as this site supports small areas of swamp forest, the occurrence of Hog Deer, at least historically, is feasible (Anon. 1999, Le Trong Trai verbally 2001).
13. This species is mapped as occurring within Priority Landscape CA1 by Corbet and Hill (1992) and Dang Huy Huynh *et al.* (1994), and there is an unconfirmed record from Kon Cha Rang Nature Reserve (Anon. 1999).
14. To date, there are no records of this recently described species from Priority Landscape CA1. This species is known to occur further north in the Annamite mountains, in both Vietnam and Lao P.D.R., and, given that the distribution and habitat requirements of this species are still poorly known, its occurrence within Priority Landscape CA1 cannot be ruled out.

APPENDIX III: PROVISIONAL LIST OF PRIORITY BIRD TAXA IN PRIORITY LANDSCAPE CA1

Common Name	Scientific Name	DK	PD	BM	BN	QN	KT	KP	KK	KC	XS	PA	DP	DA	No	Status	VN	End.	RRS	Intrin.	Signif.	Priority	
Annam partridge*	<i>Arborophila merlini</i>	X	X	X											3	[EN]		EV	RRS	a,b	1a	3	
imperial pheasant	<i>Lophura imperialis</i>	X													1	DD	E	EV	RRS	a,b	1a	2	
Edwards's pheasant	<i>Lophura edwardsi</i>	X	X	X											3	EN	E	EV	RRS	a,b	1a	4	
[Vietnamese pheasant]	[<i>Lophura hatinhensis</i>]														0	EN	E	EV	RRS	a,b	2b	3	
Siamese fireback	<i>Lophura diardi</i>	X	X	X			X		X	X			[X]	X	7	NT	T			a,b	1b	2	
crested argus	<i>Rheinardia ocellata</i>	X	X	X	X	X	X	X		X	[X]	X		[X]	9	VU	T		RRS	a,b,e	1a	3	
green peafowl	<i>Pavo muticus</i>			X							[X]			[X]	1	VU	R			a,e	3a	1	
[white-winged duck]	[<i>Cairina scutulata</i>]													[X]	0	EN	V			c,e	3c	1	
red-collared woodpecker	<i>Picus rabieri</i>		X	X						X				X	4	NT	T				1b	1	
great hornbill	<i>Buceros bicornis</i>						X	X	X	X	X			X	6	NT	T			d,e,f	2a	1	
brown hornbill	<i>Anorrhinus tickelli</i>		X	X	X	X	X	X	X	X				X	9	NT	T			d,e,f	2a	1	
Blyth's kingfisher	<i>Alcedo hercules</i>	X	X	X						X	X				5	NT	T			c	2a	1	
coral-billed ground cuckoo	<i>Carpococcyx renauldi</i>		X	X											2	lc	T			a	1b	1	
[pale-capped pigeon]	[<i>Columba punicea</i>]														0	VU	T			f	3b	1	
masked finfoot	<i>Heliopais personata</i>									X				X	2	VU	R			c,e	1b	3	
grey-headed fish eagle	<i>Ichthyophaga ichhyaetus</i>			X						X					2	NT				c,e	2a	1	
[white-rumped vulture]	[<i>Gyps bengalensis</i>]														0	CR				e,g,h	3b	3	
[long-billed vulture]	[<i>Gyps indicus</i>]														0	CR				e,g,h	3b	3	
[greater spotted eagle]	[<i>Aquila clanga</i>]														0	VU				e,g	3b	1	
[imperial eagle]	[<i>Aquila heliaca</i>]														0	VU				e,g	3b	1	
[lesser adjutant]	[<i>Leptoptilos javanicus</i>]														0	VU	R			c,e,h	3b	1	
yellow-billed nuthatch	<i>Sitta solangiae</i>					X	X	X	X		X	X	X		7	NT	T		RRS	b	1a	2	
[Manchurian reed warbler*]	[<i>Acrocephalus tangorum</i>]														0	VU	n/e			c	3b	1	
black-hooded laughingthrush	<i>Garrulax milleti</i>					X	X	X	X	X		X		X	7	NT	R	EI	RRS	b	1a	2	
chestnut-eared laughingthrush	<i>Garrulax konkakinhensis</i>							X	X			[X]			2	[VU]	n/e	EC	RRS	b	1a	3	
golden-winged laughingthrush	<i>Garrulax ngoclinhensis</i>					X	X	X							3	VU	n/e	EC	RRS	b	1a	3	
short-tailed Scimitar babbler	<i>Jabouilleia danjoui</i>	X	X	X			X	X	X	X					7	NT	T	EI	RRS	b	1a	2	
black-crowned barwing	<i>Actinodura sodangorum</i>						X							X	2	VU	n/e	EC	RRS	b	1a	3	
Total number of priority species confirmed to occur at site		7	9	11	2	5	9	8	7	10	3	3	2	6									

Species names (common and scientific), order and species limits follow Inskipp *et al.* (1996), apart from species marked with an asterisk (*).

For species in square brackets, there are no confirmed recent records from Priority Landscape CA1. Rather, these species are either provisionally recorded, known from the priority landscape historically or expected to occur as vagrants. If they are confirmed to be resident at or a visitor to one or more sites in CA1, their priority level should be adjusted accordingly.

Sites: DK = Dak Rong; PD = Phong Dien; BM = Bach Ma; BN = Ba Na; QN = Ngoc Linh (Quang Nam); KT = Ngoc Linh (Kon Tum); KP = Kon Plong; KK = Kon Ka Kinh; KC = Kon Cha Rang; XS = Xe Sap; PA = Phou Ahyon; DP = Dakchung Plateau; DA = Dong Ampham.

No. = Number of sites from which there are confirmed recent records

Status: CR = Critical; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient; lc = least concern as per the 2000 IUCN Red List of Threatened Species (IUCN 2000). For species not evaluated by IUCN (2000), the most appropriate status in the first author's opinion is given in square brackets.

VN (Threat status in Vietnam): E = Endangered; V = Vulnerable; R = Rare; T = Threatened as per the Red Data Book of Vietnam (Anon. 1992); n/e = not evaluated.

End. (Endemism): EI = endemic to Indochina (Vietnam, Lao P.D.R. and Cambodia); EV = endemic to Vietnam; EC = endemic to Priority Landscape CA1.

RRS = Restricted-range Species as per Stattersfield *et al.* (1998).

