Landscape High Conservation Values in East Kalimantan

Mapping & Recommended Management, with special focus on Berau and East Kutai Regencies

Prepared by

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Landscape High Conservation Values in East Kalimantan: Mapping and Recommended Management, with special focus on Berau and East Kutai Regencies

By Philip L. Wells[1], Gary D. Paoli[1], and Indrawan Suryadi[2]

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[1] Philip Wells and Gary Paoli are Directors of Daemeter Consulting an independent firm promoting sustainable and equitable management of natural resources.
[2] Indrawan Suryadi was an employee of Daemeter at the time of the report was prepared, and became an employee of TNC at the time the report was published.

Acknowledgements

The authors thank and acknowledge The Nature Conservancy (TNC) for its foresight to commission this groundbreaking study. The study's scope exceeded TNC's immediate site-based conservation management needs at the time, but makes available to the public a wide range of landscape-level data sets, analysis and threat assessment critically needed to highlight priorities for conservation action, especially in relation to spatial planning and private sector engagement. It is the first application of methods developed in the revised HCV Toolkit for Indonesia (*Guidelines for the Identification of High Conservation Values in Indonesia*) to identify so-called Landscape HCVs – values whose mapping requires looking at the broader landscape beyond a single management unit. The authors also wish to thank the people of United States of America through the United States Agency for International Development (USAID) and RAFT; Australian Government's Overseas Aid Program (AusAID); The Home Depot Alliance; and Xerox; whose funding made this work possible. A special mention should be made to Damayanti Buchori, Yana Suryadinata, Lex Hovani, Lenny Christy, and Ben Jarvis for their comments, and to Professor Lilik Budi Prasetyo for his independent peer review of an earlier draft.

Executive Summary

Overview

This report describes results of a landscape High Conservation Value (HCV) mapping project commissioned by The Nature Conservancy for East Kalimantan Province, Indonesia. The project was designed to support development and strategic planning for the TNC-initiated Berau Forest Carbon Program (BFCP). The report will be made available as a public domain resource to support private sector certification, land use planning and other sustainability initiatives in East Kalimantan that incorporate HCV principles and practices.

The Project Mapping Area covers four Physiographic Regions of eastern Kalimantan, modified slightly from RePPProT (1990), totalling c. 18,000,000 ha, or 91% of East Kalimantan province. Rare or Endangered Ecosystems (HCV3) were identified and mapped throughout this area. Within a smaller area of interest for Berau and Kutai Timur Regencies (c. 6,000,000 ha), Large Landscapes with Capacity to Maintain Natural Ecological Processes (HCV 2.1 and 2.2) were also mapped. Definitions and methods employed in the study follow the revised HCV Toolkit for Indonesia (2008), except where modified as noted in the text. Within Berau and East Kutai Regencies, a more detailed examination of threats to landscape HCVs is carried out, and management recommendations are provided aimed at maintaining these values.

The HCV Toolkit for Indonesia (2008) provides a detailed and objective approach to identify HCVs, but only limited and general guidance on management. In this report, we have developed refined management guidance considered suitable to maintain the HCVs identified (HCV 2 & 3). We believe this management guidance is applicable more generally for other landscapes in Indonesia and abroad, but it should be seen as work in progress intended to stimulate discussion.

Methods

Physiographic Regions

Physiographic Regions are composed of land systems grouped according to their general similarity and geographic position. The Physiographic Region is an intuitive concept that resembles how a geographer might subdivide a country into units for descriptive purposes, with each Region containing repeated motifs of land systems different from one another. Brief descriptions of the four Physiographic Regions are provided:

(i) Mahakam Lowlands
The region is approximately 5.2 million ha and is drained almost entirely by the lower and middle Mahakam River and its tributaries (Fig. 1.2.4). Most of the region is part of the Neogene Kutai Mahakam Basin that in more recent geological time has been uplifted and heavily folded and faulted. A central depression remains that forms the swampy area around the Mahakam lakes with extensive areas of peat soils.

(ii) Northern Lowlands
The region is approximately 3.1 million ha of lowlands drained by a number of rivers most notably the Berau, Kayan and Sesayap. The region is largely formed from the Paleogene Tarakan Basin and recent Quaternary deltic deposits.

(iii) Northern Mountain Ranges
This region is approximately 7.3 million ha and is mountainous, rising to more than 1,700 m in a few areas. The Region also contains a number of distinctive basins at the headwaters of East Kalimantan's major rivers, the most notable being the upper reaches of the Mahakam River, which forms an extensive lowland area within this Region. Geologically the region is formed from mainly turbiditic deposits and melange with some volcanic intrusions.

(iv) Nyapa Mangkalihat Mountains and Plains
This region of approximately 2.4 million ha, is a geanticlinal zone between the Tarakan and Kutai Mahakam Basins. The lithology of the area is sandstones, conglomerates and shale, with notable deposits of limestone that form karstic outcrops and plains.

Forest Cover Mapping

Past and present forest cover was mapped using on screen digitisation of Landsat imagery (Landsat 1-7) using over 88 scenes to produce c. 1975 and 2009 forest cover maps. *Forest was defined as: all closed canopy natural forest including logged over areas*. Highly degraded forests were also included if they appeared to have potential for recovery, following the principle (mapping rule) that the more highly degraded, homogeneous, and isolated from other natural forests a fragment might be, then the less likely such forests could recover and, therefore, more likely to be excluded from our forest cover map. Forests that had been completely destroyed by catastrophic fire in the recent past were excluded, irrespective of their state of re-growth in 2009. Areas of mature swidden fallow agriculture with long rotation times and at low density, embedded in a matrix of forest (as defined above), were generally included as forest, as they are too difficult to delineate reliably with Landsat, especially over such large areas (c.18,000,000 ha).

HCV3 Identification – Rare or Endangered Ecosystems

Forest cover maps were overlain with an ecosystem proxy map derived from the RePPProT land system classifications to measure past and present extent for each ecosystem proxy. East Kalimantan's land use plans (both current and proposed) were then used to project future extent of forested ecosystems, assuming legally defined Forest Lands will remain as forests and Non-forest Lands will be converted at some point in the future (e.g. to oil palm). Current loss and future expected loss were calculated for each ecosystem within each of the four Physiographic Regions per the Toolkit. The Toolkit's HCV 3 criteria of >50% current loss or >70% expected future loss were used to determine if a particular ecosystem is Endangered. In this study we also introduced the concept of a Critically Endangered HCV3 area (>90% loss), an attribute used later to provide more stringent management recommendations (Chapter 3).

Two tests were applied to determine if an ecosystem should be considered Rare under HCV 3. The first, as per the Toolkit, was any ecosystem comprising <5% of remaining natural vegetation within a Physiographic Region, and the second, which we propose as a more suitable alternative, was an ecosystem with an original extent comprising <1% of total area within a Physiographic Region. On closer examination of the criteria for Rarity defined in the Toolkit, and preliminary evaluation of mapping results, we believe the Toolkit set the criterion for Rare ecosystems too high. This is because: (a) most Physiographic Regions have 20 or more land systems present, and (b) if the extent of all land systems were equal and more than 20 were present, then all would be considered rare. This does not capture the essence of rarity, as intended by most. We therefore propose that in a future revision of the Toolkit, the criterion should be made more restrictive, for example, a 1% cut off. In addition, we would further propose that the criterion be measured against past natural vegetation cover, and not present as the Toolkit outlines, as this avoids the potential perverse outcome of an ecosystem that was naturally rare (<1%) being classified as common today due to greater loss of other ecosystem types.

HCV2.1 Identification – Large Landscapes

Using current forest cover for the Berau and East Kutai Regencies, we identified HCV 2.1 areas – *Large Natural Landscapes with capacity to maintain natural ecological processes and dynamics*. HCV 2.1 is defined as a cohesive landscape mosaic of natural ecosystems with a size and configuration comprising both: (i) a core area of >20,000 ha, where internal fragmentation is absent or limited, surrounded by (ii) a vegetation buffer of 3 km from the external landscape border to the Core Zone.

For purposes of delineating the buffer, the forest cover map was modified to remove small gaps of less than c. 200 m in width to create the *effective* forest area. Water bodies contiguous with the forest were not considered as gaps in the landscape, as they are an integral natural part of it. The size of each core area (>3 km from landscape edge) found within the effective forest area was then tested against the minimum size requirement of 20,000 ha to establish which forest units are considered HCV 2.1 landscapes.

HCV 2.2 Identification – Areas with two or more contiguous ecosystems

Following methods defined in the Toolkit, HCV 2.2 areas were mapped based on the phase boundaries between altitudinal, wetland, and heath forest transitions determined from the juxtaposition of ecosystem proxies. The Toolkit provides limited guidance on how an HCV 2.2 ecotone should be mapped, even less for how it should be managed. The extent and form of all three ecotones are very difficult to model with any sort of precision, so as a precautionary measure, a 3 km zone was delimited along the extent of all ecosystem transitions. This was deemed appropriate for the spatial scale of large landscapes, and ensures that natural ecosystem processes should be maintained within such a generous buffer.

Peer Review

A draft of this report was completed in May 2010 and provided to TNC for review. An external peer review was commissioned in late 2010, performed by Professor Lilik Budi Prasetyo. The review focused largely on technical aspects of forest cover mapping, and reported a total of 630 ha of forest cover misclassification (corresponding to an error rate of 0.01%). The peer review and Daemeter response can be downloaded here (www.daemeter.org).

HCV Identification

Within the four physiographic regions (c.18,000,000 ha) the extent of natural ecosystems in c. 1975 was c. 17 million ha. Since that date, 30% (c. 5,000,000 ha) of this area has been lost, leaving c. 12 million ha of natural (and largely disturbed) ecosystems remaining (Figure A). Losses were not equally distributed, with only a 2% loss in the Northern Mountain Ranges compared to a 76% loss in the Mahakam Lowlands. A large part of Mahakam Lowland losses were caused by catastrophic fires of 1982/83 and 1997/98. Based on land use plans, a further c. 2 million ha of natural ecosystems are expected to be lost due to planned (legal) conversion.

Reflecting ecosystem variation throughout this region, a total of 40 terrestrial land systems (excluding river and lakes) are present in the Project Mapping Area. This is more than 80% of the 49 land systems found throughout Kalimantan. Applying HCV 3 criteria for Endangered status, c. 1.5 million ha of remaining natural ecosystems are classified as Endangered (c. 13% of the remaining area). Of this, c. 1 million ha are Endangered due to current losses of >50% of their original extent, and a further c. 0.5 million ha are Endangered due to future expected losses (Figure B). Thirty-two of 40 ecosystem proxies are classified as HCV 3 in at least one Region. The extent and number of Endangered ecosystems was not evenly distributed, with 28 of 35 ecosystems present in the heavily impacted Mahakam Lowlands classified as Endangered (c. 1 million ha), representing two-thirds of the total extent of Endangered ecosystems throughout the Mapping Area. In contrast, the heavily forested Northern Mountain Ranges contain almost no endangered ecosystems. It must be emphasized, however, that when landscape mapping results are used for site level HCV assessments, e.g. in oil palm plantations or logging concessions, ground verification of ecosystem types and forest cover mapping must be performed.

The extent of ecosystems meeting criteria for Rare is c. 563,000 ha according to the <1% threshold, and c. 1,221,000 by the <5% threshold. Using the <1% criterion, 39 of the 42 ecosystem proxies in the Mapping Area were found to be rare in one or more Region. This large number may seem surprising, but it emphasizes one strength of using Physiographic Regions to contextualize rarity (and this HCV 3 status), by accounting for ecosystems being common in some regions but rare in others where they carry local ecological significance. The Mahakam Lowlands has the highest proportion of Rare ecosystems, with 31 of 35 ecosystem types considered Rare under HCV 3.

In regard to HCV 2.1 within Berau and East Kutai Regencies (c. 6 million ha), a total of 62 landscape blocks were identified with Core Areas (i.e. possess an interior >3km from forest edge). Of these, only three were found to meet the HCV 2.1 criterion of supporting a Core Area >20,000 ha (Figure C). The largest, Hulu Kelai-Telen, is c. 1,300,000 ha, and forms part of the mountains and foothills of the central Borneo mountain range. It covers much of the western half of the two Regencies. The second, Mangkalihat Peninsula, is c. 400,000 ha, and contains the largest extent of Karst forest on Borneo. The third, Tanjung Batu Peninsula, is much smaller (c. 40,000 ha) and comprises a complex mosaic of mixed dipterocarp, heath and swamp forests.

HCV 2.2 ecosystem transition zones were found to be extensive, with c. 1,400,000 ha of elevational transitions; 250,000 ha of heath to non-heath transition zones; and 230,000 ha of wetland to non-wetland transitions (Figure D). Large parts of these were overlapping, especially between heath and the other transition zones. Many of the ecosystem transitions of all three types were found to occur within Cores Areas of HCV 2.1 Large Landscapes and Core Areas of non-HCV2.1 landscape blocks, and as such show good potential for long term management to maintain this important ecological attribute.

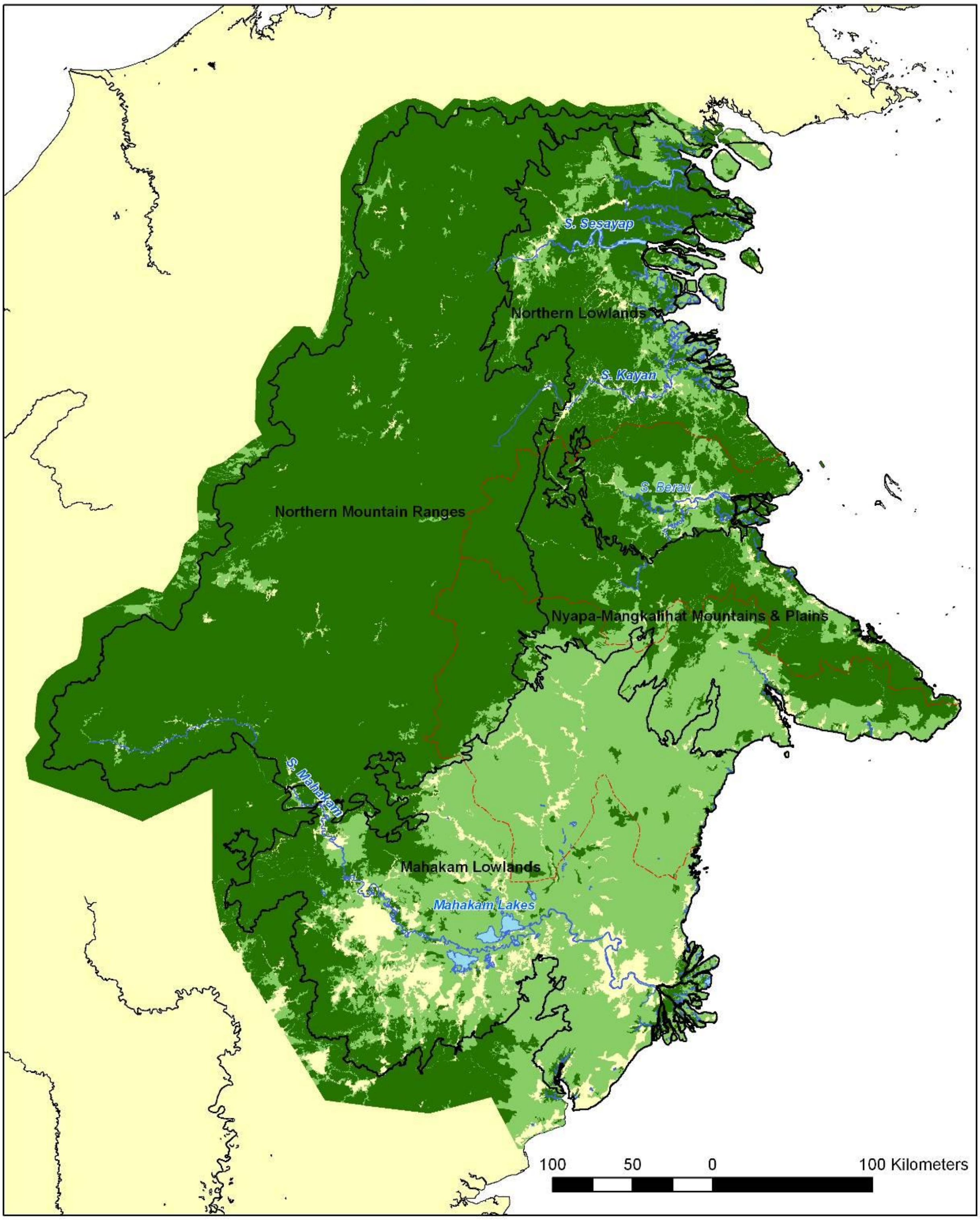


Figure A. Past and present forest cover and water bodies. Dark green depicts forest cover 2009; light green is forest cover c. 1975. Also shown are boundaries of the four Physiographic Regions (black) and Berau and Kutai Timor Regencies (red).

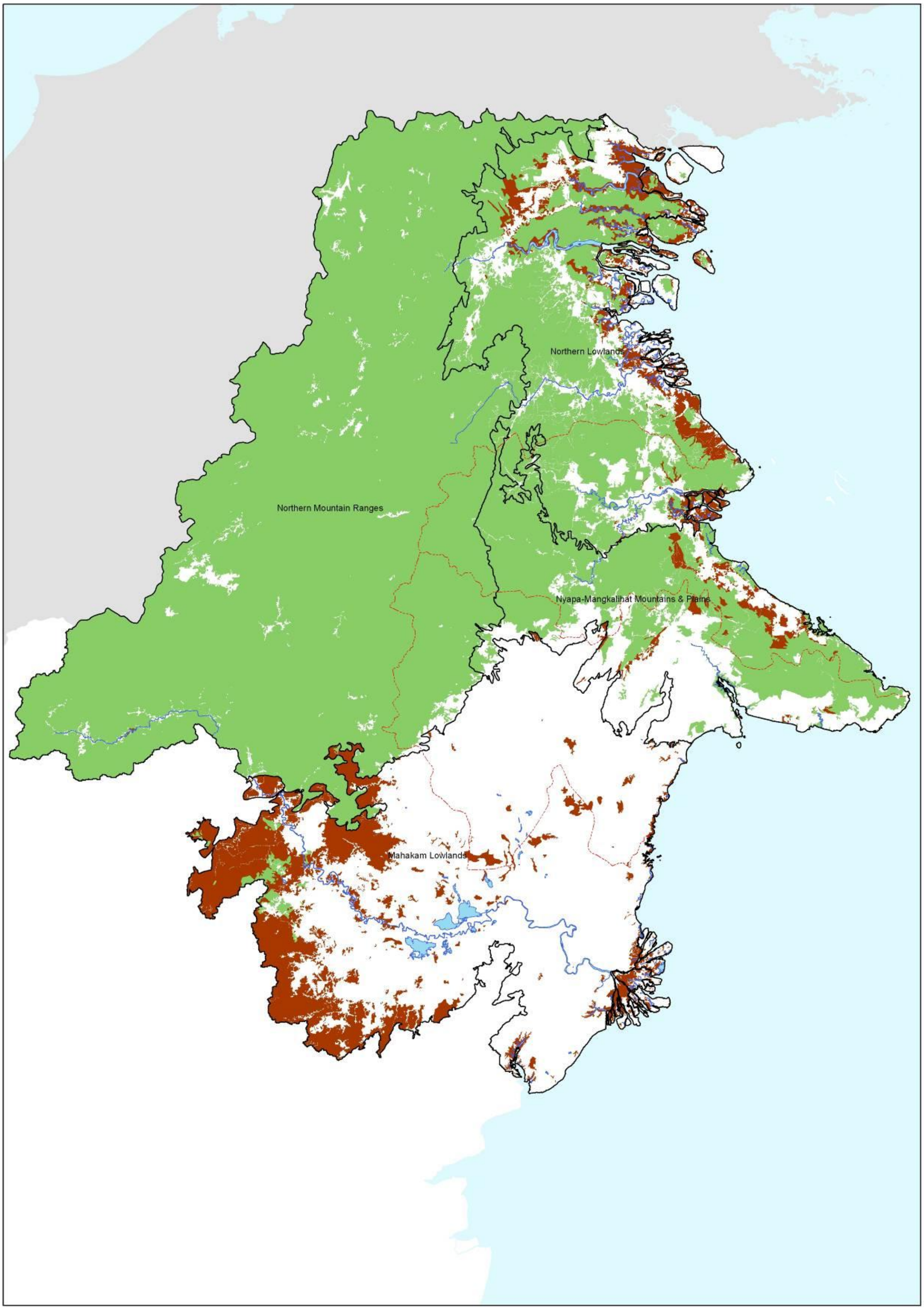


Figure B. Current extent of Endangered Ecosystems (HCV 3) as a result of current forest loss and future expected land cover change based on existing Provincial land use plans. HCV 3 areas are shown in burnt orange; non-HCV 3 areas in light green.

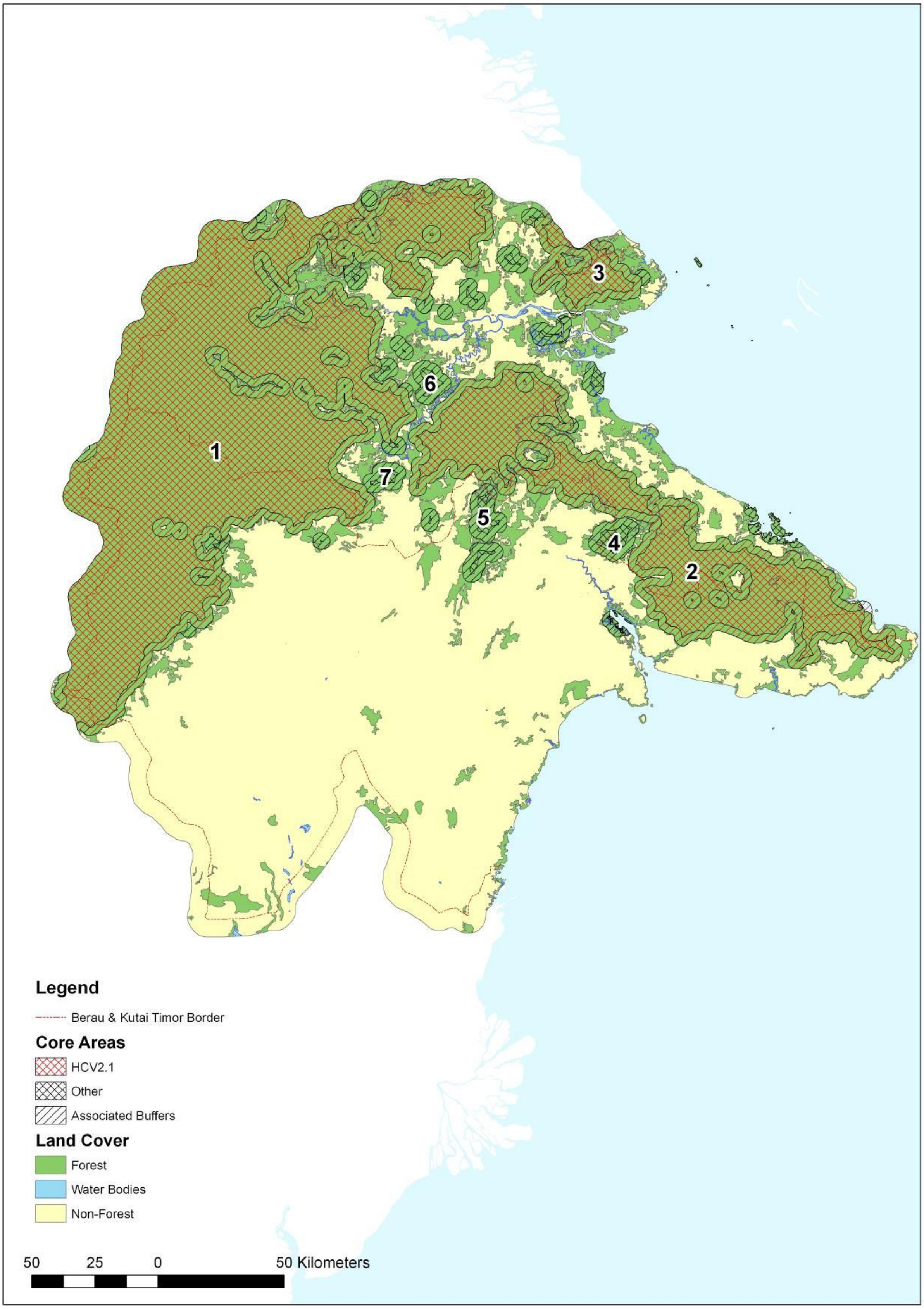


Figure C.A map of three HCV 2.1 Large Landscape blocks supporting Core Areas greater than 20,000 ha (cross hatched red, numbered 1, 2, & 3). Associated 3-km buffers (red stripes), and other landscape blocks too small to meet HCV 2.1 criteria (4-7) are also shown.

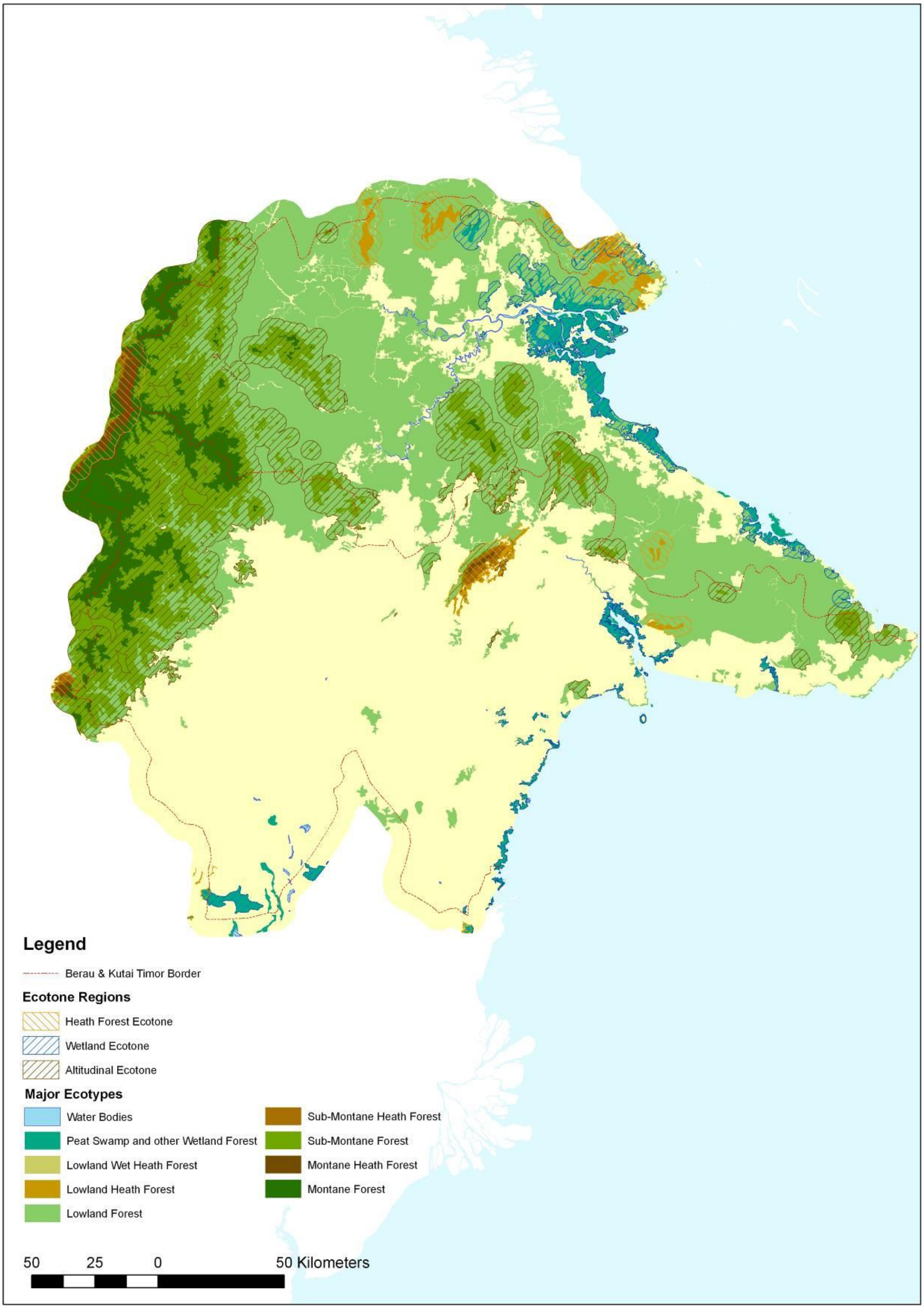


Figure D. Ecosystem Transitions zones (HCV 2.2) between specified major ecosystem types, with a 3 km buffer applied to either side of the transition boundaries.

HCV Management Recommendations

The approach employed to develop management recommendations for landscape HCVs within the area of interest (Berau and East Kutai Regencies, c. 6.1 million ha) was first to examine general threats to the HCV 2.1 landscapes defined (Figure A above) and second to consider impact of these threats with specific reference to HCV 2.2 and HCV 3 areas they contain. Secondary consideration was then given to HCV 2.2 and HCV 3 areas that fall within the area of interest but outside the HCV 2.1 landscapes.

The HCV Toolkit for Indonesia does not provide specific guidelines for HCV management. For this report, we therefore develop management recommendations appropriate to the spatial scale and deemed adequate to maintain the values identified. Management recommendations should be seen as well-developed proposals for consideration not mandated requirements. Importantly, the recommendations serve as a basis for coherent future discussion by a broader audience of stakeholders to define HCV 2 and 3 management requirements in the Indonesian context.

For each Large Landscape the following threats were considered:

- Planned deforestation from government land use plans
- Selective logging within long term timber concession licenses
- Industrial fast-wood timber estate (plantation) expansion
- Oil palm expansion
- Forest degradation from informal logging and/or small scale encroachment
- Fire

HCVs within Large Landscapes

Overall, the biggest threat to integrity of Large Landscapes (HCV 2.1) and HCVs they contain is legal conversion permitted under Provincial (RTRWP) and Regency (RTRWK) level spatial plans. Such conversion will fragment HCV 2.1 landscapes, lead to conversion of ecosystems already considered Rare and Endangered (HCV 3), and destroy or greatly reduce ecosystem transition zones (HCV 2.2) critical for long term survival of migratory frugivorous species and other ecosystem properties.

The large Hulu Kelai-Telen block is considered the least threatened Large Landscape. However, if forest conversion legally permitted under current provincial plans (RTRWP v2008) takes place, then (i) some fragmentation will occur,(ii) currently tenuous connectivity with Mangkalihat Peninsula to the east will be lost, and (iii) most of the remaining intact lowland areas along its eastern edge (undoubtedly the richest area biologically) will be cleared (Figure E).

The Mangkalihat Peninsula (c.400,000 ha) is highly threatened by proposed RTRWP to be fragmented into 13 smaller blocks, only two of which would still form blocks sufficient to maintain Core Areas >20,000 ha (Figure F). Large areas of endangered ecosystems would also be lost. For the remaining forest in Mangkalihat Peninsula, there is a substantial risk of catastrophic fires during extended (and unpredictable) dry seasons as a result of (i) forest degradation combined, with (ii) extensive areas of combustible, freely draining karst forest and (iii) prevalence of surface coal seams.

The smallest of the three HCV 2.1 landscapes, Tanjung Batu Peninsula (c.40,000 ha), is threatened by provincial plans reducing it to a small forest block with Core Area of only c. 4,300 ha in size, far below the HCV 2.1 threshold (Figure G). In the process, the exceptional mosaic of coastal wetlands, heath forest and other endangered lowland ecosystems would be lost.

Maintaining these three Large Landscapes and preserving connectivity between them requires foregone forest conversion, which carries with it opportunity costs of forgone economic development for Berau and East Kutai Regencies. The Berau Forest Carbon Project (BFCP) currently under development by TNC and partners, provides an opportunity for carbon finance through REDD+ to offset these costs in part or in whole, or in some cases even provide income streams of greater value than conventional land uses (e.g. returns of REDD+ on high carbon, low productivity soils such as peatlands could exceed those of oil palm), especially when valuated from the perspective of local communities (assuming equitable REDD+ benefit sharing arrangements are put in place). Furthermore, considerable biodiversity co-benefits of REDD+ can be accrued if sites for REDD+ interventions are chosen at least partly on the basis of where biodiversity benefits are most needed (see e.g. Paoli et al. 2010; Stewart et al. 2010).

The management recommendations described in this report do not eliminate the possibility of partial clearance of large HCV 2.1 landscapes for conversion to agriculture or industrial timber plantations, subject to the requirement that critical elements such as connectivity, rare and endangered ecosystems, Core Areas and ecotones are maintained. This requires structured and transparent stakeholder consultation on a site-level basis. We also emphasize that neither National, Provincial nor Regency level spatial plans differentiate between Production Forest (PF) that will remain as natural forest, versus PF that will be converted to industrial fast-wood plantations. Development of the latter would entail loss of many natural attributes, thus creating HCV losses beyond those currently expected. We therefore recommend, as a matter of urgency, that spatial plans be modified to exclude industrial fastwood plantations in those legally defined PF areas where conversion should be prohibited in order to maintain HCVs mapped in this study. Furthermore, for fastwood plantation licences already granted in areas deemed high risk for HCV loss should conversion take place, these companies should be approached to use HCV as a tool for delineating HCV management areas within the concessions to maintain HCVs delineated in this study (through e.g. integration with existing “Micro-delineation” requirements under forestry law). This is discussed more fully in Chapter 2 of the report.

Within the Large Landscapes where legally defined Non-Forest lands are found, oil palm expansion is the most likely threat. Specific recommendations have been made in this report for those estates where licences have been granted that will require engagement with companies to modify their plans to clear natural forest, or even to be relocated to another area altogether (challenges of the latter are acknowledged).

Logging concessions can be relatively benign towards HCVs if managed well, especially in concessions that have passed third party certification through organisations such as the Forest Stewardship Council (FSC). Poorly managed concessions, however, can lead to severe degradation that would cause HCV losses directly and increase the risk of catastrophic fires, has already shown to have been responsible for most forest loss in the region. We recommend the engagement of logging concessions within and near the Large Landscapes identified here (Figures E-G) and in the report provide generic management recommendations for how logging concessions can operate to reduce negative impacts and increase positive ones.

HCVs outside Large Landscapes

Among HCV 2.2 areas found outside the HCV 2.1 Large Landscapes, wetland ecosystem transition zones were most highly threatened due to planned conversion of wetlands and adjoining forests on well-drained mineral soils (Figure H). Coastal mangroves are the most threatened, with rapid past and further planned expansion of fish ponds within the Northern Lowlands region. Only general management guidelines are provided in the Toolkit for HCV 2.2 areas. Such guide lines do not preclude some conversion of ecosystem transition zones, nor do they specify how large an area of transition should be maintained and in what configuration. However, we recommend that plans for fish pond expansion be reviewed and rationalised to prevent excessive loss of these important, high carbon ecosystem transitions and their component mangrove forests, also classified as HCV 3.

In addition to HCV 3 areas found within the Large Landscapes identified in Berau and East Kutai Regencies, a further 17 ecosystem types classified as Rare or Endangered were found outside Large Landscapes, covering a total extent of c.150,000 ha. For these areas, we determine which ones were most threatened, by examining past and future expected forest losses, and then provide a suite of generic management prescriptions that vary in scope/stringency depending on threat status (Table A, Figure I). These recommendations were developed in the absence of sufficient and explicit guidance from the Toolkit, especially in relation to whether partial conversion of HCV 3 ecosystems is permitted, and if so under what circumstances. In some situations, a pragmatic approach may be required, e.g. in areas legally permitted for conversion and where government is strongly supportive of conversion to other use. In such areas, partial conversion might be the only option to ensure persistence of a rare or endangered ecosystem, albeit in a reduced form, where some losses are deemed acceptable in exchange for a larger landscape conservation plan that delivers meaningful gains, such as long term ecosystem persistence. This topic has since been taken up by the HCV Resource Network, where additional guidance can be sought (www.hcvnetwork.org).

Table A. Generalised framework for setting management priorities for HCV 3 Endangered Ecosystems as a function of current and future expected threat status

Current HCV 3 Status	Future Expected HCV 3 Status (under RTRWP)		
	<75% loss	75-90% loss	>90% loss
<50% loss	N/A	1	1
50-75% loss	1	2	3
75%-90% loss	N/A	2	3
>90% loss	N/A	N/A	3

Category 1 Some losses acceptable only if some localised gains can be achieved for the same HCV 3 type, through e.g. pro-active enhanced protection, OR a conservation gain for that ecosystem type is made elsewhere and the spatial plans allow at least 25% to be maintained in its natural state (note this would require the exclusion of HTI within this 25%).

Category 2 Any further loss is unacceptable, unless it can be demonstrated that without management intervention by the company (which might entail partial loss) the entire patch will be eliminated due to planned or unplanned conversion, and that proposed operations will guarantee that overall losses do not exceed a stakeholder endorsed upon maximum amount (and which under no circumstances may be greater than 90% of the historical extent within the Physiographic Region)

Category 3 Any further loss is unacceptable, with urgent need to amend spatial plans and implement conservation strategies to maintain all remaining patches in their entirety and if necessary expand the current extent through rehabilitation.

Management of Rare ecosystems should be prioritized in a similar fashion as described for Category 2 Endangered Ecosystems in Table A.

Further to these recommendations, if an HCV 3 area is found within an HCV 2.2 transition zone or a forest block supporting Core Area(s) less than 20,000 ha (and thus not qualifying as an HCV 2.1 landscape), in the report we make more specific recommendations aiming to maintain not just the HCV 3 area, but also the ecotone as well as forest comprising the Core Area and its associated buffer.

Conclusion

This report is the first attempt to identify and map HCV 2 and 3 areas across a very large extent in Indonesia, using methods outlined in the revised HCV Toolkit for Indonesia. The study will support short, medium and long-term biodiversity co-benefit goals within the emerging low emissions development paradigm in Indonesia.

In the short term, the maps and supporting threat analysis presented can be used immediately to support a wide range of volunteer certification schemes being pursued across East Kalimantan by NGOs, government and the private sector, including (i) FSC and RSPO certification, (ii) REDD+ project or program development, and (iii) corporate commitments to responsible purchasing and investment. The maps provide extremely valuable guidance for due diligence at a variety of spatial scales, as well as landscape level decision making and planning. We emphasize that forest cover and ecosystem maps should be verified on the ground, however, when applied at the site-level to support conservation planning for individual management units (c. 10,000-100,000 ha in size),

In the medium term, we hope the report will serve as a model for similar projects to refine and 'scale up' landscape HCV mapping across Indonesia, using methods outlined in the Toolkit. In this context, the report also highlights the urgent need for coherent multi-stakeholder dialogue to formalize HCV management guidelines, especially requirements for managing HCV 2.1 (Large Landscapes) and HCV 3 (Rare or Threatened Ecosystems) areas that differ in threat status based on current versus future expected losses arising from conversion.