Intrin. (Intrinsic susceptibility): a = ground dwelling; b = small range; c = lowland wetland association; d = congregatory; e = susceptible to hunting; f = fruit eating; g = open habitats, largely those supporting people; h = dependence on adequate prey base of large mammals

Signif. (Significance of CA1 population):

1. Globally significant,
 - if a. restricted-range species, confirmed resident at or regular visitor to at least one site
 - or b. CA1 supports more than 10% of global population/range size of species
2. Regionally significant,
 - if a. confirmed resident at or regular visitor to at least two sites
 - or b. restricted-range species, provisionally recorded from CA1
3. Marginal,
 - if a. confirmed resident at or regular visitor to only one site
 - or b. vagrant to CA1
 - or c. provisionally recorded from CA1

Priority score:

	Intrinsically susceptible	CR	EN	VU	NT/DD	lc	
	Not intrinsically susceptible		CR	EN	VU	NT/DD	lc
Globally significant population		5	4	3	2	1	0
Regionally significant population		4	3	2	1	0	0
Marginal occurrence		3	2	1	0	0	0

References:

Dak Rong	Le Trong Trai <i>et al.</i> (1999b)	Kon Ka Kinh	Le Trong Trai <i>et al.</i> (2000)
Phong Dien	Le Trong Trai <i>et al.</i> (1999b)	Kon Cha Rang	Robson <i>et al.</i> (1989), Anon. (1999)
Bach Ma	Eve (1996)	Xe Sap	Duckworth <i>et al.</i> (1999), Steinmetz <i>et al.</i> (1999)
Ba Na	Hill <i>et al.</i> (1996)	Phou Ahyon	Duckworth <i>et al.</i> (1999)
Ngoc Linh (Quang Nam)	Tordoff <i>et al.</i> (2000)	Dakchung Plateau	Duckworth <i>et al.</i> (1999)
Ngoc Linh (Kon Tum)	Le Trong Trai <i>et al.</i> (1999a)	Dong Ampham	Duckworth <i>et al.</i> (1999)
Kon Plong	Eames <i>et al.</i> (in press)		

APPENDIX IV: PROVISIONAL LIST OF PRIORITY REPTILE TAXA IN PRIORITY LANDSCAPE CA1

Common Name	Scientific Name	LA	DK	PD	BN	WQ	QN	KT	KP	KK	No. in Lao P.D.R.	Priority	Intrinsic R.suscept.	Status	VN	End.	Signif.	Priority
Turtles	Testudinata																	
big-headed turtles	Platysternidae																	
big-headed turtle	<i>Platysternon megacephalum</i>	[I]	[I]	[I]		[S]		[D]	S		6	High	High	EN	R		2	3
typical turtles	Emydidae																	
[Indochinese box turtle]	<i>[Cuora galbinifrons]</i>		[I]	[I]		[S]		[D]			4	High	High	CR	V		1	5
[Chinese three-striped box turtle]	<i>[Cuora trifasciata]</i>		[I]			[O]		[D]			3	Acute	High	CR	V		1	5
leaf turtle species	<i>Cyclemys spp</i>	O									1		High	lc		EI?	1	1
[black-breasted leaf turtle]	<i>[Geoemyda spengleri]</i>				[X]	[D]		[D]			3		High	EN			1	4
[Annam leaf turtle]	<i>[Mauremys annamensis]</i>					[D]					1		High	CR			3	3
[Asian yellow pond turtle]	<i>[Mauremys mutica]</i>										0		High	EN			3	2
[keeled box turtle]	<i>[Pyxidea mouhotii]</i>					[S]		[D]			2	High	High	EN			2	3
[four-eyed turtle]	<i>[Sacalia quadriocellata]</i>					[D]					1	Ind	High	EN			3	2
Tortoises	Testudinidae																	
[elongated tortoise]	<i>[Indotestudo elongata]</i>	[I]		[I]		[O]		[D]	[I]		5	High	High	EN	V		2	3
impressed tortoise	<i>Manouria impressa</i>	O			[X]	[S]			[I]	S	5	High	High	VU	V		2	2
Softshell Turtles	Trionychidae																	
[Asiatic softshell turtle]	<i>[Amyda cartilaginea]</i>	O		[I]							2	Ind	High	VU			2	2
[wattle-necked softshell turtle]	<i>[Palaia steinachneri]</i>		[I]	[I]		[S]		[D]			4		High	EN			1	4
[Chinese softshell turtle]	<i>[Pelodiscus sinensis]</i>		[I]	[I]							2		High	VU			2	2
Snakes	Serpentes																	
Pythons	Boidae																	
Burmese python	<i>Python molurus</i>	[I]	[I]	[I]	[X]	[D]		[I]	P	O	8	Ind	High	NT	V		2	1
Crocodiles	Crocodylia																	
Crocodiles	Crocodylidae																	
[Siamese crocodile]	<i>[Crocodylus siamensis]</i>	[I]									1	Acute	High	CR	E		3	3

Taxonomy follows Duckworth *et al.* (1999), except for species not recorded in Lao P.D.R., for which it follows Nguyen Van Sang and Ho Thu Cuc (1996).

Species in square brackets are only provisionally recorded from Priority Landscape CA1. If they are confirmed to occur, their priority level should be adjusted accordingly.

Sites: LA = Lao P.D.R.; DK = Dak Rong; PD = Phong Dien; BN = Ba Na; WQ = western Quang Nam province; QN = Ngoc Linh (Quang Nam); KT = Ngoc Linh (Kon Tum); KP = Kon Plong; KK = Kon Ka Kinh.

No. = Number of sites from which there are recent records. For the purposes of the analysis, the Laotian component of Priority Landscape CA1 is treated as a single site.

Priority in Lao P.D.R. follows Duckworth *et al.* (1999); Acute = Acute National Priority; High = High National Priority; Ind = Indeterminate National Priority.

Intrinsic susceptibility: High = population in Priority Landscape CA1 seriously threatened by trade.

Status: CR = Critical; EN = Endangered; VU = Vulnerable; NT = Near Threatened as per the 2000 IUCN Red List of Threatened Species (IUCN 2000).

VN (Threat status in Vietnam): E = Endangered; V = Vulnerable; R = Rare as per the Red Data Book of Vietnam (Anon. 1992).

End. (Endemism): EI = endemic to Indochina.

Signif. (Significance of CA1 population):

1. Globally significant, if
 - a. endemic to Indochina
 - or b. CA1 supports more than 10% of global population/range size of species
2. Regionally significant, if
 - a. not globally significant and recorded at at least two sites within CA1
3. Marginal, if
 - a. not globally significant and recorded at only one site within CA1

Priority score:

	Intrinsically susceptible	CR	EN	VU	NT/DD	lc	
	Not intrinsically susceptible		CR	EN	VU	NT/DD	lc
Globally significant population		5	4	3	2	1	0
Regionally significant population		4	3	2	1	0	0
Marginal occurrence		3	2	1	0	0	0

References:

Lao P.D.R.	Duckworth <i>et al.</i> (1999), Steinmetz <i>et al.</i> (1999)	Ngoc Linh (Quang Nam)	Tordoff <i>et al.</i> (2000)
Dak Rong	Le Trong Trai <i>et al.</i> (1999b)	Ngoc Linh (Kon Tum)	Le Trong Trai <i>et al.</i> (1999a)
Phong Dien	Le Trong Trai <i>et al.</i> (1999b)	Kon Plong	Eames <i>et al.</i> (in press)
Ba Na	Le Vu Khoi (2000)	Kon Ka Kinh	Le Trong Trai <i>et al.</i> (2000)
Western Quang Nam	Wikramanayake <i>et al.</i> (1997)		

Notes: following Duckworth *et al.* (1999), only specimen records, sight records of the more easily identified species and photographic records of species of unambiguous taxonomy are considered as confirmed records. Unconfirmed records appear in square brackets. All records from western Quang Nam province are considered provisional.