In the long term, we hope the report will instigate action to address threats to HCVs in East Kalimantan arising from land use planning and forestry regulations that permit conversion of Permanent Forest Estate into fast wood fiber plantations. To protect HCVs under such threat, a long term strategy to convene structured multi-stakeholder dialogue will be needed to prioritize and lobby for changes to Provincial- and Regency-level land use plans, as well as sub-national regulations to specify further where fiber plantation expansion will be permitted (and prohibited) within forested areas of the Forest Estate across the province.

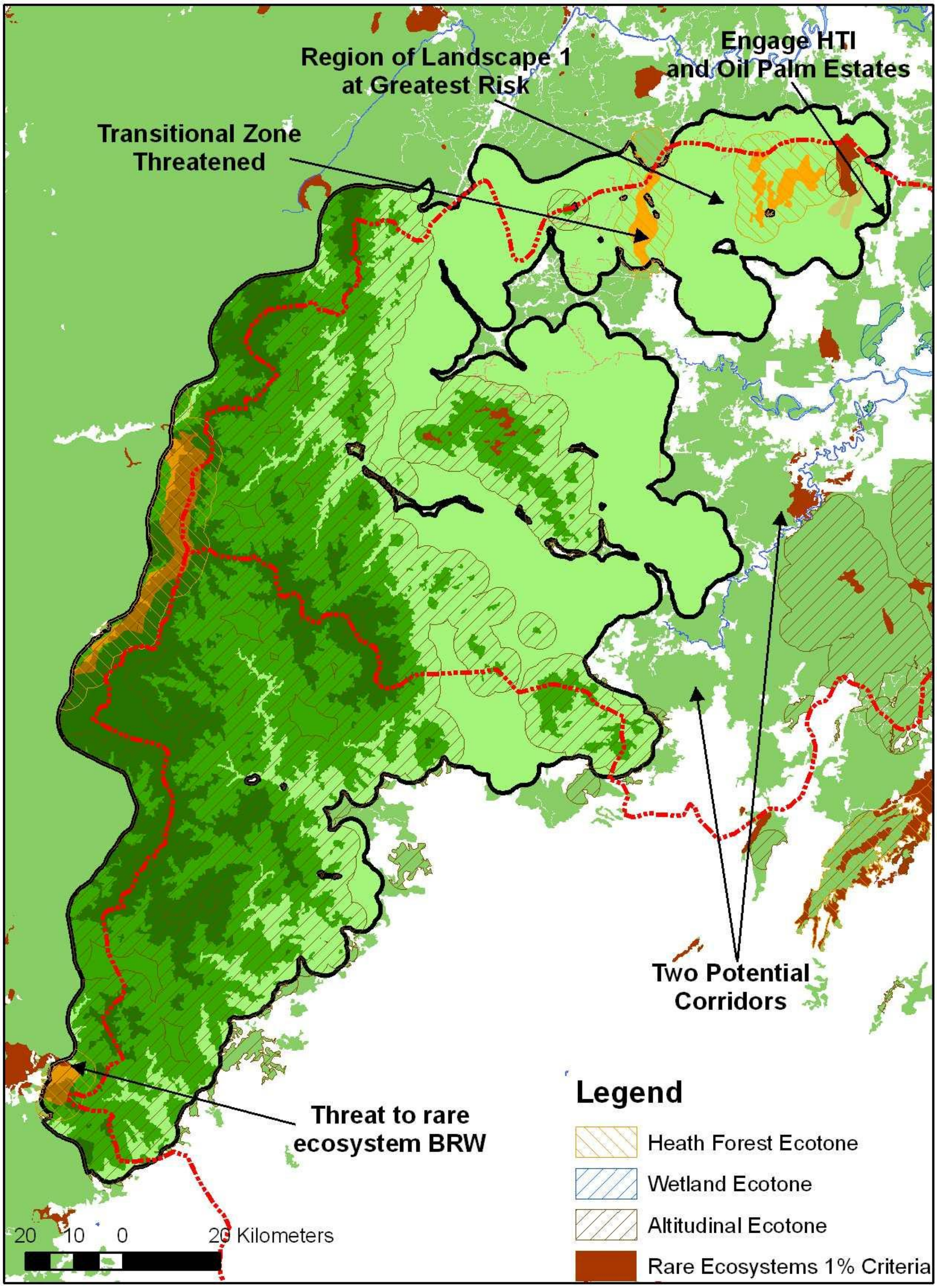


Figure E. Candidate site interventions recommended for consideration to maintain HCVs in the Hulu Kelai-Telen Landscape (c.1,500,000 ha).

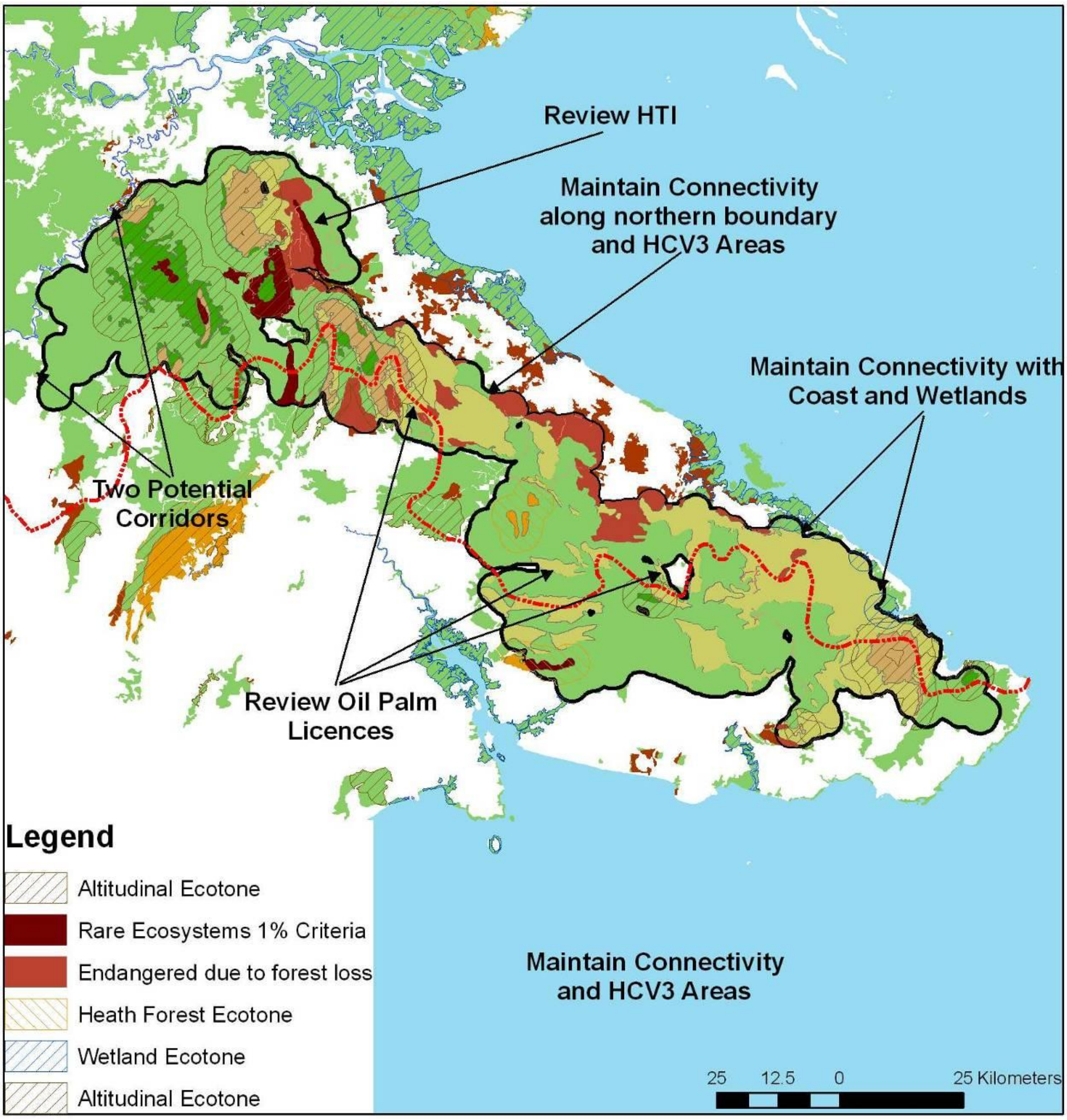


Figure F. Candidate site interventions recommended for consideration to maintain HCVs in the Mangkalihat Peninsula Landscape (c.400,000 ha).

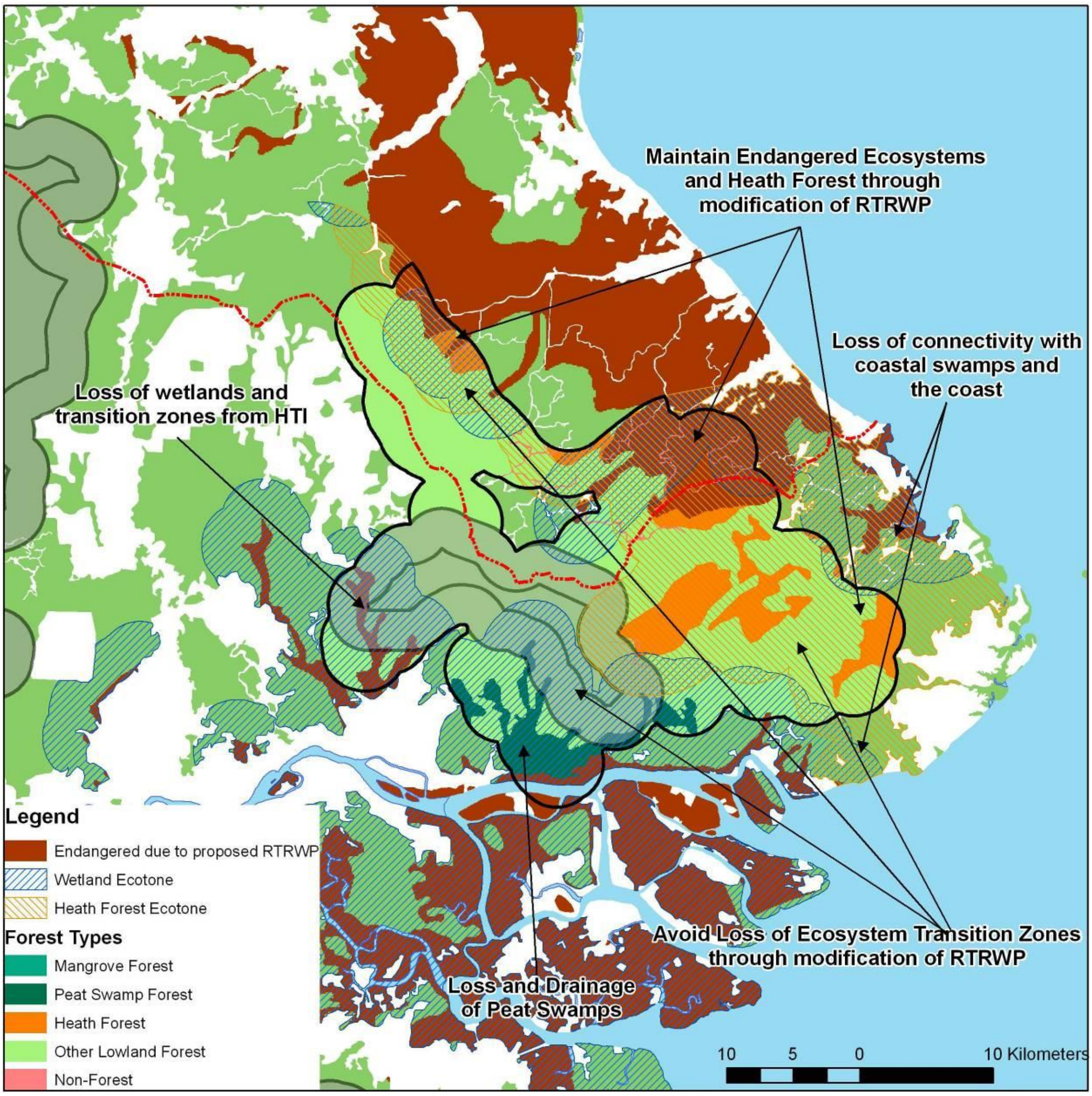


Figure G. Candidate site interventions recommended for consideration to maintain HCVs in the Tanjung Batu Peninsula Landscape (c.40,000 ha).

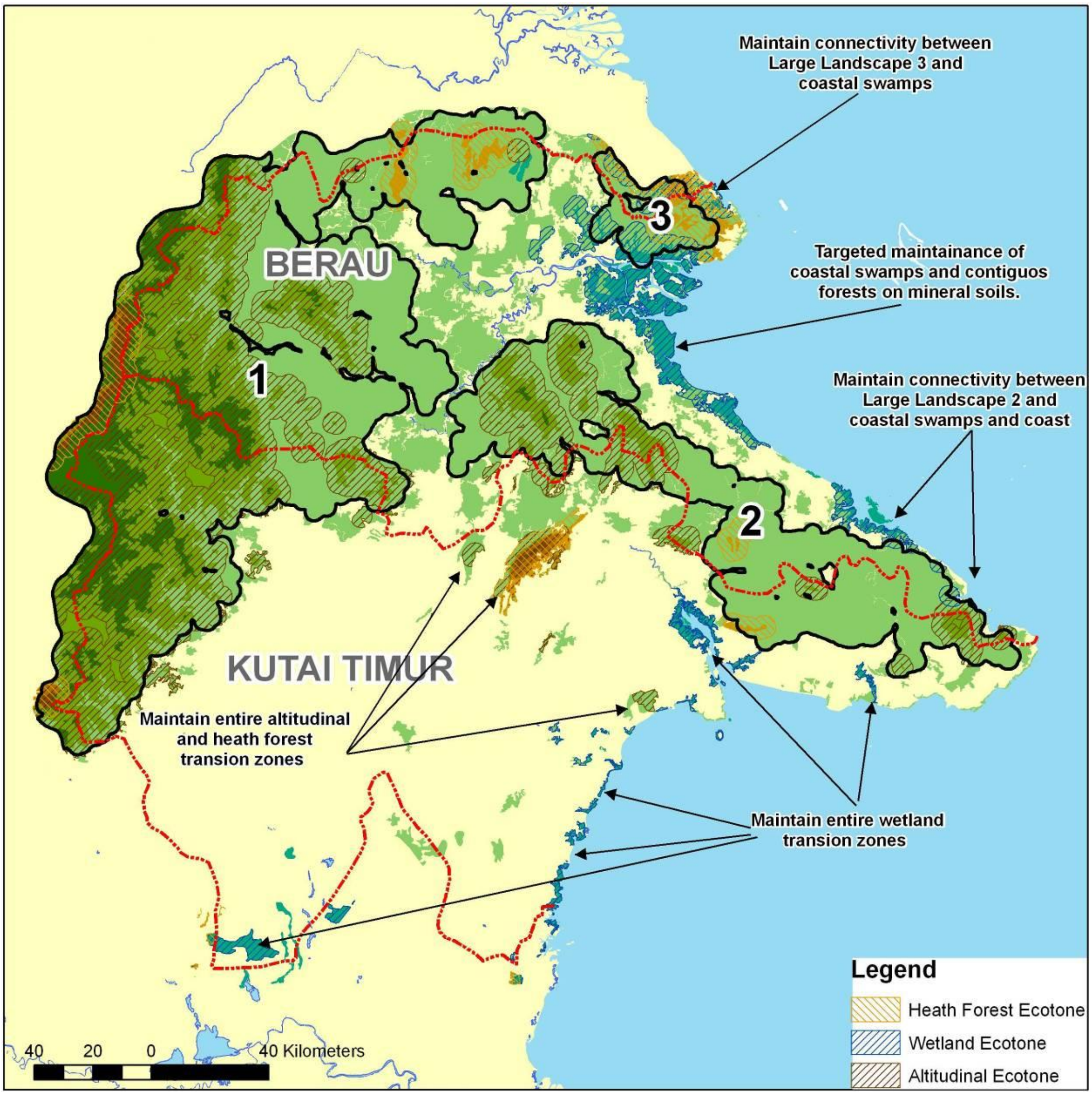


Figure H. Candidate site interventions recommended for consideration to maintain HCV 2.2 areas that occur outside Large Landscape blocks identified under HCV 2.1.

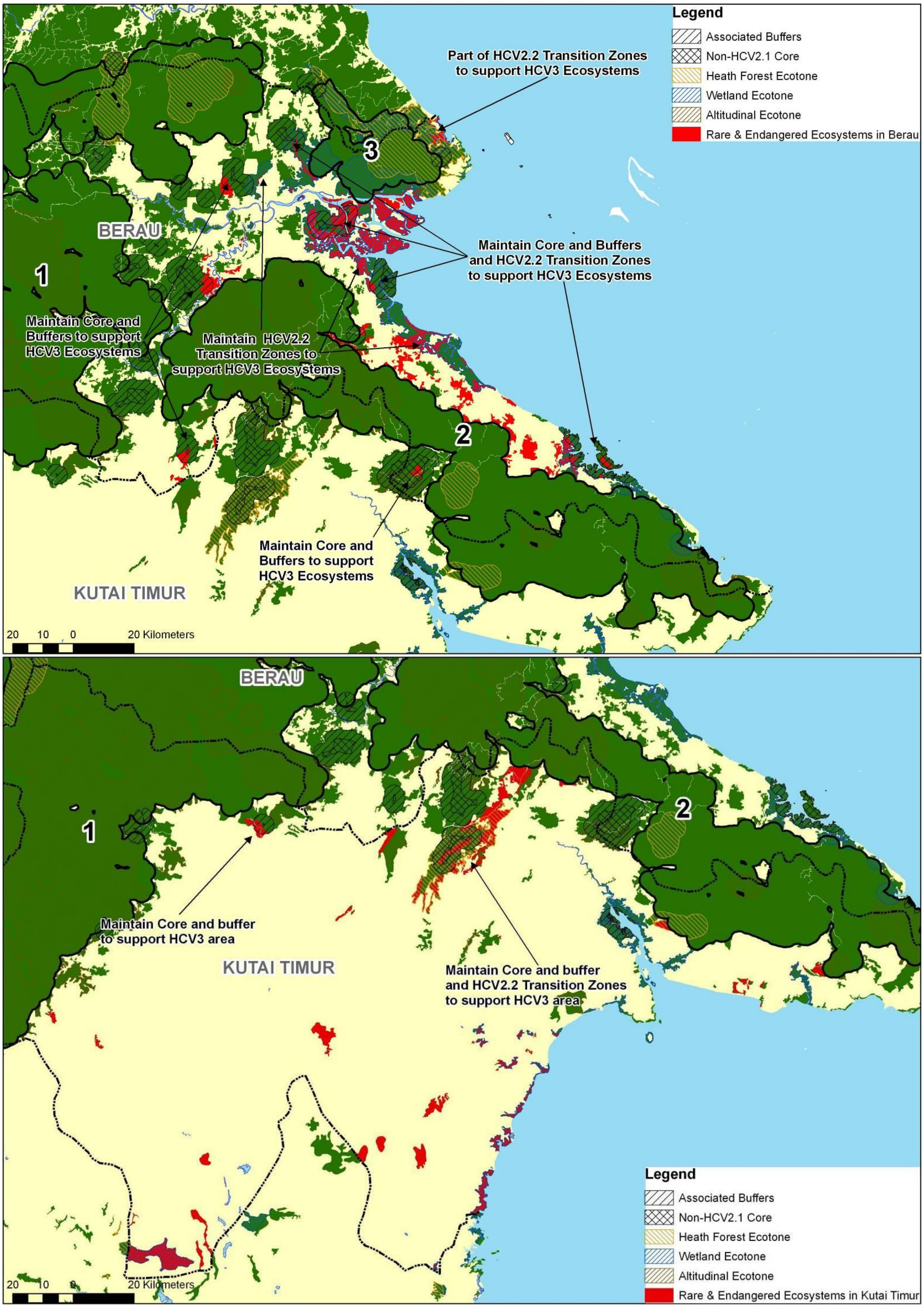


Figure I. Distribution of endangered ecosystems in Berau (top Panel) and East Kutai (lower Panel) Regencies, highlighting areas where of overlap with forest blocks supporting Core Areas (<20,000ha) and HCV 2.2 Ecosystem Transition Zones.

Table of Contents

INTRODUCTION

This report describes results of a landscape High Conservation Value (HCV) mapping project commissioned by The Nature Conservancy for East Kalimantan Province, Indonesia. The project was designed to support development and strategic planning for the TNC-initiated Berau Forest Carbon Program (BFCP), and as a public domain resource to support private sector certification, land use planning and other sustainability initiatives in East Kalimantan that incorporate HCV principles and practices.

The mapping was undertaken by Indonesia-based Daemeter Consulting, a leading independent firm promoting sustainable and equitable management of natural resources in Indonesia. The mapping project follows protocols described in the revised HCV Toolkit for Indonesia (2008), with minor modification as noted in the report (Table 1). Rare or Endangered ecosystems (HCV 3) were mapped across the full extent of four Physiographic Regions (c. 18,000,000 ha) of Kalimantan, representing 91% of East Kalimantan Province, or 33% of the total land surface of Kalimantan. Within a more limited area of interest for Berau and Kutai Timur Regencies (c. 6,000,000 ha),attributes related to Large Landscapes with Capacity to Maintain Natural Ecological Processes (HCV 2) were also mapped (see Table 1).

The mapping was mainly a desktop exercise, drawing on a large variety of primary and secondary spatial data sets, enriched by results of extensive past field experiences by TNC and Daemeter across the mapping area. The mapping also builds on findings from past landscape scale conservation planning exercises undertaken by TNC, most notably the Ecoregional Biodiversity Conservation Assessment performed by the TNC East Kalimantan Program in 2002 (Moore *et al.*).

Landscape HCV mapping across the vast spatial extent performed in this study serves the valuable purpose of drawing attention to spatial and temporal patterns of deforestation, which is necessary to place local forest remnants in proper historical and ecological context. In HCV terms, such landscape mapping identifies ecosystems that merit special conservation attention because they are naturally rare or have become endangered (HCV 3), as well as large remnant forest areas of highest priority for management because they retain potential for natural ecological dynamics to be maintained (HCV 2). It must be emphasized, however, that ground verification of ecosystem types and forest cover mapping must still be performed when results of this study are used for site level HCV assessments in oil palm, logging concessions or other sectors. Forest cover mapping should also be updated on at least an annual basis (note: maps presented in this report, which was completed in early 2010, present late 2009 forest cover; see below).

Beyond the study's immediate use for TNC East Kalimantan Program, potential users and applications of its findings include: local government land use planners across East Kalimantan Province; forestry or agriculture companies considering license acquisition for new areas or developing conservation management plans for existing operations; NGOs working with the private sector to promote responsible practices, or to ensure companies are meeting corporate commitments to maintain HCVs in their areas of operation; certification bodies such as the FSC or the Roundtable on Sustainable Palm Oil (RSPO) seeking to provide decision support tools for their members; auditors evaluating companies against these standards; and possibly commercial lenders as a tool for screening investments, or requiring formal consideration of HCV impacts by loan applicants.

The complete HCV mapping and management report comprises two Chapters. Chapter 1 describes methods and results for identification and mapping of HCV 2 and HCV 3 areas. Chapter 2 describes threats and management recommendations to maintain these HCV areas, with a restricted emphasis on Berau and East Kutai Regencies.

Much of the spatial data created during completion of this project can be made available by request through TNC (indonesia@tnc.org) or Daemeter Consulting (info@daemeter.org). The report was prepared by Philip L. Wells (philip.wells@daemeter.org) and Gary D. Paoli (gary.paoli@daemeter.org), who may be contacted directly for technical questions or comments related to interpretation of results or HCV management recommendations.

Table 1. High Conservation Values for Indonesia presented in the HCV Toolkit for Indonesia (2008). The HCVs mapped in this report include HCV 2.1, HCV 2.2 and HCV 3.

HCV 1 Areas with Important Levels of Biodiversity	1.1	Areas that Contain or Provide Biodiversity Support Function to Protection or Conservation Areas
	1.2	Critically Endangered Species
	1.3	Areas that Contain Habitat for Viable Populations of Endangered, Restricted Range or Protected Species
	1.4	Areas that Contain Habitat of Temporary Use by Species or Congregations of Species
HCV 2 Natural Landscapes & Dynamics	2.1	Large Natural Landscapes with Capacity to Maintain Natural Ecological Processes and Dynamics
	2.2	Areas that Contain Two or More Contiguous Ecosystems
	2.3	Areas that Contain Representative Populations of Most Naturally Occurring Species
HCV 3 Rare or Endangered Ecosystems	3	Rare or Endangered Ecosystems
HCV 4 Environmental Services	4.1	Areas or Ecosystems Important for the Provision of Water and Prevention of Floods for Downstream Communities
	4.2	Areas Important for the Prevention of Erosion and Sedimentation
	4.3	Areas that Function as Natural Barriers to the Spread of Forest or Ground Fire
HCV 5 Basic Needs	5	Natural Areas Critical for Meeting the Basic Needs of Local People
HCV 6 Cultural Identity	6	Areas Critical for Maintaining Cultural Identity of Local Communities

CHAPTER ONE

HCV IDENTIFICATION and MAPPING

1.1. Introduction

1.1.1 The High Conservation Value (HCV) Concept

The High Conservation Value Forest (HCVF) concept was developed in 1999 as Principal 9 of the Forest Stewardship Council (FSC) standard for certified well-managed forest. HCV was originally designed to help forest managers improve the social and environmental aspects of responsible wood production through a two-step process of identifying areas with exceptional social, cultural, or environmental attributes, and then implementing a system of management and monitoring to ensure these attributes are maintained. It is fundamental to the HCV concept that areas found to support one or more HCV are not necessarily designated as no-go protection zones where development is forbidden, but rather that if development happens, then it must be undertaken in a manner consistent with management plans to maintain the values. The HCV approach, therefore, can be seen as a planning tool for helping society balance environmental, social and economic features of development.

While HCV was originally designed to enhance the management of logging operations within the FSC framework, it gained widespread popularity and is used for spatial planning at the national or provincial level; in natural resource sectors such as plantation forestry as a planning tool to minimize impacts of natural forest conversion; and as a key provision of emerging commodity standards, such as the multi-stakeholder Roundtable on Sustainable Palm Oil (RSPO) and Roundtable on Responsible Soy (RTR) among others.

One distinguishing feature of more recent HCV applications in both certification and land use planning is an emphasis on the need for proper consideration of landscape context to understand not only the threats jeopardizing persistence of a value, but also alternative management approaches to maintain it that require action beyond the border of one or more management unit.

1.1.2 Goals of this Chapter

Chapter 1 of this report describes methods and results for landscape HCV mapping across four Physiographic Regions of Kalimantan, covering c. 18,000,000 ha. This represents 91% of East Kalimantan province, or 33% of the land surface area of Kalimantan. The landscape HCVs mapped includes HCVs 2.1 & 2.2, which focus on large landscapes with a capacity to maintain natural ecological processes, and HCV 3, which draws attention to rare or endangered ecosystems (Table 1).

Chapter 1 has four sections: Methods, Findings, Maps and Statistical Tables.

1.2. Methods

Definitions and methods employed in this study follow the HCV Toolkit for Indonesia (2008), except where noted otherwise. Detailed descriptions are provided below for Forest Cover mapping, Ecosystem mapping and HCV Identification.

1.2.1 Forest Cover

Area of Interest (AOI) versus Mapping Area

Two terms are used throughout this report in reference to geographic areas over which different kinds of mapping analyses were performed: Area of Interest (AOI) and Mapping Area.

The AOI refers to the area over which threat analysis was undertaken and management recommendations are provided to maintain landscape HCVs. This area covers the full extent of Berau and East Kutai Regencies (c. 3.2 million ha and c. 2.2 million ha, respectively), plus a small buffer around Regency borders, making a total area of c. 6 million ha.

The AOI is embedded within a much larger Mapping Area, comprising the four Physiographic Regions of eastern Borneo in which Berau and East Kutai Regencies are found. These four Regions are

- Mahakam Lowlands
- Northern Lowlands
- Northern Mountain Ranges
- Nyapa-Mangkalihat Mountains and Plains

The method used for identifying Rare or Endangered Ecosystems under HCV 3, the so-called Analytical Method as defined in the revised HCV Toolkit for Indonesia (2008), requires rare or endangered status to be evaluated within Sub-units of the major Indonesian islands, referred to as Physiographic Zones of each island. Because this study used the Analytical Method to map and recommend management for HCV 3 throughout Berau and East Kutai, and because these Regencies cover four such Zones, the complete 'Mapping Area' over which mapping was performed covered the full extent of these four Zones (**Fig. 1.2.1** and **Fig. 1.2.4**), covering c. 18 million ha (see Section 1.2.2 below).

It should be noted that HCV 2 areas can be assessed independent of Physiographic boundaries. For this study, such as analysis is restricted to the AOI and a small surrounding buffer.

Natural Ecosystems and Water Bodies

HCV 3 considers not only forest, but also non-forest natural ecosystems, such as open water swamps and marshlands. The natural state of most of western Indonesia (Sundaland) is forest, but natural grasslands, open swamps, lakes and large rivers are also found, and merit consideration. (The term 'natural' requires further discussion among HCV practitioners to settle on a consensus functional approach to its definition). For the determination of Rare and Endangered status under HCV 3, the Toolkit does not require evaluating the ecosystem to be in pristine intact condition (i.e. undegraded by logging or roads), but rather that the ecosystem maintains native plant species and other distinctive attributes. If anthropogenic disturbances have transformed the ecosystem, e.g. into *alang-alang* grass land or rubber agro-forestry, then such areas are excluded from the map of remaining natural ecosystems.

In this analysis, all closed canopy forest or logged over forest were mapped as 'Forest'. Highly degraded forests were also included if they appeared to have potential for recovery, following the principle that the more highly degraded, homogeneous, small and isolated from other natural forests a given stand might be, the less likely such forests could recover and, therefore, more likely they should be excluded (i.e. mapped as non-forest). Forests that had been completely destroyed by fire in the recent past were excluded. Areas of mature swidden fallow agriculture with long rotation times and at low density, embedded in a matrix of forest, were likely to be mapped as part of the natural ecosystem, as they are too difficult to delineate reliably with Landsat, especially over such a large area.

Natural non-forest ecosystems can be detected against a backdrop of non-forest, where such areas show no signs of anthropogenic activity and no record of change occurring over time, with reference to historical Landsat imagery. In East Kalimantan, large areas would appear at first glance to meet these criteria, but through examination of 1970's imagery to present, it becomes evident such non-forest areas were, in fact, once forested but destroyed by fire. The 1982/83 fires destroyed an estimated 2.7 million ha of forest across Indonesia (Schindele *et al*. 1989). Since that time, other fires have occurred, the most recent major episode being in 1997/98, affecting 5.2 million ha across Indonesia (Hoffmann *et al.*, 1999). The areas previously destroyed by fire and replaced by scrub or immature secondary growth often lack apparent anthropogenic signs of disturbance, and so care must be taken not to include them as natural, given that they are the result of catastrophic disturbance since the 1970's. Non-forest natural ecosystems considered present in the mapping area include open, standing water wetlands; various forms of coastal and riparian swamp; other more localized aquatic habitats; and coastal estuarine mud-flats. No other natural non-forest ecosystems, such as meadows or grasslands, are believed to be present.

In coastal areas of the Mahakam lowlands, and in floodplains of major rivers, non-forest wetlands and lakes can be found. It is very difficult to use remote sensing to distinguish between natural and non-natural wetlands and lakes, as the texture, reflectance and shape of the wetlands change seasonally. Those surrounded by forest today were assumed to be natural; those without forest boundaries were considered as non-natural. For water bodies, the SRTM Water Body Data set (SWBDv2.0) published by NASA[4] was used, after editing and augmenting using the decadal Landsat orthorectified sets to ensure all the major rivers were included. The modified SWBD was used additionally as the base map for Kalimantan, referred to below as the 'Daemeter Base Map'. It is assumed that the water bodies and coastline are constant over time, an assumption that is not true in a strict sense but allows direct comparability between the 1970's and the present.

[2] Downloadable from http://dds.cr.usgs.gov/srtm/version2_1/SWBD/

Figure 1.2.1 The four Physiographic Regions mapped in this study (shown in yellow), and the Regency borders of Berau and Kutai Timur (shown in red). The rest of Kalimantan (grey) and Sarawak and Sabah (white) are also shown.

Both the c. 1975 and current forest cover classification were undertaken by a single remote sensing analyst (Indrwan Suryadi) using onscreen manual interpretation based on false colour composites of Landsat images at a scale of 1:70,000 or better. The areas of natural forest were determined based on colour and texture having taken into account changes of reflectance due to topography as indicated from SRTM hillshade and natural variation in forest types using the ecosystem proxy map (described below).

Each scene was processed one at a time using the best available appropriate image as a base which in the c. 1975 data set was the earliest best image, and for current forest cover was the most recent best image. In areas of cloud cover an alternate scene was used which was the earliest (for c. 1975 cover) or most recent (for current cover) image available. For c.1975 cover, in some areas where no similarly dated cloud free image for the area could be found, more recent images were examined. In such cases, if the location was found to be forested in the more recent image, and then it was assumed that the area supported forest at the earlier date. For current forest cover where no suitable recent image could be found, then earlier images were examined. If the location at an earlier date was found to be forested and there was little change in the surrounding area, then the area obscured by clouds was classified as forest. On occasion, judgement had to be used with the assumption that if an area obscured by cloud was surrounded by forest, then the location obscured by cloud was treated as forest, and vice versa for non-forest.

Both the c. 1975 and current forest cover data were carefully reviewed by a single supervisor (PLW) checking one scene at a time. The review was based on the most suitable image, but when a difference of opinion arose, the entire library of images was used to obtain a full historical perspective. Most of the differences of opinion found were in the areas of the Mahakam lowlands that had been affected by fire in the past, and other areas where the forest had become severely degraded requiring judgement on whether a location should still be classified as natural forest. Corrections to the data sets were made directly by PLW.

Past Forest Cover c. 1975

Past forest cover was mapped using 44 Landsat MSS 1, 2, & 3 images from between 1972 and 1982 (Table 1.2.1 and **Fig. 1.2.2**). The large number of images over a ten year period was required to achieve a ‘cloud free’ view of this part of Kalimantan. In general, the earliest available image was used. The nominal date of the forest cover is given as c.1975, reflecting the predominant reliance on images from this year or earlier to map past forest cover. All scenes were rectified using the Landsat orthorectified TM and ETM imagery[5]. Due to the relatively poor resolution and limited spectral range provided by Landsat MSS, the Landsat orthorectified images and other recent images were used to assist in their interpretation (see Table 1.2.1 for the list of reference scenes used). Results are depicted in **Fig. 1.4.1**. It should be noted that even with the quantity of images, the cloud cover in some parts made interpretation very difficult. None of the scenes was sufficiently cloud free or of a quality to enable more sophisticated and automated approaches to be used, such as a supervised classification.

Current Forest Cover

Current (2009) forest cover was mapped using onscreen digitization of 44 Landsat 7 scenes from between 2006 and August 2009 (Table 1.2.1 and **Fig. 1.2.3)**. The number of scenes

[5] Provided by USGS Earth Observation & Science (EROS) via Global Visualisation Viewer

was required to obtain a relatively cloud free image of this part of Kalimantan. In general, the most recent scene was used. Typically Landsat bands 5, 4, and 3 were used during the classification. In areas that were highly degraded or had previously been affected by fire, it was often difficult to delineate a boundary between natural and non-natural areas, and we acknowledge that different operators may reach different conclusions. In these areas, the historical Landsat reference scenes were useful to provide the operator with a richer historical background. It should be noted that even with the quantity of images used, the cloud cover in some parts made interpretation very difficult. As for current forest cover, none of the scenes was sufficiently cloud free or of a quality that would enable more sophisticated and systematic approaches to be used such as a supervised classification.

Table 1.2.1 The 44 Landsat MSS 1, 2, & 3 scenes used to classify historical forest cover. See **Fig. 1.2.1** and **Fig. 1.2.2**. During some years more than one scene may have been used if required.

Path	Row	Year					
123	**60**	1972					
124	**59**	1972	1973	1979	1982		
124	**60**	1973					
124	**61**	1978					
125	**57**	1972	1982				
125	**58**	1975	1979	1981	1982		
125	**59**	1972	1973	1975	1979	1981	1982
125	**60**	1973	1979				
125	**61**	1973	1979	1980			
126	**57**	1972	1973	1979			
126	**58**	1973	1979				
126	**59**	1973	1979				
126	**60**	1972	1973	1979	1980		
126	**61**	1973	1980				
127	**57**	1972					
127	**58**	1972					
127	**59**	1972	1973				
127	**60**	1972	1979	1980			

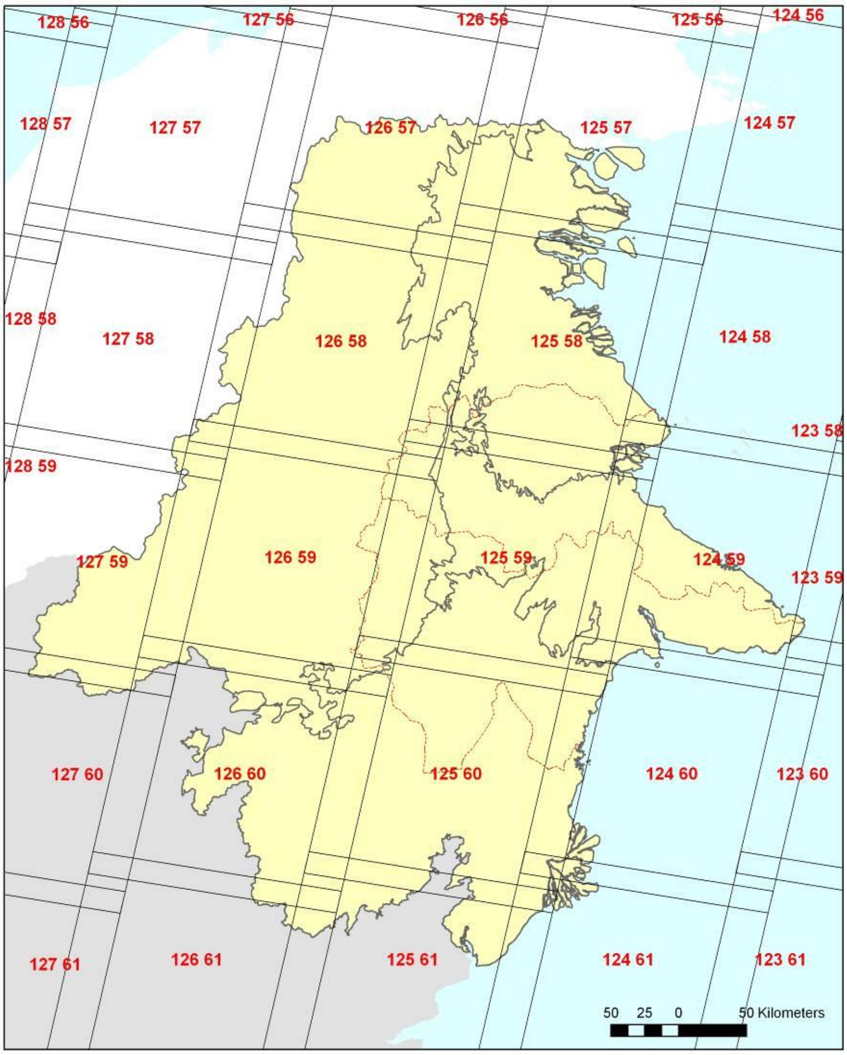


Figure 1.2.2 The approximate location coverage of Landsat 1, 2, &3 MSS images used in the study. Numbering follows World Reference System 1 (WRS1)

Table 1.2.2 The Landsat 7 scenes used to classify current forest cover. For some years more than one date was used. The reference scenes were used to enable better interpretation of difficult areas for past and present forest cover. During some years more than one scene may have been used if required.