APPENDIX V: PROVISIONAL LIST OF PRIORITY FRESHWATER FISH TAXA IN PRIORITY LANDSCAPE CA1

Species	XK	XS	BA	SA	Status
Clupeiformes					
Chanidae					
<i>Chanos chanos</i>				X	T
Clupeidae					
<i>Clupanodon thrissa</i>				X	V
<i>Clupanodon punctatus</i>	X			X	V
Anguilliformes					
Anguillidae					
<i>Anguilla marmorata</i>		X		X	R
Cypriniformes					
Cyprinidae					
<i>Onychostoma laticeps</i>				X	V
<i>Altigena lemassoni</i>				X	V
<i>Spinibarbus caldwelli</i>				X	V
<i>Spinibarbichthys denticulatus</i>				X	V
<i>Probarbus jullieni</i>	X	X			T
<i>Cirrhinus microlepis</i>		X			T
<i>Morulus chrysophekadion</i>		X			T
<i>Cosmocheilus harmandi</i>		X			T
<i>Tor tambroides</i>	X	X	X		V
<i>Megalobrama terminalis</i>				X	V
Siluriformes					
Claridae					
<i>Clarias batrachus</i>		X		X	T
Bagridae					
<i>Hemibagrus elongatus</i>				X	V
<i>Cranoglanis sinensis</i>				X	V
Sisoridae					
<i>Bagarius bagarius</i>	X	X	X		V
Perciformes					
Lobotidae					
<i>Datnioides quadrifasciatus</i>	X				R
Ophiocephaliformes					
Ophiocephalidae					
<i>Ophiocephalus micropeltes</i>		X			T
<i>Ophiocephalus striatus</i>		X		X	T

Status: V=Vulnerable; T = Threatened; R = Rare as per the *Red Data Book of Vietnam* (Anon. 1992).

Distribution: XK = Xe Kong river basin; XS = Xe San river basin; BA = Ba river basin; SA = Southern Annamites.

APPENDIX VI: PROVISIONAL LIST OF PRIORITY BUTTERFLY TAXA IN PRIORITY LANDSCAPE CA1

Taxon	Habitat	Elevation range (m)	CA1a	CA1b	Notes
Papilionidae					
<i>Troides helena</i>	Lowland and montane evergreen forest, forest edge, and secondary vegetation	300-1,500	X	X	Potential trade threat
<i>T. aeacus</i>	Lowland and montane evergreen forest, forest edge, and secondary vegetation	300-1,500	X	X	Potential trade threat
<i>Byassa polyeuctes</i>	Montane evergreen forest	700-1,500		X	Endemic to Indochina
<i>B. dasarada</i>	Montane evergreen forest	700-1,500		X	Endemic to Indochina
<i>Pachliopta coon</i>	Lowland evergreen forest and secondary vegetation	0-300	X		Rare
<i>Chilasa epicides</i>	Montane evergreen forest and riverine forest	700-1,500		X	Rare; isolated population
<i>C. agestor</i>	Montane evergreen forest	>1,500		X	Rare; isolated population
<i>Papilio noblei</i>	Lowland evergreen forest	0-300	X		Rare
<i>P. dialis doddsi</i>	Open areas, clearings in evergreen forest, forest edge and secondary vegetation	300-1,500	X	X	Endemic to South-East Asia
<i>P. arcturus</i>	Evergreen forest on mountain tops	>1,500		X	Rare
<i>Teinopalpus imperialis</i>	Evergreen forest on mountain tops (male), deep montane evergreen forest (female)	>1,500		X	Rare; CITES listed; potential trade threat
<i>Meandrusa sciron</i>	Evergreen forest on mountain tops, and montane evergreen forest	>700		X	Rare
<i>Pazala glycerion</i>	Evergreen forest on mountain tops, and forested mountain streams	>1,500		X	Rare; isolated populations
<i>Graphium cloanthus</i>	Mountain tops, in the vicinity of evergreen forest	>1,500		X	Rare
Pieridae					
<i>Delias belladonna ssp.</i>	Mountain tops, and forest canopy near mountain streams	>1,500		X	Isolated endemic race
<i>D. vietnamensis</i>	Montane evergreen forest: canopy (males) and deep forest (females) (possible <i>Fokienia hodginsii</i> association)	1,000-1,500		X	Endemic to Priority Area CA1
<i>Talbotia naganum</i>	Montane riverine forest	700-1,500	X	X	Isolated endemic race
Satyridae					
<i>Lethe siderea</i>	Montane bamboo forest	>1,500		X	Rare
<i>L. dura ssp.</i>	Montane bamboo forest	>1,500		X	Rare; isolated race
<i>L. distans</i>	Close to or in montane evergreen forest	700-1,500		X	Rare; isolated population
<i>L. latiaris</i>	Montane evergreen forest understorey	~1,500		X	Rare
<i>L. konkakini</i>	Montane evergreen forest understorey	~1,500		X	Endemic to Priority Area CA1
<i>Neope bhadra</i>	Montane evergreen forest and forest edge	1,000-1,500		X	Isolated race
<i>N. armandii ssp.</i>	Montane evergreen forest and forest edge	1,000-1,500		X	Isolated race
<i>Neorina neosinca</i>	Montane evergreen forest	>1,500		X	Very rare; recently described species
<i>Orinoma damaris</i>	Montane evergreen forest	>1,500		X	Very rare
<i>Ypthima dohertyi</i>	Understorey of montane evergreen forest	1,000-1,500		X	Isolated population
<i>Y. similis</i>	Understorey of montane evergreen forest	1,000-1,500		X	Distinctive, isolated race
Amathusiidae					
<i>Aemona amathusia</i>	Montane bamboo forest	>1,500		X	Distinctive, isolated race
<i>Aemona sp. nov.</i>	Montane bamboo forest	>1,500		X	Endemic to Priority Area CA1
<i>Faunis aerope</i>	Montane bamboo forest	1,000-1,500		X	Distinctive, isolated race
<i>Zeuxidia sp. nov.</i>	Lowland evergreen forest	200-600	X		Endemic to Priority Area CA1
<i>Stichopthalma louisa</i>	Interior of evergreen forest (mostly in mountains)	300-1,000	X	X	Endemic to Vietnam
<i>S. uemurai</i>	Understorey of flat evergreen forest	500-600		X	Distinctive, isolated race; endemic to Vietnam
<i>Amathuxidia amythaon</i>	Undergrowth of primary lowland evergreen forest	0-300	X		Very rare; highly sensitive to disturbance

Taxon	Habitat	Elevation range (m)	CA1a	CA1b	Notes
Nymphalidae					
<i>Limenitis rileyi</i>	Montane evergreen forest, near forested rocky streams	>1,500		X	Distinctive, isolated race
<i>Bassarona francaiae</i>	Montane evergreen forest, near forested rocky streams	>1,500		X	Very rare
<i>Calinaga sudassana</i>	Riverine forest along wide, flat rivers	700-1,000		X	Very rare; distinctive, isolated race
Riodinidae					
<i>Dodona katerina</i>	Montane evergreen forest	1,000-1,700		X	Endemic to Priority Area CA1
<i>D. speciosa</i>	Montane evergreen forest	>1,500		X	Endemic to Priority Area CA1
<i>Paralaxita telesia</i>	Flat montane forest	700-1,000		X	Distinctive, isolated race
Lycaenidae					
<i>Heliophorus emeraldus</i>	Vegetation in the vicinity of rocky mountain streams	>1,500		X	Endemic to Priority Area CA1
<i>Ravenna nivea</i>	Montane evergreen forest	1,000-1,500		X	Very rare; isolated population
Hesperiidae					
<i>Capila pauripunctata</i>	Interior of montane evergreen forest, and rocky montane streams	1,000		X	Endemic to Vietnam
<i>C. lidderdali</i>	Interior of montane evergreen forest, and rocky montane streams	1,000		X	Isolated population
<i>Pintara capilloides</i>	Interior of lowland evergreen forest	500-700	X		Endemic to Priority Area CA1

Data on priority butterfly taxa in Priority Landscape CA1 were provided by Alexander Monastyrskii.

APPENDIX VII: THE CONSERVATION LANDSCAPE FOR PRIORITY LANDSCAPE CA1

The conservation landscape for Priority Landscape CA1 comprises six priority 1 areas, six priority 2 areas and two (provisionally defined) priority 3 areas. This appendix contains more detailed information about each priority 1 and priority 2 area than is contained in the main document.

Summary data for priority 1 areas defined during the biological assesement

Priority 1 area	Area (ha)	A (%)	B (%)	C (%)
Phong Dien/Dak Rong	137,634	54.7	14.7	54.0
Xe Sap/Nam Thua Thien Hue	295,104	63.9	24.4	45.3
Bach Ma/Ba Na/Hai Van	98,121	68.4	17.9	51.9
Ngoc Linh/Song Thanh/Phou Ahyon	431,412	66.4	10.8	35.9
Dong Ampham	146,156	77.8	24.0	62.0
Kon Ka Kinh/Kon Cha Rang	318,500	68.2	33.0	33.6
Whole network	1,426,927	66.5	21.0	42.9

Key: A = percentage of priority area supporting habitat of high conservation importance
 B = percentage of habitat of high conservation importance more than 2 km from the habitat edge
 C = percentage of habitat of high conservation importance more than 5 km from human settlement

Summary data for priority 2 areas defined during the biological assesement

Priority 2 area	Area (ha)	A (%)	B (%)	C (%)
A Luoi	16,254	48.4	1.8	11.5
East Dong Ampham	30,999	62.5	18.6	25.9
Dak To	58,275	39.0	0.6	29.7
Thach Nham	25,263	26.8	0.0	7.6
Dak Choong	3,189	22.2	0.0	19.5
Xe Kong/Quang Nam	182,291	61.1	18.7	32.0
Whole network	316,271	53.4	14.6	29.0

Key: A = percentage of priority area supporting habitat of high conservation importance
 B = percentage of habitat of high conservation importance more than 2 km from the habitat edge
 C = percentage of habitat of high conservation importance more than 5 km from human settlement

The Phong Dien/Dak Rong priority 1 area

Description: The Phong Dien/Dak Rong priority 1 area is centred on Phong Dien and Dak Rong proposed nature reserves, and includes adjacent areas, one of which is under the management of Huong Hoa Forest Enterprise. The priority 1 area supports a significant area of habitat of high conservation importance with high integrity, which is believed to be important for a number of conservation foci, including primates, wide-ranging large mammals, lowland galliformes, saola and tiger.

Total area: 137,634 ha

Biogeographical unit(s): Sub-landscape CA1a

Existing protected area(s): Phong Dien, Dak Rong

Forest enterprise(s) (Vietnam only): Huong Hoa

Watershed protection forest(s) (Vietnam only): none

Administrative units: Thua Thien Hue province (Phong Dien, A Luoi and Huong Tra districts), Quang Tri province (Dak Rong district)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	23,894	42,935	222
300 - 700 m	34,574	17,707	2
700 - 1,200 m	15,311	1,501	0
1,200 - 1,500 m	1,487	1	0
> 1,500 m	0	0	0
Total	75,266	62,144	224

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	18,329	10,207	3,301	13,288	237
300 - 700 m	31,944	17,986	1,172	8,391	3,815
700 - 1,200 m	15,311	11,638	311	2,437	5,912
1,200 - 1,500 m	1,487	802	13	164	1,081
> 1,500 m	0	0	0	0	0
Total	67,071	40,633	4,797	24,280	11,045

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Bo	231.3	61.2	26.5
Huong	4.3	0.6	14.5
Olau	162.9	53.9	33.1
Quang Tri	374.5	101.3	27.0

Focal taxa and groups:

Saola: confirmed

Tiger: confirmed

Wide-ranging large mammals: gaur (unconfirmed)

All primates: red-shanked Douc langur (confirmed)

Lowland galliformes: Annam partridge (confirmed), Edwards's pheasant (confirmed), Imperial pheasant (confirmed)

Endemic and near-endemic animal taxa: *Zeuxidia* sp. nov. and *Pintara capilloides* (confirmed)

The Xe Sap/Nam Thua Thien Hue priority 1 area

Description: The Xe Sap/Nam Thua Thien Hue priority 1 area comprises Xe Sap NBCA and a large area of southern Thua Thien Hue province, which is currently under the management of A Luoi, Nam Dong, Nam Hoa, Huong Giang, Huong Thuy and Khe Tre Forest Enterprises. The priority 1 area supports a large area of habitat of high conservation importance over a wide altitudinal range. However, there is a need to rehabilitate areas of habitat of medium conservation importance into habitat of high conservation importance, in order to consolidate the transition between low and high elevations. The priority 1 area is believed to be important for a number of conservation foci, including wide-ranging large mammals, Saola, eels in the genus *Anguilla* and rapids.

Total area: 295,104 ha

Biogeographical unit(s): Sub-landscapes CA1a, Sub-landscape CA1c

Existing protected area(s): Xe Sap

Forest enterprise(s) (Vietnam only):

A Luoi, Nam Dong, Nam Hoa, Huong Giang, Huong Thuy, Khe Tre

Watershed protection forest(s) (Vietnam only): none

Administrative units: Thua Thien Hue province (A Luoi, Huong Thuy, Huong Tra and Nam Dong districts), Xe Kong province, Salavan province

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	20,867	20,784	17
300 - 700 m	43,698	32,478	12,983
700 - 1,200 m	82,464	33,891	3,276
1,200 - 1,500 m	30,844	2,663	96
> 1,500 m	10,624	417	2
Total	188,497	90,233	16,374

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	18,609	11,184	3,646	13,206	1,027
300 - 700 m	34,813	14,897	2,212	13,340	5,252
700 - 1,200 m	69,477	31,289	3,275	18,758	15,999
1,200 - 1,500 m	29,672	19,556	1,028	5,568	16,588
> 1,500 m	10,567	8,549	239	1,964	7,072
Total	163,138	85,475	10,400	52,836	45,938

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Bo	63.0	14.9	23.6
Huong	472.5	132.1	28.0
Xe Bang Hieng	64.4	23.1	35.9
Xe Kong	227.5	107.5	47.3

Focal taxa and groups:

Saola: confirmed

Tiger: confirmed

Wide-ranging large mammals: gaur (confirmed)

All primates: red-shanked Douc langur (confirmed)

Eels in the genus *Anguilla*: *A. marmorata* (confirmed)Endemic and near-endemic animal taxa: *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Zeuxidia* sp. nov., *Stichophthalma louisa eamesi*, *Dodona katerina*, *Dodona speciosa*, *Heliophorus emeraldus*, *Ravenna nivea* and *Pintara capilloides* (predicted)

The Bach Ma/Ba Na/Hai Van priority 1 area

Description: The Bach Ma/Ba Na/Hai Van priority 1 area is the smallest priority 1 area in the conservation landscape. The priority 1 area incorporates Bach Ma National Park, Ba Na Nature Reserve, and Bac Hai Van and Nam Hai Van proposed cultural and historical sites. The priority 1 area may be important for the conservation of such conservation foci as lowland galliformes and primates.