Path	Row	Year				Reference Scenes				
115	**59**	2009	2008			2000				
116	**58**	2008	2007			2005	2001	1991		
116	**59**	2009	2008	2007	2006	2001	1993	1991		
116	**60**	2009	2008			2001	1991			
116	**61**	2009	2007			2005	2001	1992		
117	**57**	2009	2008			2001	1989			
117	**58**	2009	2008	2007		2001	1991			
117	**59**	2009	2008	2007		2004	2002	2000	1991	1989
117	**60**	2009	2008	2006		2000	1991	1990		
117	**61**	2009	2007			2005	2003	2000	1992	
118	**57**	2009	2007			2001	1991			
118	**58**	2009	2007			2001	1991			
118	**59**	2009	2008			2000	1991	1990		
118	**60**	2008				2004	2000	1991	1990	
119	**59**	2008				1992	1990			

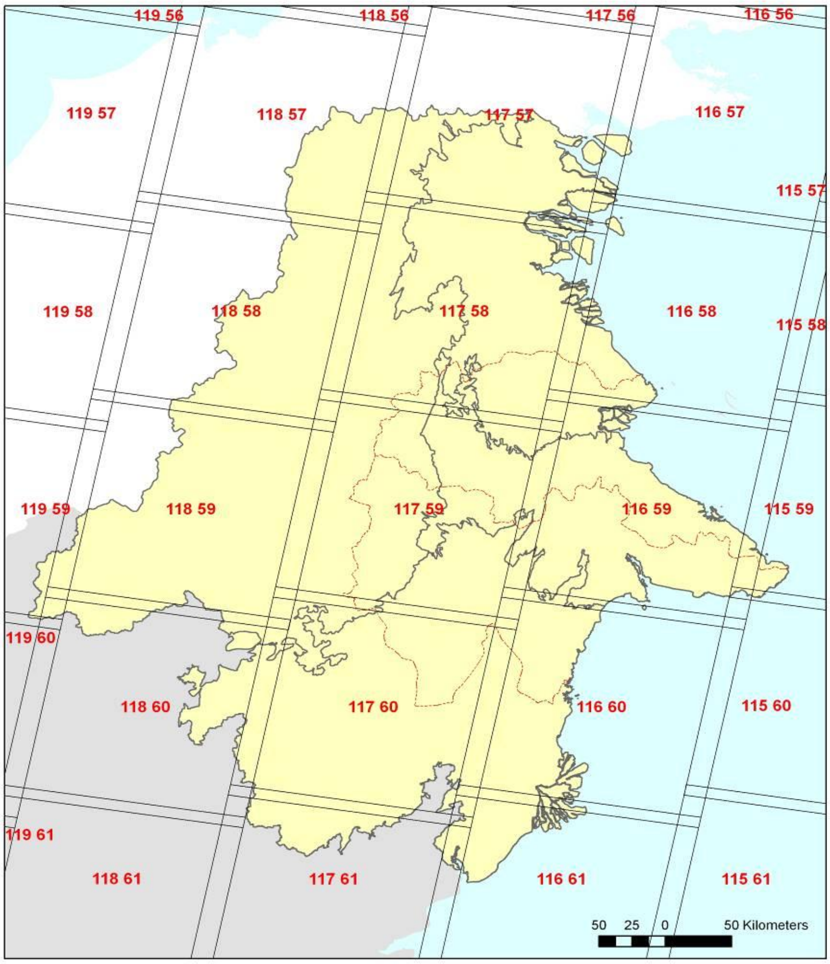


Figure 1.2.3 The approximate location coverage of each Landsat 5TM & 7ETM image using World Reference System 2 (WRS2).

Future Forest Cover

Future expected forest cover was mapped using a simplified but realistic approach recommended in the HCV Toolkit for Indonesia (2008) whereby: (i) the most recent legal provincial land use plan (RTRWP) is used to delineate areas that are legally permitted for conversion from forest to non-forest; and (ii) areas permitted for conversion are assumed to be converted at some point in the future. Any currently forested areas permissible for conversion are subtracted from the ‘current forest cover’ map to produce a hypothesis of future expected forest cover under a full conversion scenario. See Table 1.2.3 below for land use planning categories in East Kalimantan provincial spatial plans and how these types were treated in this study in terms of whether forest conversion is permitted. It should be noted that in areas where conversion to non-forest is not permitted, loss of natural forest may still occur through either: (i) planned conversion of natural forest to Acacia plantations (legally defined as ‘forest’), or (ii) through unplanned deforestation due to smallholder encroachment or, most common in the past, fire.

The mapping area falls within East Kalimantan whose most recent RTRWP is 1999. This old RTRWP was found to be nearly identical to the Ministry of Forestry’s (MoF) forest zonation map, so the MoF map was not considered further. The 1999 spatial plan is currently being revised. In order to better understand what that revision might mean with respect to HCV’s, a draft of the proposed RTRWP (dated 2008) was also used in the analysis. *It is important to note that the East Kalimantan RTRWP does not provide information on where, if any, legally defined Forest Lands will be allocated to industrial wood fibre plantations such as Acacia for the pulp and paper industry – which the Ministry of Forestry classifies as ‘forest’ -- so there is no guarantee that natural production forest within designated Forest Lands will, in fact, remain natural forest.*

Table 1.2.3 The land use planning types used in provincial spatial planning (RTRWP) for East Kalimantan. The National Strategic Area along the border with Sarawak and Sabah is only included in the proposed new spatial plan. Whether this will maintain forest or not is uncertain, therefore to be precautionary it is considered in this study as a land use that will not maintain forest.

Land Use Planning Types	Symbol	Considered to Maintain Forest
Strict nature reserve	CA	✓
National park	TN	✓
Botanical and zoological garden	THR	✓
Protected Forest	HL	✓
Research and education forest	HPP	✓
Forestry utilisation area	KBK	✓
Non-Forestry utilisation area	KBNK	×
National Strategic Area*	KSN*	×

1.2.2 Ecosystem Mapping

RePPProT land systems as ecosystem proxy

An ecosystem can be defined as the community of all plants, animals, and the physical environment with which they interact and function as an interdependent unit. The ecosystem concept is fundamentally scale invariant, encompassing ‘ecosystems’ ranging from a drop of water to the entire planet Earth. In general the occurrence of a particular type of terrestrial ecosystem at a given place will depend on a number of abiotic factors, including climate, soil, hydrology, landform and fire, as well as biotic factors that interact in complex ways.

In order to assess the rare and endangered (HCV 3) status of an ecosystem, a suitable spatial scale must be chosen that reflects prevailing understanding of factors determining ecosystem distribution and ability to map them. For the purpose of HCV in Indonesia, it must also be applicable across the archipelago. In the 1980’s, Indonesia embarked on an ambitious project called the Regional Physical Planning Programme for Transmigration (RePPProT) to evaluate the development potential of each province. The corner stone of the project was the mapping of land systems, a concept based on ecological principles that presumes closely interdependent links between rock types, hydro-climatology, landforms, soils and organisms[6]. A total of 414 land systems were described and mapped across Indonesia by RePPProT, 49 of which are found in Kalimantan. The goal of land system mapping in RePPProT was to evaluate land suitability for agricultural crops, but by extension it can also be used for ecosystem mapping, as the factors defining land systems are the same factors influencing distribution of species and thus ecosystem sub-types. Building on the scientific tradition of using land systems as an objective tool for ecosystem-based research (Beier & Brost 2010; Pressey & Logan 1995; Gong et al. 1996), the HCV Toolkit for Indonesia therefore recommends use of RePPProT to map ecosystems across Indonesia. It is used in this study. A brief description of the land systems present in the mapping area can be found in **Statistic Table 1.5.6**.

The land system concept is hierarchical and at its broadest scale defines Physiographic Regions, consisting of land systems grouped according to their general similarity and geographic position. The Physiographic Region is an intuitive concept that resembles how a geographer might subdivide a country for narrative descriptive purposes, with Regions containing widespread repeated motifs of land systems different from one another. The RePPProT project used these Physiographic Regions for descriptive purposes, however the revised Toolkit recommends their use for defining sub-units of the major islands within which past and present ecosystem extent can be assessed formally to contextualise rare or endangered status. Benefits of using this natural Sub-island scale include:

1. It transcends administrative borders, which bear limited relationship to ecological patterns.

2. It promotes the maintenance of multiple replicates of ecosystem types in geographically distinct locations, which reduces the overall risk of extinction, and increases the likelihood of maintaining local genetic adaptations or unique species assemblages that might not otherwise be achieved through an island-wide approach or the management of other HCVs.

[6] Review of Phase 1 Results East and South Kalimantan RePPProT

3. It gives special consideration to ecosystem types that may be locally rare or unusual, with special ecological significance, such as isolated hilly areas within lowland swamp landscapes.

As noted above, the Mapping Area for this project encompasses four Physiographic Regions, described briefly below (see also **Fig. 1.2.1** and **Fig. 1.2.4**).

The Physiographic Regions

Physiographic Regions consist of land systems grouped according to their general similarity and geographic position. The Physiographic Region is an intuitive concept that resembles how a geographer might subdivide a country for descriptive purposes, with defined Regions containing widespread repeated motifs of land systems different from other Regions. RePPProT used these Physiographic Regions for descriptive purposes only, but the Toolkit recommends their use for defining island sub-units across which ecosystem distributions can be assessed to determine rare or endangered status. The Physiographic Regions studied in this report follow those originally described by RePPProT, with slight modification and correction (as described in Digital Appendices to the Toolkit). Brief descriptions of the Physiographic Regions are provided.

<u>(i) Mahakam Lowlands</u>
The region is approximately 5.2 million ha and is drained almost entirely by the lower and middle Mahakam River and its tributaries (**Fig. 1.2.4**). Most of the region is part of the Neogene Kutai Mahakam Basin that has since been uplifted and heavily folded and faulted. A central depression remains that forms the swampy area around the Mahakam lakes with extensive areas of peat soils.

<u>(ii) Northern Lowlands</u>
The region is approximately 3.1 million ha of lowlands drained by a number of rivers most notably the Berau, Kayan and Sesayap. The region is largely formed from the Paleogene Tarakan Basin and recent Quaternary deltic deposits.

<u>(iii) Northern Mountain Ranges</u>
This region is approximately 7.3 million ha and is mountainous, rising to more than 1,700 m in a few areas. The Region also contains a number of distinctive basins at the headwaters of East Kalimantan's major rivers, the most notable of which is the upper reaches of the Mahakam River, which forms an extensive lowland area within this Region. The region geologically is formed from mainly turbiditic deposits and melange with some volcanic intrusions.

<u>(iv) Nyapa Mangkalihat Mountains and Plains</u>
This region of approximately 2.4 million ha is a geanticlinal zone between the Tarakan and Kutai Mahakam Basins. The lithology of the area is sandstones, conglomerates and shale, but with notable deposits of limestone that form karstic outcrops and plains.

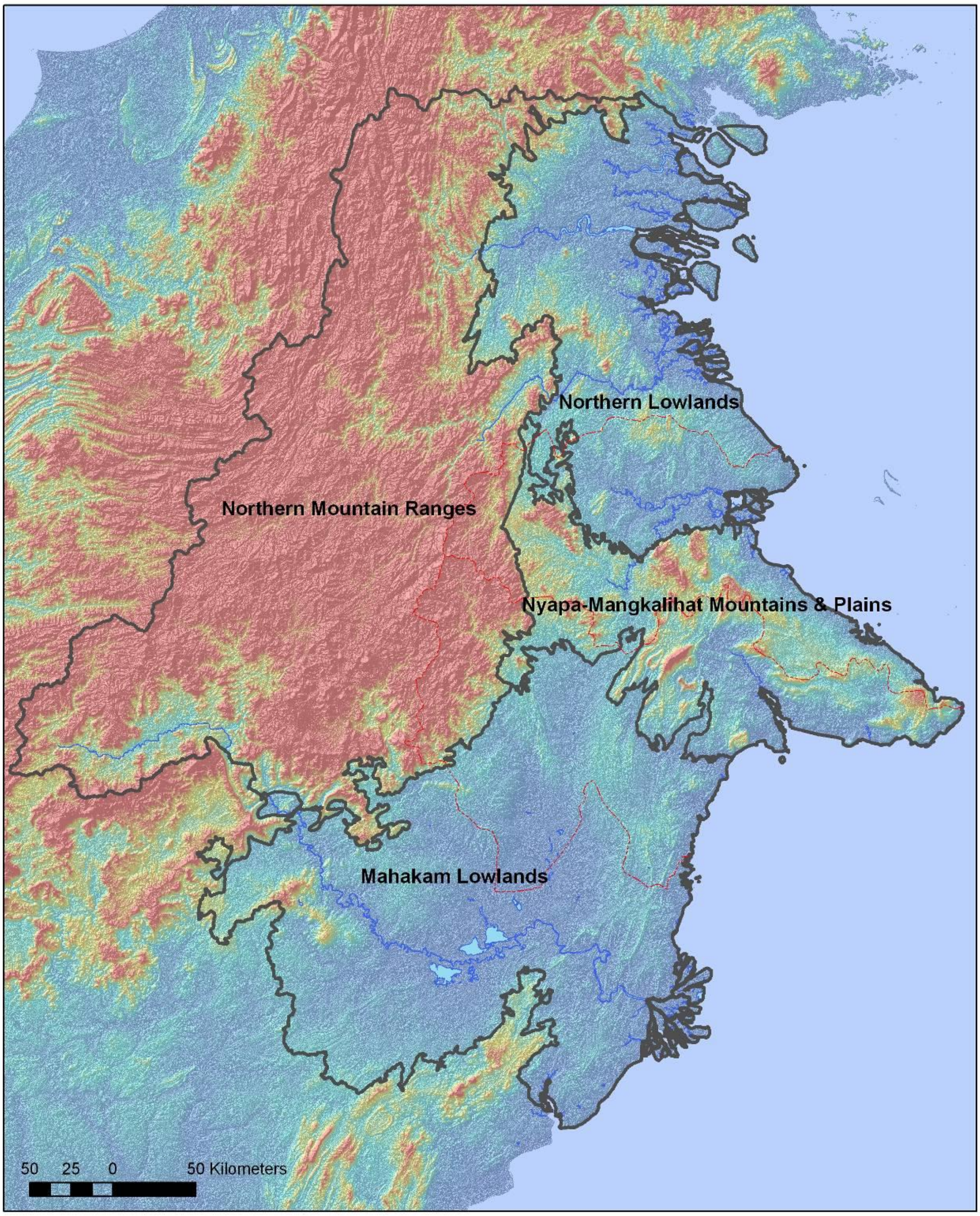


Figure 1.2.4 Topography of the four Physiographic Regions mapped in this study. Topography was produced using SRTM data.

Improvements to RePPProT

Since RePPProT was completed, there have been great improvements in technology and increased availability of data that enable the original maps to be greatly improved. For this project, the original RePPProT base maps were re-digitised for the whole of Kalimantan, and as far as possible data gaps were filled and geographic inaccuracies were corrected using geological maps in conjunction with SRTM and Landsat imagery. The coastline and water bodies were determined by Daemeter's Kalimantan base map. The resulting output creates a land system/ecosystem proxy map that can be used directly with and comparable to other data sources. Following the HCV Toolkit, land systems spanning elevation ranges above/below 500m and/or above/below 1000m a.s.l. were parsed by elevation class (<500m, 500-1000m, >1000m) and reclassified as lowland, Sub-montane and Montane zones, respectively. A filter was then applied such that small patches <50 ha of one elevation zone embedded within a much larger area of another zone (e.g. a small patch of 500-1000m Sub-montane within a larger <500m lowland zone) were merged with the surrounding dominant zone. Such filtering was considered necessary to produce a map that was readable and does not greatly reduce the information content. See **Fig. 1.4.4** for a colour-coded representation of land systems/ecosystem proxies present within the mapping area.

1.2.3 HCV 3 Identification

HCV 3 Criteria

According to the Analytical Approach defined in the Toolkit for determining HCV 3 status, an ecosystem is Endangered if it meets one or both of these criteria:

1. *The ecosystem has lost 50% or more of its original extent in the Physiographical region of the assessment.*
2. *The ecosystem is expected to lose 75% or more of its original extent in the Physiographical region where it occurs, based on the assumption that all areas currently allocated for conversion by government planning will be converted.*

An ecosystem is considered Rare if it meets the following criterion under HCV 3:

3. *A natural ecosystem that covers less than 5% of the remaining natural vegetation cover in the Physiographical region of the assessment.*

On closer examination of the criteria for rarity, and preliminary evaluation of mapping results, we believe the Toolkit has set the criteria for Rare ecosystems too liberally (i.e., the % threshold is too high). Most Physiographic Regions have 20 or more land systems present. If the extent of all land systems were equal and more than 20 land systems were present, then all would be considered rare. This does not capture the essence of the term Rare, as intended by most. We therefore propose that in a future revision of the Toolkit, the criterion should be made more restrictive, for example, 1% cut off. In addition, we would further propose that the criterion be measured against past natural vegetation cover, and not present, as this avoids the potential perverse outcome of an ecosystem that was naturally rare historically (<1%) no being classified as not rare due to higher loss of other ecosystem types increasing the % representation of the 'rare' ecosystem in current vegetation. In the following analysis, both the 1% and the 5% criteria have been used, to enable comparison.

Forest Cover & Ecosystem Overlay

For each Physiographic Region, forest cover c.1975 and 2009 (**Fig. 1.4.1)** was overlaid with land systems (**Fig. 1.4.4**). The resulting overlay provides an estimate of the extent of each ecosystem proxy at the two time periods within each region. Future expected forest cover based on current and proposed land use plans was then overlaid on the present ecosystem map to project future expected ecosystem losses.

Comparison of past, present and future ecosystem distribution

For each Physiographic Region in turn, the original, present, and future expected extent of each ecosystem proxy was mapped, where future extent was modelled based on the current and 2008 proposed RTRWP. Summary statistics were also produced for extent and current and future percentage loss. Each ecosystem was tested against the HCV 3 criterion of current (>50%) or future expected (>75%) loss and results for each test were noted. The future projected extent resulting from different provincial spatial plans were treated separately, but due to uncertainty over which plan should be used, the precautionary principle was invoked such that if an ecosystem met one or more criterion based on either land use plan, then it was classified as Endangered.

1.2.4 HCV 2 Identification

HCV 2 identification was performed within the AOI only, defined as Berau and Kutai Timur Regencies plus a 10 km buffer surrounding their borders.

Delimiting forest blocks & mapping forest buffers (HCV 2.1)

The Toolkit describes HCV 2.1 as a large natural landscape with capacity to maintain natural ecological function and dynamics is defined as a cohesive landscape mosaic of natural ecosystems with a size and configuration comprising both (i) a core area of >20,000 ha, where internal fragmentation is absent or relatively limited, surrounded by (ii) a vegetation buffer of 3 kilometres from the external landscape border to that of the Core Zone.