Total area: 98,121 ha

Biogeographical unit(s): Sub-landscape CA1a, Sub-landscape CA1b

Existing protected area(s): Ba Na, Bach Ma, Bac Hai Van, Nam Hai Van

Forest enterprise(s) (Vietnam only): Song Nam, Nam Dong, Khe Tre, Phu Loc

Watershed protection forest(s) (Vietnam only): Hoa Trung

Administrative units: Thua Thien Hue province (Nam Dong and Phu Loc districts), Da Nang city (Hoa Vang and Lien Chieu districts)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	11,908	12,179	4,099
300 - 700 m	36,222	10,242	2,111
700 - 1,200 m	18,480	2,213	29
1,200 - 1,500 m	523	115	0
> 1,500 m	0	0	0
Total	67,133	24,749	6,239

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	9,381	2,848	1,194	4,990	181
300 - 700 m	35,283	18,815	884	5,672	7,065
700 - 1,200 m	18,463	12,772	380	2,089	4,447
1,200 - 1,500 m	523	421	15	19	304
> 1,500 m	0	0	0	0	0
Total	63,650	34,856	2,473	12,770	11,997

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Ca De	323.9	165.6	51.1
Huong	243.3	84.8	34.9
Thu Bon	67.5	22.5	33.3

Focal taxa and groups:

Saola: confirmed

Tiger: confirmed

Wide-ranging large mammals: gaur (unconfirmed)

All primates: red-shanked Douc langur (confirmed)

Lowland galliformes: Annam partridge (confirmed), Edwards's pheasant (confirmed)

Endemic and near-endemic animal taxa: Owston's civet (unconfirmed), *Zeuxidia* sp. nov. and *Pintara capilloides* (confirmed)

Endemic and near-endemic plant taxa: forest dominated by *Parashorea stellata*

The Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area

Description: The Ngoc Linh/Song Thanh/Phou Ahyon priority 1 area is the largest priority 1 area in the conservation landscape. The priority 1 area comprises a section of the main Annamite spine, and associated areas of lower elevation to the north-east. The priority 1 area incorporates Ngoc Linh (Kon Tum) Nature Reserve, and Ngoc Linh (Quang Nam) and Song Thanh proposed nature reserves. The priority 1 area supports the greatest altitudinal transition of habitat of high conservation importance in the priority landscape, and is of high importance for a number of conservation foci, especially endemic and near-endemic plant and animal taxa.

Total area: 431,412 ha

Biogeographical unit(s): Sub-landscape CA1b, Sub-landscape CA1c

Existing protected area(s): Song Thanh, Ngoc Linh (Kon Tum), Ngoc Linh (Quang Nam)

Forest enterprise(s) (Vietnam only):

Tra My, Thu Bon, Prao, Ngoc Linh, Phuoc Son, Rung Thong

Watershed protection forest(s) (Vietnam only): none

Administrative units: Quang Nam province (Giang, Phuoc Son, Tra My, Que Son, Hien, Dai Loc and Hiep Duc districts), Xe Kong province, Kon Tum province (Dak Glei, Dak To and Kon Plong districts)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	26,524	32,572	1,306
300 - 700 m	89,366	53,568	1,675
700 - 1,200 m	81,632	27,856	2,244
1,200 - 1,500 m	45,140	12,863	1,905
> 1,500 m	43,869	9,513	1,379
Total	286,531	136,372	8,509

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	21,452	9,945	3,259	13,131	274
300 - 700 m	68,971	34,842	2,697	18,027	3,266
700 - 1,200 m	57,005	30,096	4,497	20,427	11,306
1,200 - 1,500 m	32,384	9,643	5,504	17,926	7,229
> 1,500 m	40,015	18,362	1,498	10,574	8,954
Total	219,827	102,888	17,455	80,085	31,029

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Thu Bon	1,203.2	451.2	37.5
Xe Kong	45.6	33.5	73.4
Xe San	24.0	7.3	30.4

Focal taxa and groups:

Tiger: unconfirmed

Wide-ranging large mammals: Asian elephant (confirmed)

All primates: red-shanked Douc langur (confirmed), grey-shanked Douc langur (confirmed)

Commercially valuable catfish: *Hemibagrus elongatus* (confirmed)

Endemic and near-endemic animal taxa: *Lethe konkakini*, *Aemona* sp. nov., *Dodona speciosa* and *Heliophorus emeraldus* (confirmed), *Delias vietnamensis*, *Zeuxidia* sp. nov., *Stichophthalma louisa eamesi*, *Dodona katerina*, *Ravenna nivea* and *Pintara capilloides* (predicted)

Endemic and near-endemic plant taxa: *Amentotaxus poilanei*, formations of *Keteleeria evelyniana*, polydominant formations of *Dacrycarpus imbricatus* and *Dacrydium elatum*, monodominant formations of *Pinus dalatensis*, polydominant formations of *Fokienia hodginsii*, formations of *Erythrophleum fordii*, polydominant formations of *Dipterocarpus grandiflorus*, *D. retusus*, *D. kerrii* and *H. odorata*

The Dong Ampham priority 1 area

Description: The Dong Ampham priority 1 area is centred on Dong Ampham NBCA but also includes parts of Dak Ba and Dak Nhoong Forest Enterprises. The priority 1 area supports a large block of habitat of high conservation importance, most of which is more than 5 km from human settlement. The priority 1 area is expected, therefore, to support relatively intact biological communities. However, the location of most of the priority 1 area on the western side of the main Annamite chain indicates that it may be of lower importance for endemic and near-endemic taxa than other priority 1 areas.

Total area: 146,156 ha

Biogeographical unit(s): Sub-landscape CA1b, Sub-landscape CA1c

Existing protected area(s): Dong Ampham

Forest enterprise(s) (Vietnam only): Dak Ba, Dak Nhoong

Watershed protection forest(s) (Vietnam only): none

Administrative units: Attapu province, Xe Kong province, Kon Tum province (Dak Glei district)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	5,637	1,564	137
300 - 700 m	36,001	9,445	663
700 - 1,200 m	51,648	15,904	1,648
1,200 - 1,500 m	17,133	2,505	415
> 1,500 m	3,224	224	8
Total	113,643	29,642	2,871

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	5,581	4,781	1,825	3,849	851
300 - 700 m	34,992	31,337	2,084	11,008	6,814
700 - 1,200 m	45,866	23,631	3,289	19,681	13,618
1,200 - 1,500 m	15,762	8,331	879	5,308	5,294
> 1,500 m	3,199	2,338	85	719	687
Total	105,400	70,418	8,162	40,565	27,264

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Xe Kong	111.5	45.1	40.4
Xe San	110.4	55.5	50.2

Focal taxa and groups:

Tiger: unconfirmed

Wide-ranging large mammals: Asian elephant (unconfirmed), gaur (unconfirmed)

All primates: red-shanked Douc langur (confirmed)

Endemic and near-endemic animal taxa: *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Stichopthalma louisa eamesi*, *Dodona katerina*, *Dodona speciosa*, *Heliophorus emeraldus* and *Ravenna nivea* (predicted)

The Kon Ka Kinh/Kon Cha Rang priority 1 area

Description: The Kon Ka Kinh/Kon Cha Rang priority 1 area is centred on Kon Ka Kinh and Kon Cha Rang Nature Reserves and An Toan proposed nature reserve, and also includes significant areas in Kon Tum, Gia Lai and Binh Dinh provinces that are currently under forest enterprise management. The priority 1 area supports a large area of habitat of high conservation importance, with relatively high integrity. The priority 1 area is believed to have the greatest potential for the conservation of large mammals in the Vietnamese component of Priority Landscape CA1, both on the basis of existing populations, and the degree of habitat remaining. The priority 1 area is believed to be important for a number of conservation foci, including primates, commercially valuable catfish, wide-ranging large mammals, endemic and near-endemic plant and animal taxa, tiger, and, possibly, 'Indochinese' hog deer.

Total area: 318,500 ha

Biogeographical unit(s): Sub-landscape CA1b

Existing protected area(s): Kon Ka Kinh, An Toan, Kon Cha Rang

Forest enterprise(s) (Vietnam only): An Son, Tram Lap, Dak Roong, Tan Lap, Xa Nam, Krong Pa, Phu Cat, Ha Nung, Ka Nak, Tay Son, Mang Yang II, Mang Cang II, So Rai, Mang La

Watershed protection forest(s) (Vietnam only): Song Lieu

Administrative units: Gia Lai province (K'bang and Mang Yang districts), Binh Dinh province (Vinh Thanh, An Lao, Hoai An, Phu Cat, Tay Son and Phu My districts), Kon Tum province (Kon Plong district)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	16,545	21,872	3,388
300 - 700 m	49,921	31,511	3,571
700 - 1,200 m	122,892	29,147	6,216
1,200 - 1,500 m	24,501	5,082	207
> 1,500 m	3,278	368	1
Total	217,137	87,980	13,383

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	11,972	4,046	2,082	6,717	0
300 - 700 m	45,877	23,522	8,479	23,694	4,684
700 - 1,200 m	93,384	34,352	51,723	94,837	56,709
1,200 - 1,500 m	19,645	8,872	5,748	11,811	7,972
> 1,500 m	3,278	2,189	619	1,853	2,351
Total	174,156	72,981	68,651	138,912	71,716

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Ba	390.5	225.8	57.8
Con (Say)	578.5	240.7	41.6
Lai Giang	36.2	2.3	6.3
Tra Khuc	121.5	59.8	49.2
Ve	52.4	14.4	27.5
Xe San	55.6	21.8	39.1

Focal taxa and groups:

Tiger: confirmed

'Indochinese' hog deer: unconfirmed

Wide-ranging large mammals: Asian elephant (unconfirmed), gaur (unconfirmed)

All primates: red-shanked Douc langur (unconfirmed), grey-shanked Douc langur (confirmed)

Commercially valuable catfish: *Clarias batrachus* (confirmed)

Endemic and near-endemic animal taxa: Owston's civet (confirmed), *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Stichophthalma louisa eamesi*, *Stichophthalma uemurai*, *Dodona katerina*, *Dodona speciosa*, *Calinaga sudassana*, *Heliophorus emeraldus* and *Ravenna nivea* (confirmed)

Endemic and near-endemic plant taxa: monodominant formations of *Fokienia hodginsii*, monodominant formations of *Dacrydium elatum*, polydominant formations of *Dacrycarpus imbricatus*, polydominant formations of *D. imbricatus* and *D. elatum*, polydominant formations of *F. hodginsii*, *Pinus dalatensis* and *D. elatum*

The A Luoi priority 2 area

Total area: 16,254 ha

Biogeographical unit(s): Sub-landscape CA1a

Existing protected area(s): none

Forest enterprise(s) (Vietnam only): none

Watershed protection forest(s) (Vietnam only): none

Administrative units: Thu Thien Hue (A Luoi district), Quang Tri (Dak Rong district)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	6	0
300 - 700 m	3,439	4,250	6
700 - 1,200 m	4,412	4,091	31
1,200 - 1,500 m	19	0	0
> 1,500 m	0	0	0
Total	7,870	8,347	37

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	2,105	352	401	2,163	0
700 - 1,200 m	3,470	555	146	1,602	124
1,200 - 1,500 m	19	0	0	0	19
> 1,500 m	0	0	0	0	0
Total	5,594	907	547	3,765	143

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Quang Tri	4.4	0.0	0.0
Xe Kong	50.2	19.7	39.3

Focal taxa and groups:

Saola: unconfirmed

All primates: red-shanked Douc langur (unconfirmed)

Endemic and near-endemic animal taxa: *Zeuxidia* sp. nov. and *Pintara capilloides* (confirmed)

The East Dong Ampham priority 2 area**Total area:** 30,999 ha**Biogeographical unit(s):** Sub-landscape CA1b, Sub-landscape CA1c**Existing protected area(s):** none**Forest enterprise(s) (Vietnam only):** Dak Nhoong, Dak Plo**Watershed protection forest(s) (Vietnam only):** none**Administrative units:** Xe Kong province, Kon Tum province (Dak Glei district)**Summary data on terrestrial habitats within the priority area**

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	0	0
300 - 700 m	0	7	0
700 - 1,200 m	1,002	2,213	497
1,200 - 1,500 m	11,164	5,420	3,040
> 1,500 m	7,212	294	150
Total	19,378	7,934	3,687

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	0	0	0	0	0
700 - 1,200 m	1,001	18	77	558	43
1,200 - 1,500 m	8,730	2,091	1,321	4,913	317
> 1,500 m	6,163	2,906	327	2,154	3,243
Total	15,894	5,015	1,725	7,625	3,603

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Xe Kong	17.9	5.7	31.6
Xe San	6.0	1.4	22.5

Focal taxa and groups:

All primates: red-shanked Douc langur (unconfirmed)

Endemic and near-endemic animal taxa: *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Stichopthalma louisa eamesi*, *Dodona katerina*, *Dodona speciosa*, *Heliophorus emeraldus* and *Ravenna nivea* (predicted)

The Dak To priority 2 area

Total area: 58,275 ha

Biogeographical unit(s): Sub-landscape CA1b

Existing protected area(s): none

Forest enterprise(s) (Vietnam only): Dak To, Ngoc Linh, Po Ko

Watershed protection forest(s) (Vietnam only): none

Administrative units: Kon Tum province (Dak To, Ngoc Hoi and Dak Glei districts)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	0	0
300 - 700 m	0	14	4
700 - 1,200 m	6,253	16,335	685
1,200 - 1,500 m	10,389	12,508	636
> 1,500 m	6,099	5,204	148
Total	22,741	34,061	1,473

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	0	0	0	0	0
700 - 1,200 m	5,623	443	131	1,086	0
1,200 - 1,500 m	10,005	5,009	281	2,437	10
> 1,500 m	5,176	1,306	192	1,405	136
Total	20,804	6,758	604	4,928	146