Landscape units, buffers and Core Areas within the AOI were delineated in a four step process. Firstly, the forested area within Berau and Kutai Timur was extracted from the 2009 forest map. An additional 10 km buffer beyond the Regency boundary was also included to control for possible edge effects during the analysis within the AOI. Three km of this 10 km buffer area was later removed (the extent of possible edge effects extending into the AOI) leaving 7km along Regency borders to allow for some context and any uncertainty in Regency borders. Secondly, the forest cover map was edited to fill in small breaks in forest cover map due to rivers and logging roads. Typically, breaks less than 200m wide (although sometimes wider) were filled in, except where there was a concentration of breaks, where it was felt the internal natural conditions within the forest would have been altered too drastically to qualify for HCV 2.1 status. The resulting forest coverage is termed the *effective forest area*. Thirdly, the Core Area of all landscape blocks were delineated within the effective forest area, defined as areas greater than 3km from the nearest landscape edge.

Larger water bodies present a problem for this method when they are contiguous with a forested area. To be consistent with the intention of HCV 2.1, which focuses on natural ecological processes, a rule was adopted whereby water bodies are counted as part of the vegetative cover for purposes of defining a Core Area, but not counted as part of the vegetative buffer of a landscape block if it occurred on external portions of a landscape unit. This allowed for a small forested offshore island to be retained within a core or a series of islands in a delta region to form a core. This is a small variation from the Toolkit definition, but better models the concept of a large natural landscape maintaining the natural ecological function and dynamics of a landscape mosaic.

The final step in the four-step process was to test the size of Core Areas thus identified against the HCV 2.1 criterion of >20,000 ha.

Delimiting zones of ecosystem transition (HCV 2.2)

The Toolkit describes HCV 2.2 as a natural landscape containing

1. Two or more contiguous ecosystems that share intact border(s), especially the transitional zone (ecotone) between various types of swamp and non-swamp, or kerangas and non-kerangas

2. Forested mountain slopes covering various different types of ecosystems distributed along elevation gradients, especially those including transitions from lowland forest to submontane and montane forest, each with their distinctive floristic associations and ecological dynamics.

Three different types of transition present in the AOI were considered in this study: elevational, wetlands and non-wetland, and heath and non-heath forest.

Elevational. Flora and fauna change gradually over an elevational gradient, rarely with hard boundaries, or at an elevation that is directly comparable among sites. For HCV 3, the Toolkit draws a hard arbitrary boundary between lowland and montane ecosystems, with lowlands below 500m, Sub-montane between 500-1000m a.s.l. and montane areas above 1000m a.s.l.. These recommended boundaries have been used here to define ecotonal transitions related to elevation (see further discussion of this topic in Chapter 2).

Wetlands and non-wetlands. Wetlands, broadly defined here to include peat swamp, open swamps, and mangrove, will have an ecotone present wherever they occur adjacent to other natural non-wetland areas. The phase boundary is fairly distinct, but the biotic and abiotic flux between the wetland and non-wetland area may occur over a large area that must be maintained in order to preserve the ecological integration of the two ecotypes.

Heath and non-heath. Heath forest may have a very sharp transition from other forest types, or it may be gradual, depending on edaphic conditions that usually require ground surveys to demarcate well. For heath forest vegetation, in addition to the land systems/ecosystem proxies known to support predominantly heath vegetation (see **Statistical Table 1.5.6**), other areas of heath forest were identified during land cover mapping performed in the early 1990sby the Berau Forest Management Programme

(BFMP). After cross checking with Landsat imagery, these areas where confirmed likely to be heath and were demarcated as such for purposes of delineating HCV 2.2.

The Toolkit provides limited guidance on how an HCV 2.2 ecotone should be mapped, and even less as to how it should be managed. The extent and form of all three ecotones are very difficult to model with any sort of precision, so as a precautionary measure, a 3 km zone was delimited along the extent of all ecosystem transitions. This is considered a buffer of liberal size and therefore likely to ensure that ecological processes characteristic of an ecosystem transition will be maintained (c.f. HCV 2.1).

To delimit such a buffer, the effective forest area described above was used to remove small breaks in forest cover arising from individual logging roads and rivers. All areas of non-forest were removed from the resulting buffer and only the remaining areas of different, contiguous ecosystems were included in the final HCV 2.2 ecotone. Where ecotonal transition areas overlapped (an artefact of the 3 km buffer demarcating transitions), the ecotone for different types was dissolved into one, so that the total area could be calculated without double counting overlaps.

1.3. Findings

1.3.1 Forest Cover and Ecosystem Variation

Across c. 18 million ha of Mapping Area, historical forest cover (c. 1975) extended across c. 17 million ha (Statistic Table 1.5.1; **Fig.1.4.1**). This forested area was one very large forest block, the few large areas of non-forest are generally found only in the southern area and along the Mahakam River (**Fig. 1.4.1**). Smaller, widely dispersed areas of non-forest along the coast and along other navigable rivers were also present.

Terrestrial ecosystem variation in the Mapping Area was (and remains) extremely high, including nearly all of the major ecosystem types known for Borneo (Whitmore 1984). Coastal regions are dominated by mangrove, estuarine and mixed freshwater and peat swamp ecosystems. Inland to these swamps, extensive areas of lowland mixed dipterocarp (MDF) or hill dipterocarp (HDF) forest are present, in which localized areas of highly productive (and ecologically important) alluvial bench forest on raised riverine sediments are found. Also present in this broad inland band of well-drained lowlands are diverse forms of kerangas or heath forest, with its distinctive physiognomic structure and (in some cases) superficial peat layers (up to 1 m in extreme cases). At higher elevations (>c. 500 m a.s.l.) lowland dipterocarp and kerangas forest are replaced by Sub-montane forest, which on taller mountains (>1000m) gives way to montane forest and/or cloud forest along exposed ridges and mountain peaks. Large lakes are found close to the Mahakam River, with substantial areas of associated peat lands formed on permanently inundated sandy terraces present in inland basins. Finally, the largest expanse of limestone outcrops in Kalimantan is found on the Mangkalihat Peninsula of East Kalimantan, in the eastern portion of the AOI.

Reflecting this variation in broader ecosystem classes, a total of 40 RePPProT land systems (excluding rivers and lakes) are present in the Mapping Area (**Fig. 1.4.4**). This is more than 80% of the 49 total land systems found throughout Kalimantan. Eighteen of these 40 classes are relatively rare, each representing less than 1% of the land area (mean of all classes is 2.5%). The three most common classes are Pendreh (**PDH**, 22% of total land area), Teweh (**TWH**, 18%), and Maput (**MPT**, 12%). Pendreh comprises non-orientated sedimentary mountains, and covers much of the Northern Mountain Ranges. It is, on the whole, considered to support primarily Sub-montane (**Sub**) and Montane (**Mon**) forest. Teweh comprises hillocky sedimentary plains, and is distributed over much of the dry lowland areas, but can also be found in more gently sloping upland areas, where Sub-montane or even montane ecosystems may be present. Maput comprises non-orientated sedimentary hills, and is commonly distributed throughout the AOI, where terrain is hilly, and may also support areas of Sub-montane ecosystems. These three common land systems dominated by rock of sedimentary origin reflect the geological history of much of Borneo, which is predominated by uplifted seabeds from shallow seas.

Forest cover has changed dramatically over the Mapping Area in the last 30 years (**Fig. 1.4.1**). Current forest cover has declined by more than 5.2 million ha, or 30% of forest cover c. 1975 (**Statistics Table 1.5.1**). Spatial patterns of forest loss across the Mapping Area are not uniform, but rather are spatially aggregated in regions of high forest loss (**Fig 1.4.1**). The majority of deforestation has occurred in the Mahakam Lowlands, with a loss of c. 3.4 million ha, or 76% of its c. 1975 extent. Most of this loss was caused by fire. The El Nino events of 1982/83, 1987, and 1997/98 resulted in draught and extensive forest fires (**Fig. 1.3.1**). By 1982, most of the Mahakam lowlands had been logged, and degraded primary and young secondary forest proved to be highly combustible during the extreme El Nino draught. A drop in the water table exceeding 0.5 m increased fire susceptibility of the extensive peat swamp areas associated with the lakes, and combustible surface coal seems further exacerbated the situation (Dennis 1999). The area of forest affected by fires is estimated to be 2.7 million ha (Schindele *et al.* 1989). Comparing Landsat imagery between early 1970's and c.1990, most of the area considered non-forest today in the Mahakam Lowlands was, in 1990, either highly degraded forest or secondary scrub with limited signs of ongoing anthropogenic activity. We therefore suggest that most of the forest cover change between c. 1975 and 1990 was a direct result of the 1982/83 fires. The 1987 fires were reported to be less extensive, but the 1997/98 fires were again very large, and reported to affect 5.2 million ha (Hoffmann *et al.*, 1999; **Fig. 1.3.1**). This eliminated many of the remaining tracts of degraded or secondary forest recovering from the 1982/83 conflagration, as well as destroying almost all of the remaining inland peat swamp forest associated with the Mahakam lakes.

The southern areas of the Nyapa-Mangkalihat Mountains and Plains appear to have followed a fate similar to that of the Mahakam Lowlands, with repeated burning in the 1980's and late 1990's. Some of the hardest hit localities appear to be some of the mountainous karst outcrops immediately adjacent to the lowland areas. They became completely denuded of vegetation in parts after the 1997 fires. As one moves north toward the more inaccessible hilly and mountainous areas, the forest appears to have been relatively unaffected by fire, presumably due to the reduced intensities of logging. Overall, forest loss in this Physiographic Region has been 37%, with much of this apparently from fire.

In the Northern Lowlands, deforestation appears to be driven primarily by development for agriculture, fibre plantations, and fisheries along the coast. By inspection of Landsat imagery, the rate of deforestation appears to be accelerating, though at present is only 25% since c.1975.

The Northern Mountains by contrast has been relatively unaffected with only a 2% loss reflecting its generally steep terrain unsuitable agriculture and inaccessibility for logging.

The future expected loss of forest predicted from the current East Kalimantan spatial plans (RTRWP 1999) is depicted in **Fig.1.4.2** and **Fig. 1.4.3**. This shows an expected further 5% loss in the much denuded Mahakam Lowlands (6% in proposed revised RTRWP), a very large additional 24% in the Northern lowlands (33% in proposed RTRWP), 11% additional loss in the Nyapa Mangkalihat Mountains and Plains (11% in proposed RTRWP), and an additional 4% loss in the Northern Mountain Ranges (10% in proposed RTRWP; **Statistical Table 1.5.1**). Proposed conversion will also further fragment existing forested areas, most notably in the Nyapa Mangkalihat Mountains and Plains, where the currently contiguous forests running along the centre of the Mangkalihat peninsula will be separated from the large central forests of Borneo.

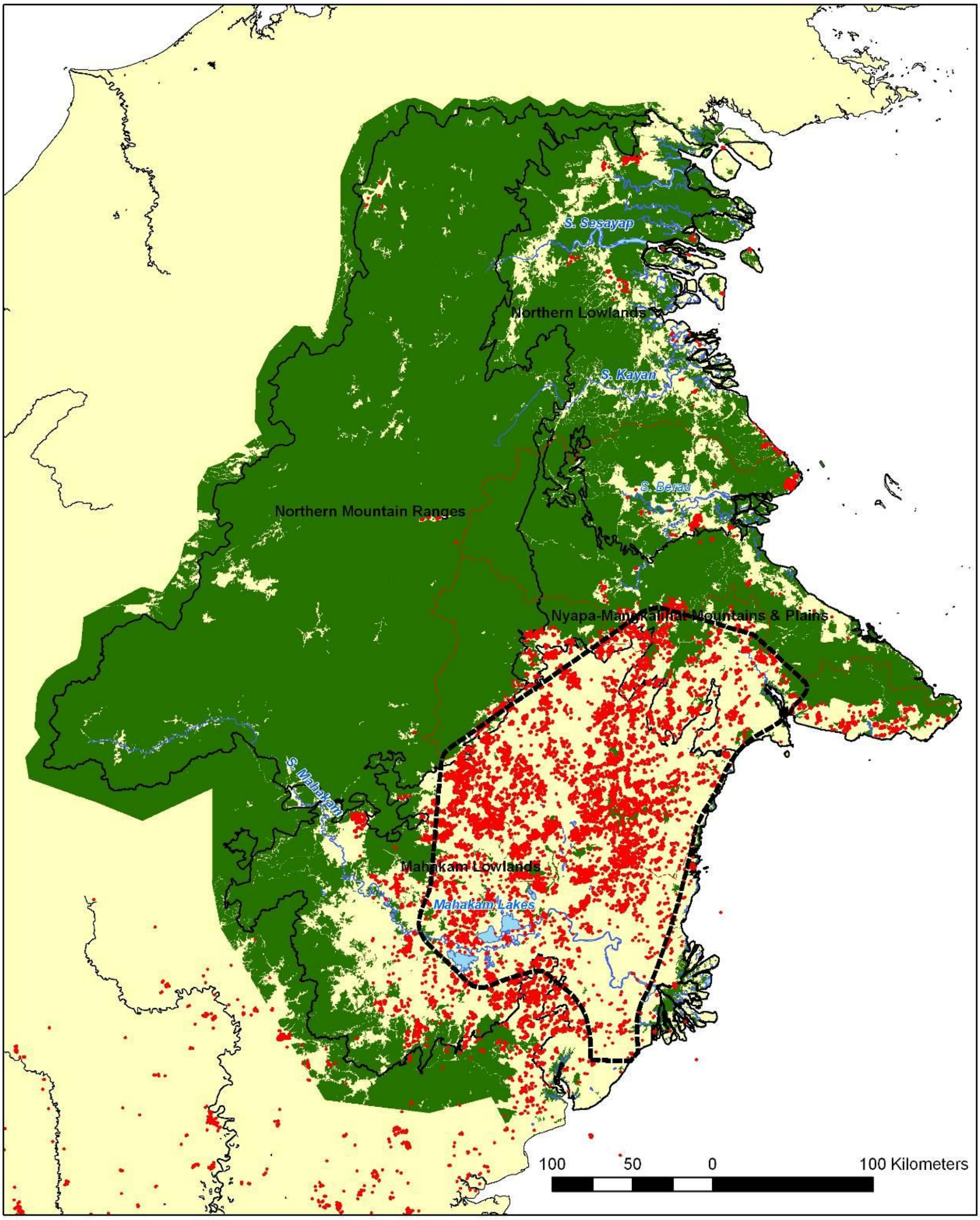


Figure 1.3.1 Fire history of the Mapping Area. Black heavy dashed line is the area estimated by RePPProT as the area damaged by fire in 1982/83 and the red dots are hotspots, indicative of fire, detected by ATSR in 1997/98.

1.3.2 HCV 3 – Rare or Endangered Ecosystems

Endangered ecosystems

Following methods described above, past, present and future forest cover were overlaid with the ecosystem map to compare past, present and future distribution of ecosystems within each Physiographic Region of the Mapping Area. Applying the criteria of 50% current loss for each ecosystem type and 75% future expected loss, a systematic comparison of ecosystems rarity and endangered status was performed.

A total of 1.1 million ha of extant ecosystems was found to be endangered as a result of habitat loss between c. 1975 and 2009. A further 0.4 million ha were classified as endangered as a result of expected future losses based on land use planning (**Fig. 1.4.5, Fig. 1.4.6; Statistical Table 1.5.1**). Comparing these by Physiographic Region, the impact of planned deforestation is highest in the Northern Lowlands, accounting for 364,000 ha (89%) of the HCV 3 areas considered endangered. In the other three Regions, the impact of planned future conversion on HCV 3 status is negligible (see Statistic Table 6).

Statistical Tables 1.5.2-1.5.5 summarise results of this comparison for each Physiographic Region. A total of 32 of the 40 ecosystem types were found to be endangered in one or more Region, with 28 of the 35 ecosystems in the heavily impacted Mahakam Lowlands classified as Endangered. The combined extent of HCV 3 areas due to current and future expected losses of habitat cover c. 1.5 million ha of land across the Mapping Area, of which c. 1 million ha of Endangered ecosystems are found in the Mahakam Lowlands, representing 89% of the remaining forest in that Region (**Fig. 1.4.6**). The Mahakam Lowlands also has the greatest number of ecosystems that have gone locally extinct, near extinct (>98% loss) or currently likely to become Critically Endangered (>90%) based on land use planning (**Statistical Table 1.5.2**). The second most severely impacted region is the Northern Lowlands with c. 0.4 million ha, representing 17% of the remaining forest in that Region (**Statistical Table 1.5.3**).

Water bodies do not constitute a land system; however, in the land system map for Kalimantan developed for the Toolkit, major rivers and all large standing water bodies have been included as separate identifiable areas. A total of c. 46,000 ha of lakes and c. 79,000 ha of rivers were delineated in the mapping area (**Statistical Table 1.5.6; Fig. 1.4.1)**. The cut off point between river and sea is, however, arbitrary in the estuaries and deltas, which is something that would be useful to improve upon. The analysis applied to land systems as ecosystem proxies cannot be applied to water bodies.

Water bodies are not a standalone ecosystem, but will be affected by the condition of areas surrounding them. The state of fresh water ecosystems will depend on the biotic and abiotic linkages with neighbouring swamp or dry land ecosystems. A major change in the surrounding habitat will alter the state of the water body.

The majority of the area of lakes identified exist within the Mahakam Lowlands (c. 43,000 ha; **Statistical Table 1.5.2**), with the largest lakes collectively referred as the Mahakam lakes. These lakes c.1975 were almost entirely surrounded by peat swamp forest, which has been almost totally destroyed and replaced by agriculture. It is considered highly likely that the ecology of these lakes has changed drastically since c. 1975, perhaps even to the point of permanence, with or without recovery of the surrounding peat swamp forests. Of the four major rivers identified in the Mapping Area, the Mahakam River is the most likely to have been altered ecologically. In c.1975, an estimate 80% of its length shown in **Fig. 1.4.1** was bordered with forests, but now only the upper reaches (constituting about 40% of its total length) are bordered by forest. The Sesayap River appears to be the least altered. The ecological changes to these rivers, and whether the lakes and rivers can be considered endangered, is beyond the scope of this study, but could be considered further in a separate study focussing on HCV 4.

Forest loss in Berau Regency has been much lower than that of East Kutai (**Fig. 1.4.1**), with a loss of 16% in Berau compared to a 67% loss in Kutai Timur (Table 1.3.1). This difference reflects the fact that most of Kutai Timur occupies the Mahakam Lowlands and southern portion of the Nyapa Mangkalihat Hills and Plains, the areas worst affected by fires.

Table 1.3.1 Extent of past and present forest cover by Regency and percentage loss

Regency	Forest Cover c. 1975 (ha)	Forest Cover 2009 (ha)	% Loss
Berau	2,138,000	1,796,000	16%
Kutai Timur	3,098,000	1,018,000	67%

Rare ecosystems

Following methods described, maps of present and future ecosystem distribution were examined to determine which if any ecosystems qualify as rare using both the <1% criteria and the <5%.

The extent of ecosystems meeting one or more criterion for Rare is c. 563,000 ha and c. 1,221,000 for the <1% and <5% criteria, respectively.

Using the <1% criteria, of the 40 ecosystems present in the Mapping Area, 39 were found to be rare in one or more Region (**Statistical Table 1.5.6)**. This large number, although surprising, emphasises the strength of the use of Physiographic Regions to contextualize HCV 3 status, by accounting for the fact that an ecosystem may be common in some regions but naturally rare in others, imparting local ecological significance. Many of the Rare ecosystems are also classified as Endangered. Not surprisingly, the Mahakam Lowlands has the highest proportion of Rare ecosystems, with 31 of 35 ecosystem types classified as Rare under HCV 3.