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Xe San	77.2	7.6	9.8

Focal taxa and groups:

Endemic and near-endemic animal taxa: *Lethe konkakini*, *Aemona* sp. nov., *Dodona speciosa* and *Heliophorus emeraldus* (confirmed)

The Thach Nham priority 2 area**Total area:** 25,263 ha**Biogeographical unit(s):** Sub-landscape CA1b**Existing protected area(s):** none**Forest enterprise(s) (Vietnam only):** Tan Lap**Watershed protection forest(s) (Vietnam only):** Thach Nham**Administrative units:** Kon Tum province (Kon Plong district)**Summary data on terrestrial habitats within the priority area**

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	0	0
300 - 700 m	106	3,879	347
700 - 1,200 m	3,565	8,827	558
1,200 - 1,500 m	2,178	3,915	64
> 1,500 m	913	911	0
Total	6,762	17,532	969

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	70	36	3	54	0
700 - 1,200 m	1,742	413	55	653	0
1,200 - 1,500 m	1,440	0	233	745	0
> 1,500 m	913	62	58	152	0
Total	4,165	511	349	1,604	0

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Tra Khuc	48.5	2.3	4.8
Xe San	19.6	3.5	17.8

Focal taxa and groups:

Wide-ranging large mammals: Asian elephant (unconfirmed)

All primates: grey-shanked Douc langur (unconfirmed)

Endemic and near-endemic animal taxa: *Delias vietnamensis*, *Stichopthalma louisa eamesi*, *Dodona katerina* and *Ravenna nivea* (predicted)

The Dak Choong priority 2 area

Total area: 3,189 ha

Biogeographical unit(s): Sub-landscape CA1b

Existing protected area(s): none

Forest enterprise(s) (Vietnam only): Rung Thong

Watershed protection forest(s) (Vietnam only): none

Administrative units: Kon Tum province (Dak Gleis district)

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	0	0
300 - 700 m	0	0	0
700 - 1,200 m	277	1,205	345
1,200 - 1,500 m	264	589	182
> 1,500 m	166	150	11
Total	707	1,944	538

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	0	0	0	0	0
700 - 1,200 m	126	32	11	94	0
1,200 - 1,500 m	219	34	0	0	0
> 1,500 m	166	72	0	0	0
Total	511	138	11	94	0

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Thu Bon	2.5	0	0

Focal taxa and groups: none

The Xe Kong/Quang Nam priority 2 area

Total area: 182,291 ha

Biogeographical unit(s): Sub-landscape CA1b, Sub-landscape CA1c

Existing protected area(s): none

Forest enterprise(s) (Vietnam only): none

Watershed protection forest(s) (Vietnam only): none

Administrative units: Quang Nam province (Hien and Giang districts), Xe Kong province

Summary data on terrestrial habitats within the priority area

Elevation zone	Habitat of high conservation importance (ha)	Habitat of medium conservation importance (ha)	Habitat of low conservation importance (ha)
< 300 m	0	0	0
300 - 700 m	16,081	11,551	399
700 - 1,200 m	61,721	41,969	2,319
1,200 - 1,500 m	28,155	12,873	1,422
> 1,500 m	5,437	215	149
Total	111,394	66,608	4,289

Summary data on habitat of high conservation importance within the priority area

Elevation zone	Habitat of high conservation importance				
	> 2 km from human settlement (ha)	> 5 km from human settlement (ha)	On slopes < 2° (ha)	On slopes < 5° (ha)	> 2 km from edge of habitat patch (ha)
< 300 m	0	0	0	0	0
300 - 700 m	14,470	9,075	2,202	9,255	2,645
700 - 1,200 m	52,257	20,037	3,353	17,496	7,767
1,200 - 1,500 m	22,645	5,224	1,589	6,804	7,187
> 1,500 m	5,339	1,301	84	702	3,248
Total	94,711	35,637	7,228	34,257	20,847

Summary data on aquatic habitats within the priority area

Catchment	Total length (km)	Length bordered by habitat of high conservation importance (km)	Percentage bordered by habitat of high conservation importance (%)
Thu Bon	444.9	99.7	22.4
Xe Kong	69.6	33.1	47.5

Focal taxa and groups:

Saola: unconfirmed; Tiger: unconfirmed

All primates: red-shanked Douc langur (confirmed), grey-shanked Douc langur (confirmed).

Endemic and near-endemic animal taxa: *Delias vietnamensis*, *Lethe konkakini*, *Aemona* sp. nov., *Zeuxidia* sp. nov., *Stichopthalma louisa eamesi*, *Dodona katerina*, *Dodona speciosa*, *Heliophorus emeraldus*, *Ravenna nivea* and *Pintara capilloides* (predicted).

APPENDIX VIII: REPORT SERIES OF THE CENTRAL TRUONG SON INITIATIVE

Towards a Biodiversity Vision for the Forests of the Lower Mekong Ecoregion Complex
Compiled by: Michael C. Baltzer, Nguyen Thi Dao, and Robert G. Shore

a) Main Report

This report, commonly termed "the biovision", details the biodiversity of the Forests of the Lower Mekong Ecoregion Complex (FLMEC). The FLMEC is an amalgamation of four ecoregions - one of which is the Greater Truong Son. This report is responsible for the delineation of the Greater Truong Son Ecoregion. Within the report is a description of the ecoregion, its biological features of importance, and the threats faced by the ecoregion. The report goes further by identifying and ranking conservation priorities within the Greater Truong Son, with the ultimate goal of ensuring the conservation of all biodiversity of the ecoregion for future generations.

b) Technical Annex

The Technical Annex is the second document in the "biovision" series. This report expands on the information provided in the main report by providing more detailed information about each area identified as a conservation priority (termed a "priority landscape"). In addition, the Technical Annex contains condensed versions of the scientific desk studies on the birds, mammals, vegetation and fish of the entire FLMEC.

Socio-economic Scoping Report for the Forests of the Lower Mekong Ecoregion Complex
Compiled by: John Baker, Bruce McKenney and Jack Hurd

To compliment the large scale biological assessment conducted for the FLMEC, a socio-economic scoping study was also conducted.

This "situational analysis" is less detailed than the biological assessment, with the intention of providing only essential background information about the main threats to biodiversity and the underlying and exacerbating socio-economic factors. In conclusion, goals and recommendations for improving biodiversity conservation are outlined.

1. A Biological Assessment of the Central Truong Son Landscape

Compiled by: Andrew W. Tordoff, Robert J. Timmins, Robert J. Smith and Mai Ky Vinh

Biodiversity Advisory Group: Nguyen Xuan Dang (IEBR); Jack Tordoff (Birdlife International); Le Trong Trai (FIPI); Le Xuan Canh (IEBR); Nguyen Cu (IEBR/Birdlife International); Nguyen Tien Hiep (IEBR); Nguyen Kim Son (IEBR); Vu Van Dung (FIPI); Do Tuoc (FIPI); Pham Mong Giao (FPD); Tran Quoc Bao (FPD); Pham Nhat (Xuan Mai Forestry College); Phan Ke Loc (Hanoi University); Nguyen Van Sang (IEBR); Nguyen Huu Duc (Hanoi Pedagogical University); Rob Shore (WWF Indochina); Alexander Monastyrski (VRTC); Andrei Kouznetzov (VRTC).