1.3.3 HCV 2 – Large Intact Landscapes

HCV 2.1 - Landscapes with capacity to maintain natural ecological processes

Out of a total of 62 forest blocks with a Core Area (as defined above) in the AOI (6 million ha of Berau and Kutai Timur), three were found to qualify as intact Large Landscapes under HCV 2.1, with core areas >20000 ha in extent. Together, these three blocks total c. 1,786,000 ha (Table 1.3.2; **Fig. 1.4.10)**. A brief description of each is provided.

> *Large Landscape 1*. The largest intact landscape (c. 1,346,000 ha) is contiguous and forms part of the very much larger forested area occupying the centre of the island of Borneo.
>
> *Large Landscape 2*. This landscape block is intermediate in size (c. 400,000 ha) and runs east west along the centre of the Mangkalihat Peninsula. It is separated from Core area 1 by an agricultural area running along the Kelai River, and is threatened under current and proposed land use plans to become fragmented.
>
> *Large Landscape 3*. This landscape block occurs on the Tanjung Batu Peninsula to the north of the Berau delta. It is much smaller (c. 40,000 ha) but contains an unusual mix of MDF wetland and heath forest ecosystems. The current land use plans keep this core area relatively intact but the current proposed change in land use plans will lead to its loss as an HCV2.1 area with loss of most the forest in the Core Area.

The numerous smaller forest blocks with Core Areas too small to qualify as HCV 2.1 are not, by any means, without ecological significance. This is most clearly apparent when these blocks are considered in conjunction with HCV 3 status (rare or endangered) as in **Fig. 1.4.13**, or HCV 2.2 (ecosystem transitions) as in **Fig. 1.4.12.** The occurrence of Core Areas of any size will greatly enhance prospects for maintaining HCV attributes within these more isolated forest blocks.

Table 1.3.2 Seven forest blocks with largest 'Core Areas' in the AOI, and the area of associated 3-km buffers for those blocks classified as HCV 2.2. A total of 62 forest blocks containing core areas were found in the AOI. *indicates that the area described within the AOI is a portion of a much larger forest block extending far beyond the border of the AOI into the interior of Borneo.

Number	Core Area (ha)	Associated Buffer HCV2.1 areas (ha)	HCV2.1
1	*1,346,049	340,486	✓
2	399,891	262,221	✓
3	39,885	49,196	✓
4	8,879	-	×
5	6,357	-	×
6	4,500	-	×
7	3,427	-	×

HCV 2.2 – Landscapes with intact ecosystem transitions

Zones of ecosystem transition (HCV 2.2) cover an area of c. 1,730,000 ha within the AOI, or when calculated individually c. 1,859,200 ha, the difference reflecting the overlap between different transition zones (Table 1.3.3; **Fig. 1.4.11**).

The most extensive types of transitional area were those related to elevational zonation, from lowland to Sub-montane to montane (1,370,300 ha). These transitions form a very complex and widespread spatial pattern, hence the large total area. The heath-non-heath transition covers an estimated 254,300 ha, and occurs in lowland, lower montane and montane areas. As such, these transitions also overlap partially with that of altitudinal zones noted above. The wetland-non-wetland transition (234,600 ha) had a large number of small transitional areas due to the occurrence of agricultural land uses contiguous with these transitional zones. It also showed the least amount of overlap with other transitional types. Many of the ecosystem transitions of all three types were found to occur within Cores Areas of HCV 2.1 Large Landscapes and Core Areas of non-HCV2.1 forest blocks, and as such will show good potential for management of this important ecological attribute.

Table 1.3.3 Zones of Ecosystem Transition (HCV 2.2) identified in the AOI.

Ecosystem transition type	Total area (ha)	Total Number
Altitudinal	1,370,300	23
Heath forest/Non-Heath Forest	254,300	14
Wetland/Non-Wetland	234,600	74
Total	1,859,200	111

1.4. Maps

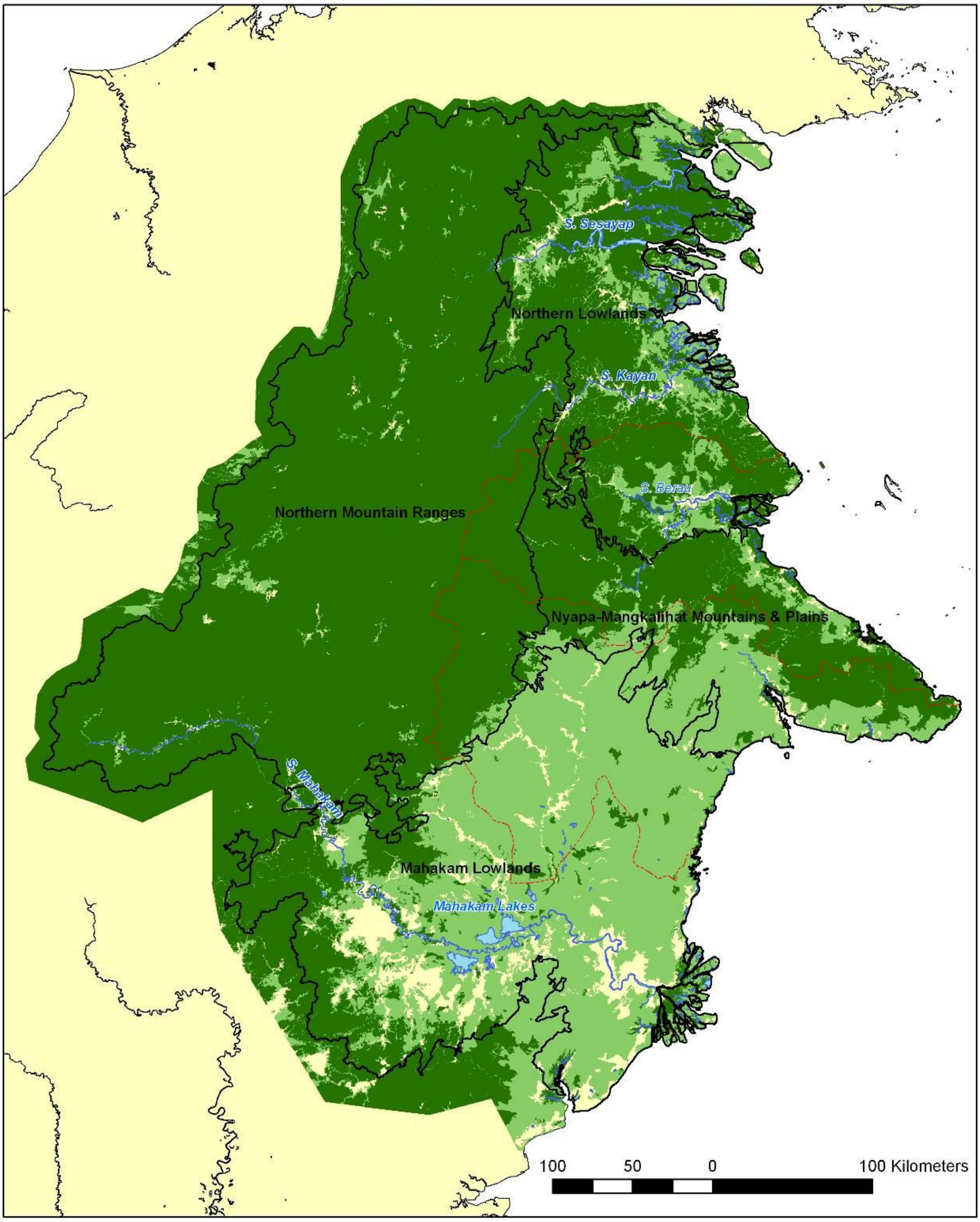


Figure 1.4.1. Past and present forest cover and water bodies. The dark green area represents forest cover 2009; light green is forest cover c. 1975. Also shown are boundaries of the four Physiographic Regions (black) and Berau and Kutai Timor Regencies (red).

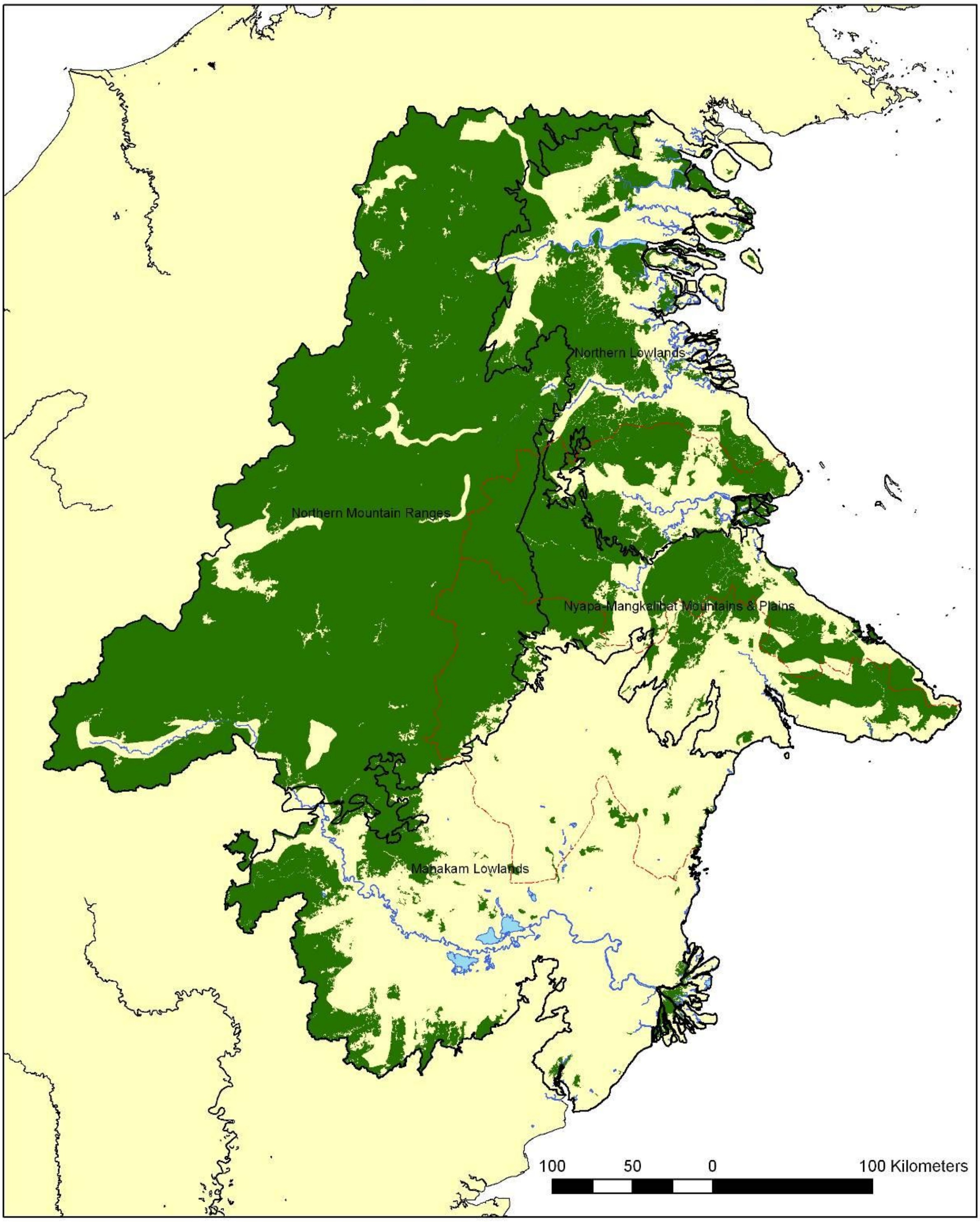


Figure 1.4.2. Future expected forest cover based on the current 1999 provincial land use planning, East Kalimantan.

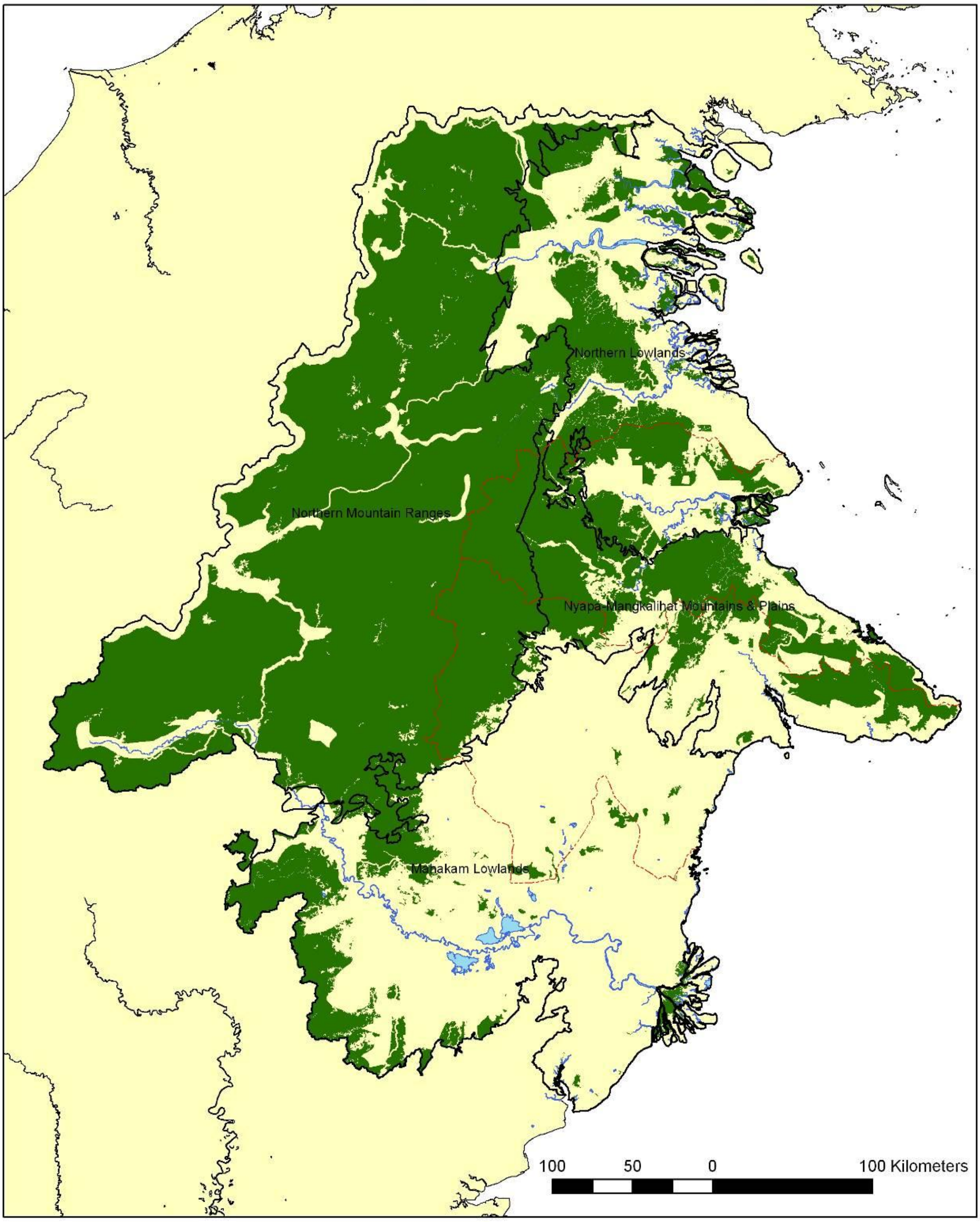


Figure 1.4.3. Future expected forest cover based on the proposed (2008) provincial land use planning, East Kalimantan.

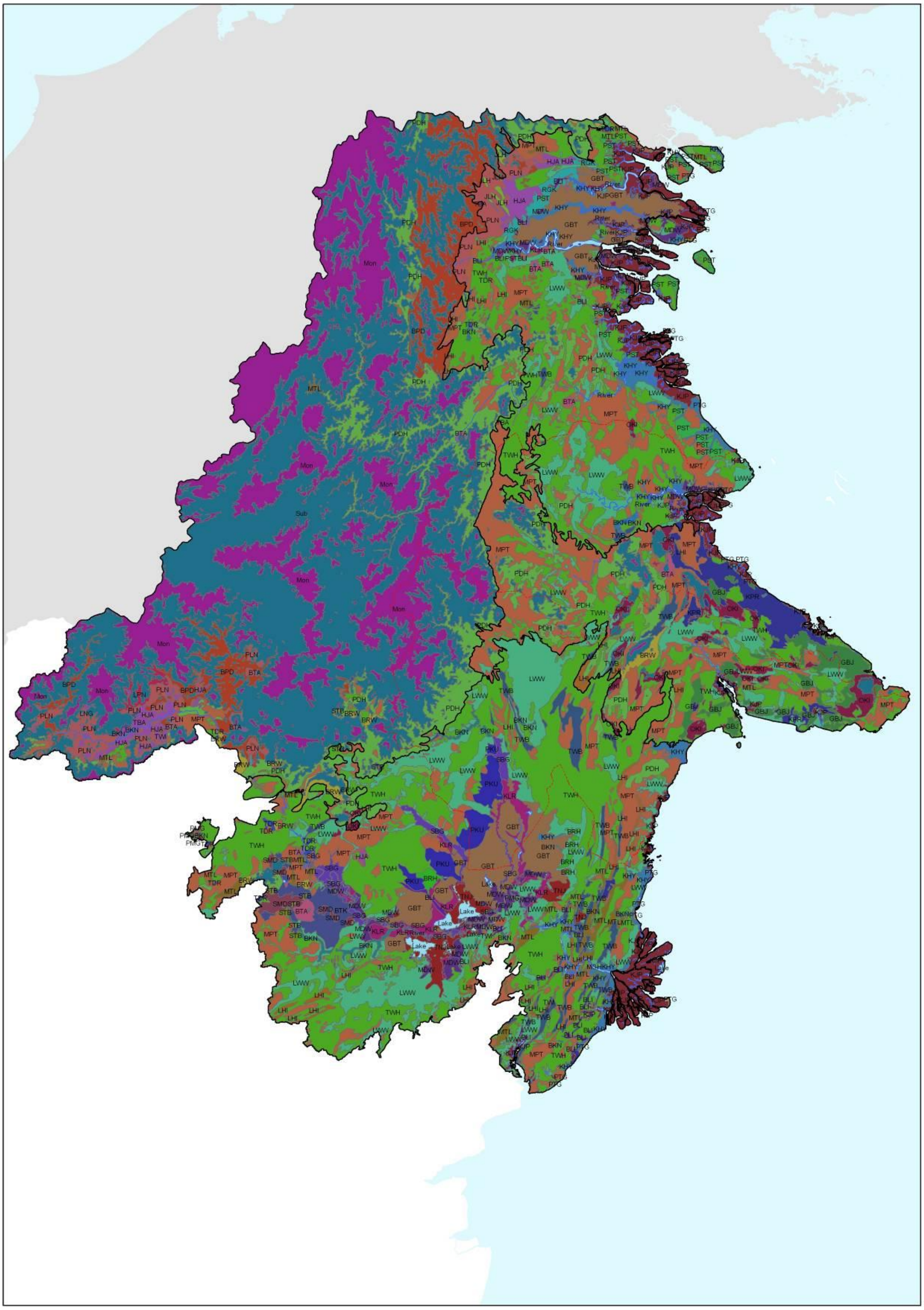


Figure 1.4.4. Colour coded representation of modified RePPProT land systems (Ecosystem proxies) present in the four Physiographic Regions.