This is the first report produced under the Central Truong Son Initiative. Covering one of the Greater Truong Son most critical priority landscapes, A Biological Assessment of the Central Truong Son Landscape follows a similar process to the "biovision" report for the Forests of the Lower Mekong Ecoregion Complex (FLMEC).

This report details the biological importance and status of the Central Truong Son Priority Landscape, and identifies threats to the region. Furthermore, the report outlines conservation priorities for the region and develops broad targets for each of these priorities. Subsequent Geographical Information Systems (GIS) analyses aid in defining a "conservation landscape" for the Central Truong Son Landscape.

2. Socio-economic Issues in the Central Truong Son Landscape

Compiled by: Nguyen Lam Thanh

This report provides an extensive overview of the socio-economic situation and issues found within the Vietnamese portion of the Central Truong Son priority landscape.

The report contains a great deal of "benchmark data" that is essential to planning for successful conservation and development efforts. This information highlights clear differences between provinces within the priority landscape, and to a lesser extent within individual provinces. Due to the diverse nature of the region, resulting from vast geographical, climatic and cultural differences, the benchmark data is needed to tailor conservation efforts to each area.

3. An Assessment of Development Initiatives in the Central Truong Son Landscape

Compiled by: Aylette Villemain, Herbert Christ, Nguyen Thanh Hai, Tran Kim Long, Bach Tan Sinh and Do Duc Tho

The Central Truong Son Initiative aims to combine successful biodiversity conservation with sustainable development. In order to achieve a balanced result, it is essential that existing and planned development initiatives are identified and integrated into conservation strategies.

This report focuses on the provinces located within the Vietnamese portion of the Central Truong Son priority landscape. Planned and existing development initiatives, such as road construction and poverty alleviation projects, are detailed in the report and the potential effects on conservation are commented upon.

4. Existing Land-use Management in the Central Truong Son Landscape

Compiled by: Tran An Phong

Research Team: Tran An Phong, Dao Van Can, Ta Hoa Binh và Nguyen Xuan Phuong

Within Vietnam, extensive work has been carried out in designating land-use management practices. This report attempts to pool the often confusing and scattered information into one cohesive map of existing land-use management practices in the Central Truong Son Landscape.

The main outputs of the study are detailed Geographical Information System (GIS) data and maps; they may be combined with additional data for further analyses. However, a brief accompanying report provides some explanation of land-use management within the Central Truong Son Landscape.

5. People, Land and Resources in the Central Truong Son Landscape

Compiled by: Huynh Thu Ba

Research Team: Huynh Thu Ba; Le Cong Uan; Vuong Duy Quang; Pham Ngoc Mau; Nguyen Ngoc Lung; Nguyen Quoc Dung

In addition to extensive biological and situational data, an understanding of how local communities utilize and interact with their environment is essential to developing effective and integrated conservation strategies.

This report aims to develop a more detailed understanding of the current issues related to people, land and resources - in particular Community Based Natural Resource Management (CBNRM). The study focuses on two pilot sites within the Central Truong Son Landscape, where extensive fieldwork was conducted. Detailed comparisons both within and between the sites are made and key recommendations are listed.

6. Tourism Potential of the Central Truong Son Landscape

Compiled by: Hoang Phuong Thao

Tourism within the region is a rapidly expanding sector. If developed properly, this could provide significant financial benefits to the inhabitants of the Greater Truong Son.

This report investigates existing tourist attractions and facilities with a view towards their potential enhancement. The study also examines the potential of developing additional tourism infrastructure, investigating the full range of possibilities (including ecotourism), as all tourism has the potential to either benefit or harm conservation in a direct or indirect manner.

7. Hunting and Collecting Practices in the Central Truong Son Landscape

Compiled by: Le Trong Trai, Dang Thang Long, Phan Thanh Ha and Le Ngoc Tuan

Phong Dien Nature Reserve (Thua Thien Hue Province) is a critical part of the Central Truong Son Landscape as it protects one of the last remnants of lowland forest and is home to important species such as Saola and Edward's pheasant.

This study builds on existing data collected from Phong Dien, and expands the scope to include seven villages. The study investigated which natural resources are used in the area, where they are collected from and their value in financial and cultural terms. The analyzed information points out a local dependence on natural resources.

WWF embarked on **Ecoregion-Based Conservation** in 1998 in response to concerns about the increasing pace of biodiversity loss and the need to increase the scale and integration of global conservation efforts. Thinking and acting across large scales (such as ecosystems, bioregions, or - in WWF's case - ecoregions) can better address both the need to conserve viable species populations and ecosystem processes, and the need to integrate conservation and human development.

Ecoregion conservation begins with the "Global 200" ecoregions - 238 large, biologically-defined regions identified as representing the highest priorities for conservation across all the Earth's major habitat types. The Forests of the Lower Mekong is a complex of four diverse and threatened ecoregions, three of which are listed as Global 200 ecoregions. Established in 1999, the Ecoregion Action Program (EAP) in the Forests of the Lower Mekong is currently working to conserve the beautiful and endangered biodiversity of two of these ecoregions - the Greater Truong Son and the Central Indochina Dry Forests.

The Greater Truong Son ecoregion comprises some of the world's most unique and threatened wildlife - from its charismatic endemic species such as the stunning Douc langur and the remarkable saola, to some of the world's most endangered and evocative species like the Asian elephant, tiger and Javan rhinoceros. The future of these, and many other species is dependant on successful, long-term conservation of the ecoregion as a whole that must be undertaken immediately, before they are lost forever. EAP in the Greater Truong Son aims to conserve this ecoregion through:

- Mobilising conservation throughout the entire Greater Truong Son ecoregion
- Protecting key sites and species through integrated conservation and development activities in priority landscapes
- Promoting a supportive policy environment for conservation and sustainable development
- Laying the foundations for lasting conservation

The Central Truong Son Initiative is a pilot initiative being developed by WWF's Greater Truong Son EAP in cooperation with the Governments of Vietnam and Lao P.D.R.. The aim of this fledgling initiative is to create partnership of a broad range of stakeholders - from local communities to government institutions and international organisations - working together to secure biodiversity conservation and sustainable development in the Central Truong Son Landscape.

WWF is one of the world's largest and most experienced conservation organizations, with almost five million supporters and a global network active in more than 90 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans can live in harmony with nature, by:

- Conserving the world's biological diversity
- Ensuring that the use of renewable natural resources is sustainable
- Promoting the reduction of pollution and wasteful consumption

WWF produced the Central Truong Son Initiative Report Series with the cooperation and support of the FPD and USAID.

Vietnam's Forest Protection Department (FPD) is a government partner in the Central Truong Son Initiative.

The FPD, located under the Ministry of Agriculture and Rural Development (MARD), is responsible for providing technical advice and guidance in regard to Special Use Forests, and for wildlife management and law enforcement.

The United States Agency for International Development (USAID), in conjunction with WWF-US, has generously provided funds towards the Central Truong Son Initiative.

USAID, an independent federal government agency, is the principal U.S. agency to extend assistance to countries recovering from disaster, trying to escape poverty, and engaging in democratic reforms.

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