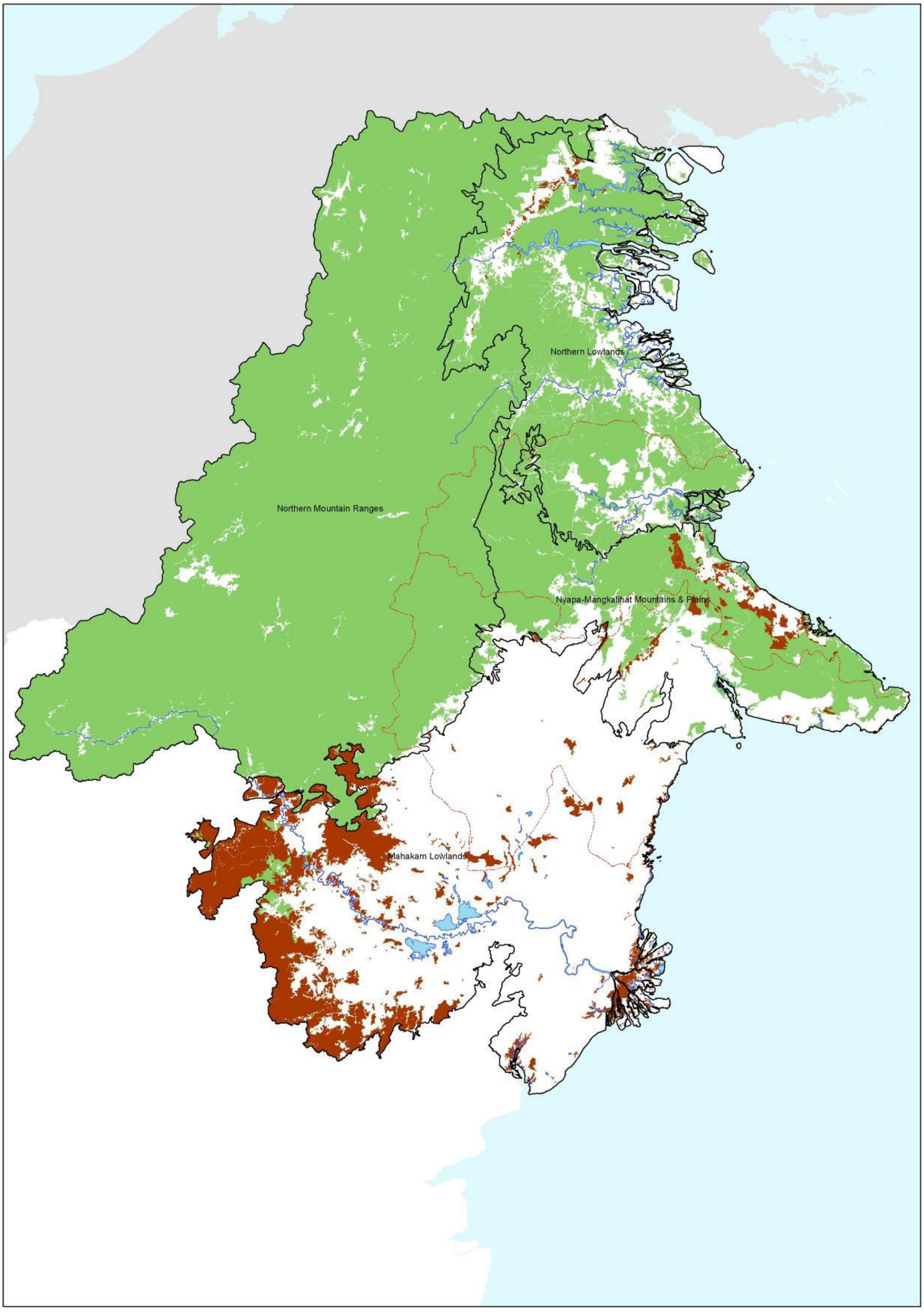


Figure 1.4.5. Current extent of Endangered ecosystems (HCV 3) as a result of current forest loss since c. 1975

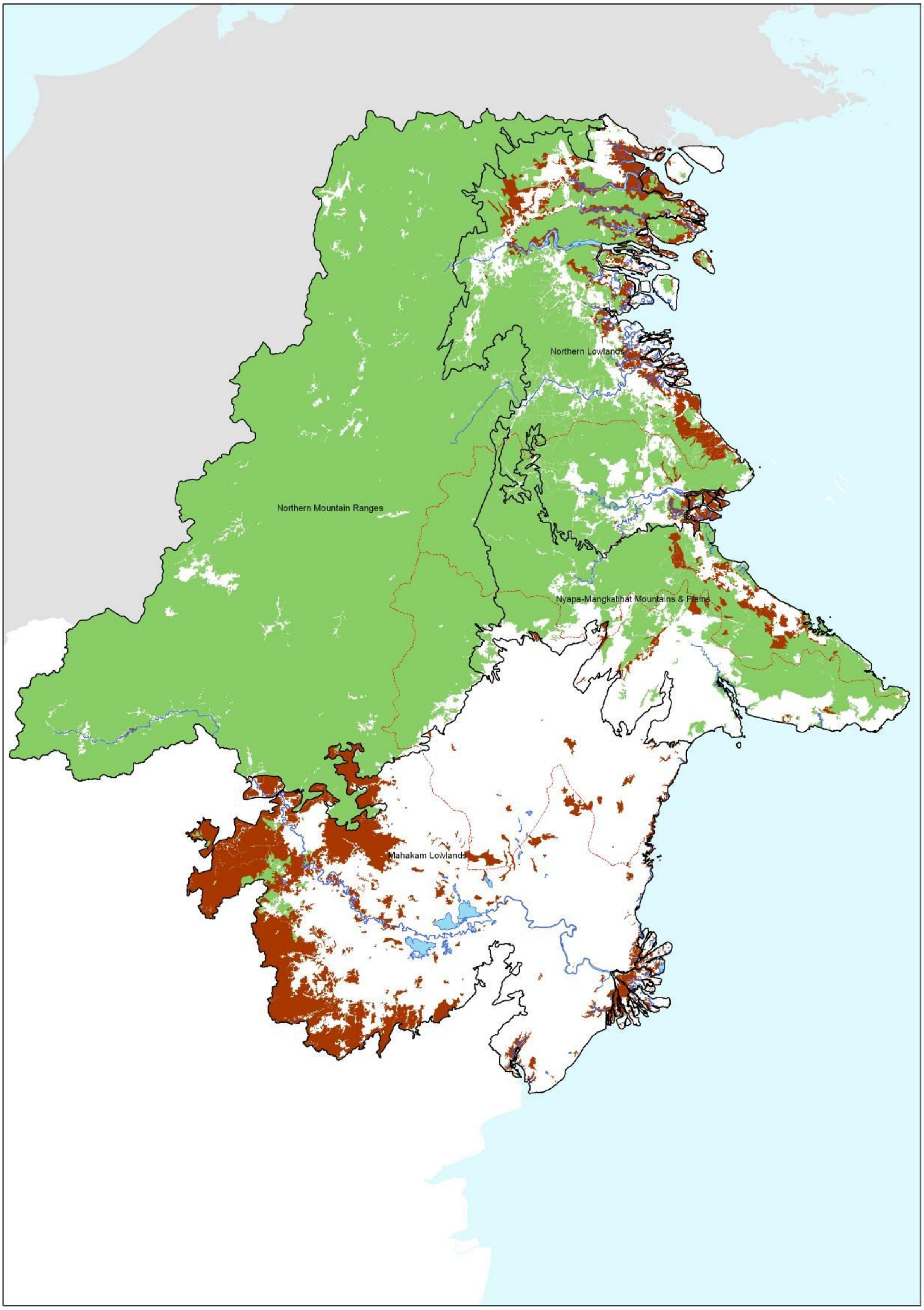


Figure 1.4.6. Current extent of Endangered ecosystems (HCV 3) as a result of current forest loss and future expected land cover change based on existing Provincial land use plans.

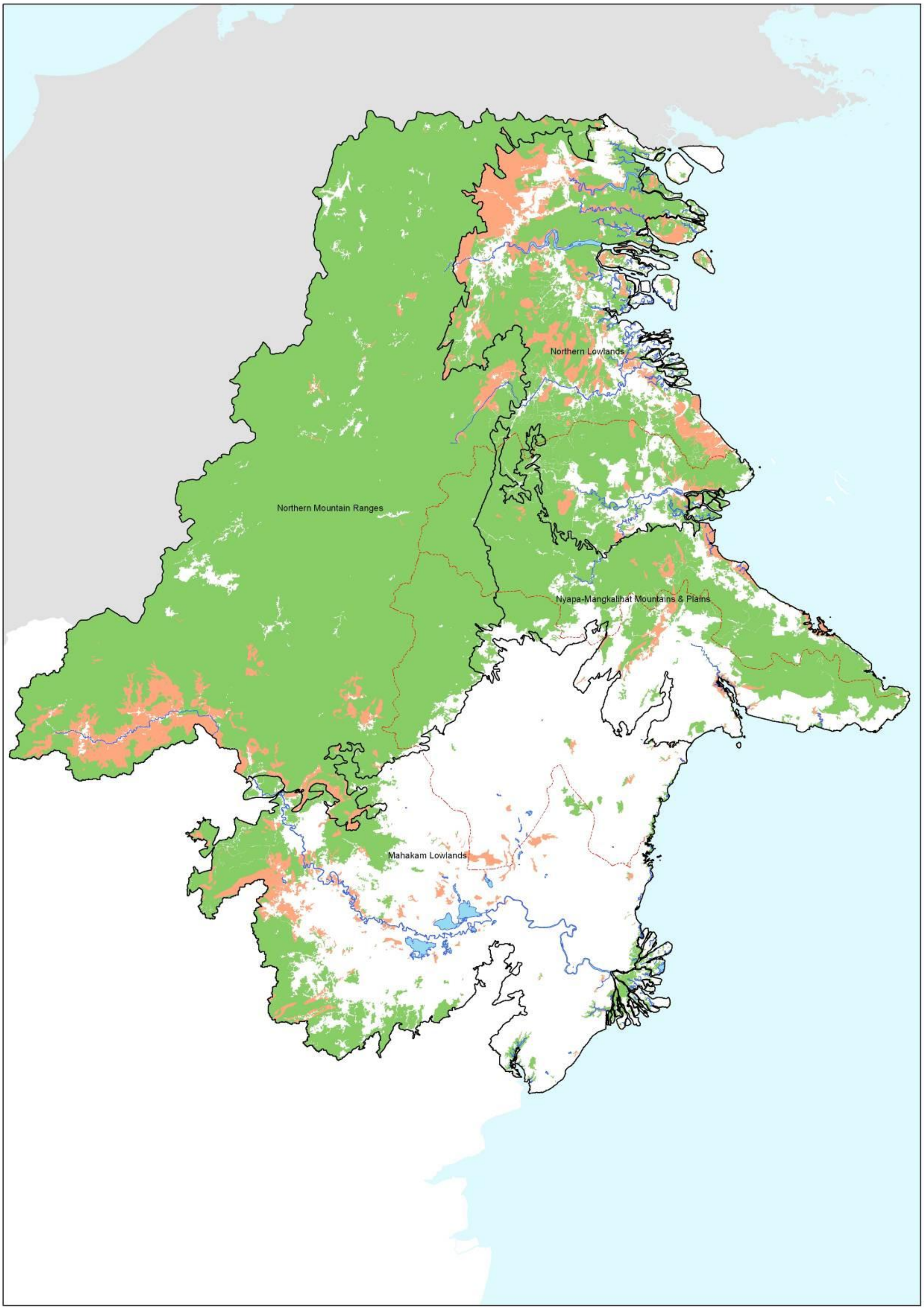


Figure 1.4.7. Distribution of Rare ecosystems (HCV 3) within the four Physiographic Regions based on 5% criterion.

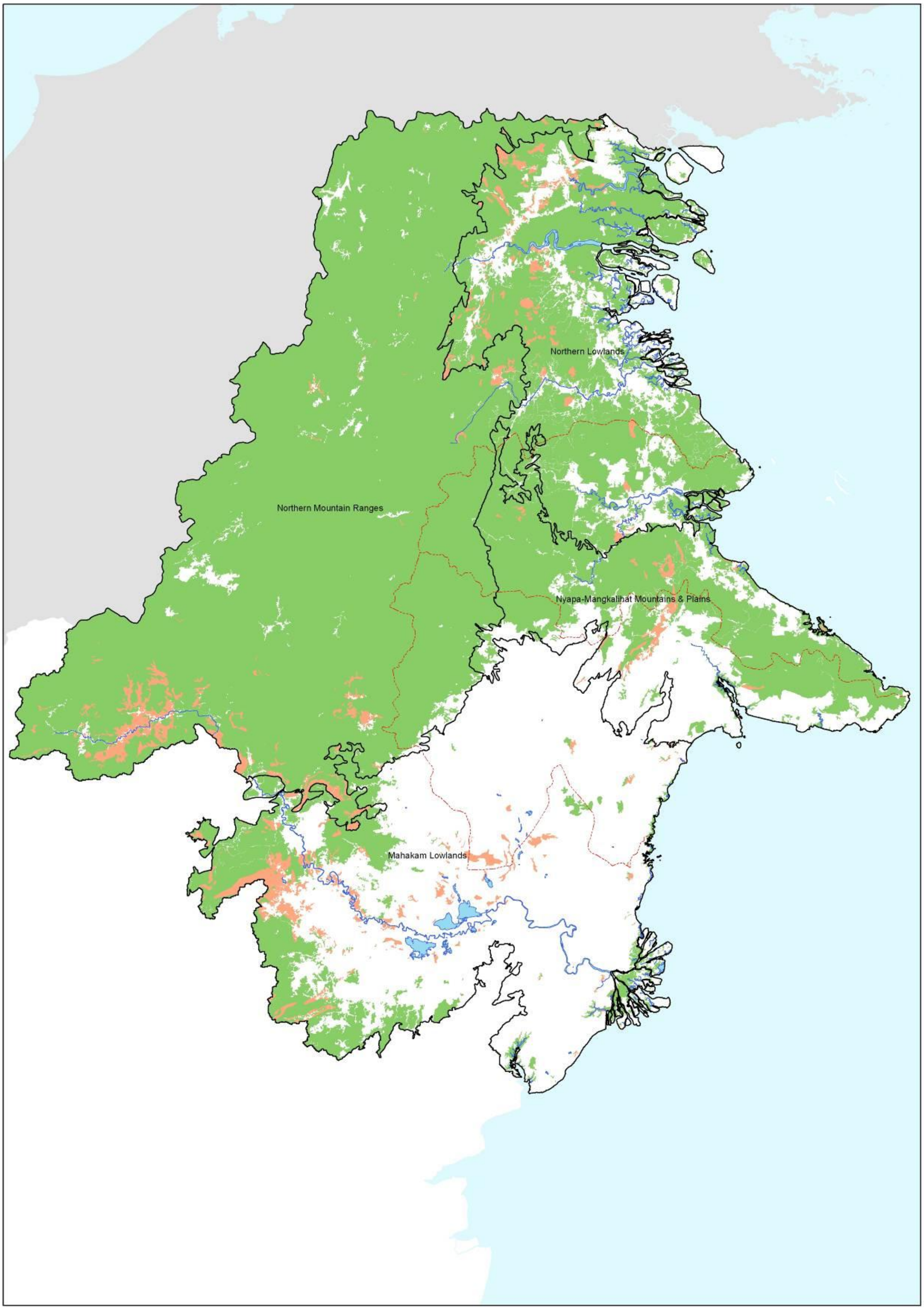


Figure 1.4.8. Distribution of Rare ecosystems (HCV 3) within the four Physiographic Regions based on 1% criterion

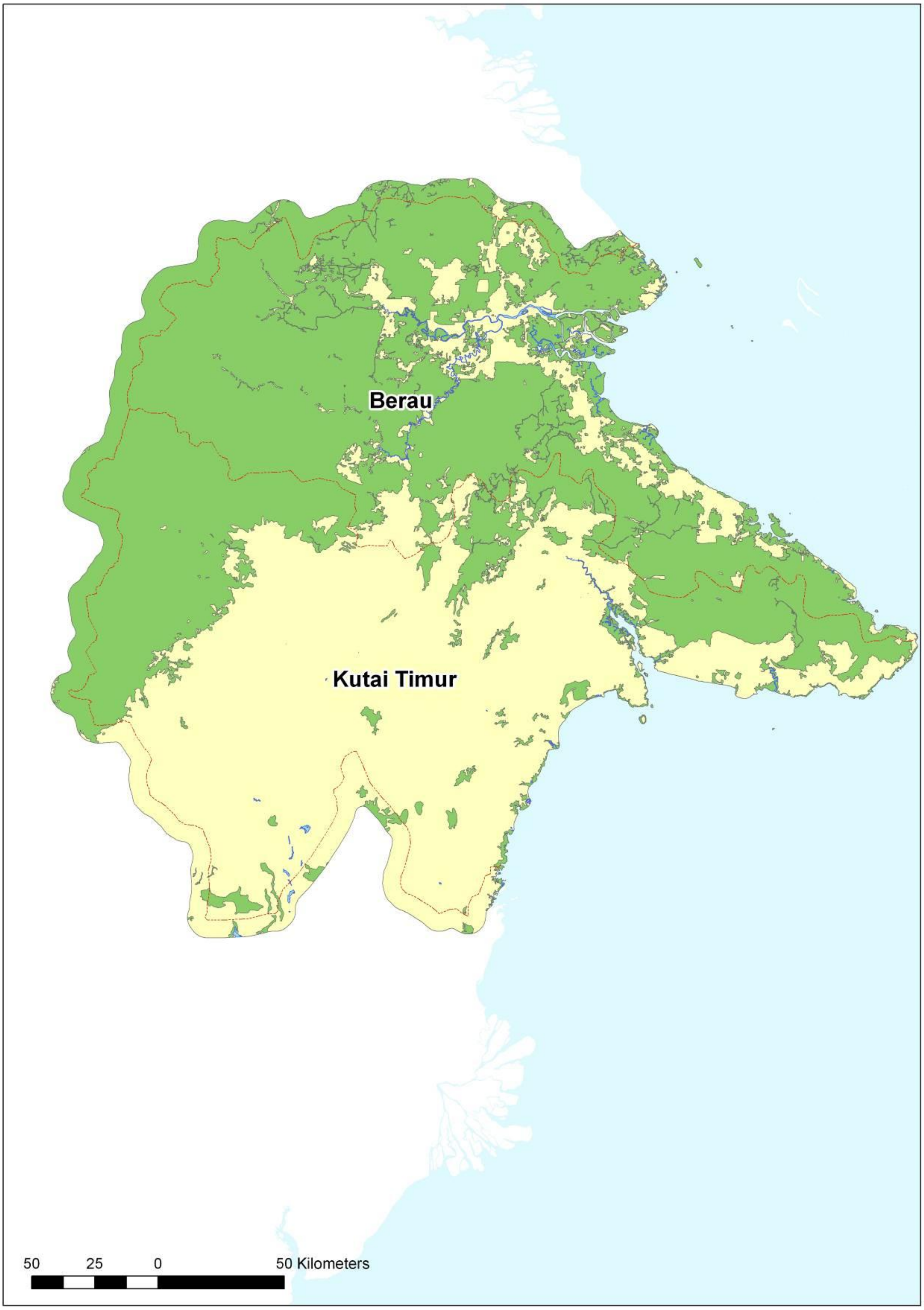


Figure 1.4.9. Map of 2009 forest cover in Berau and Kutai Timur Regencies (the Area of Interest).

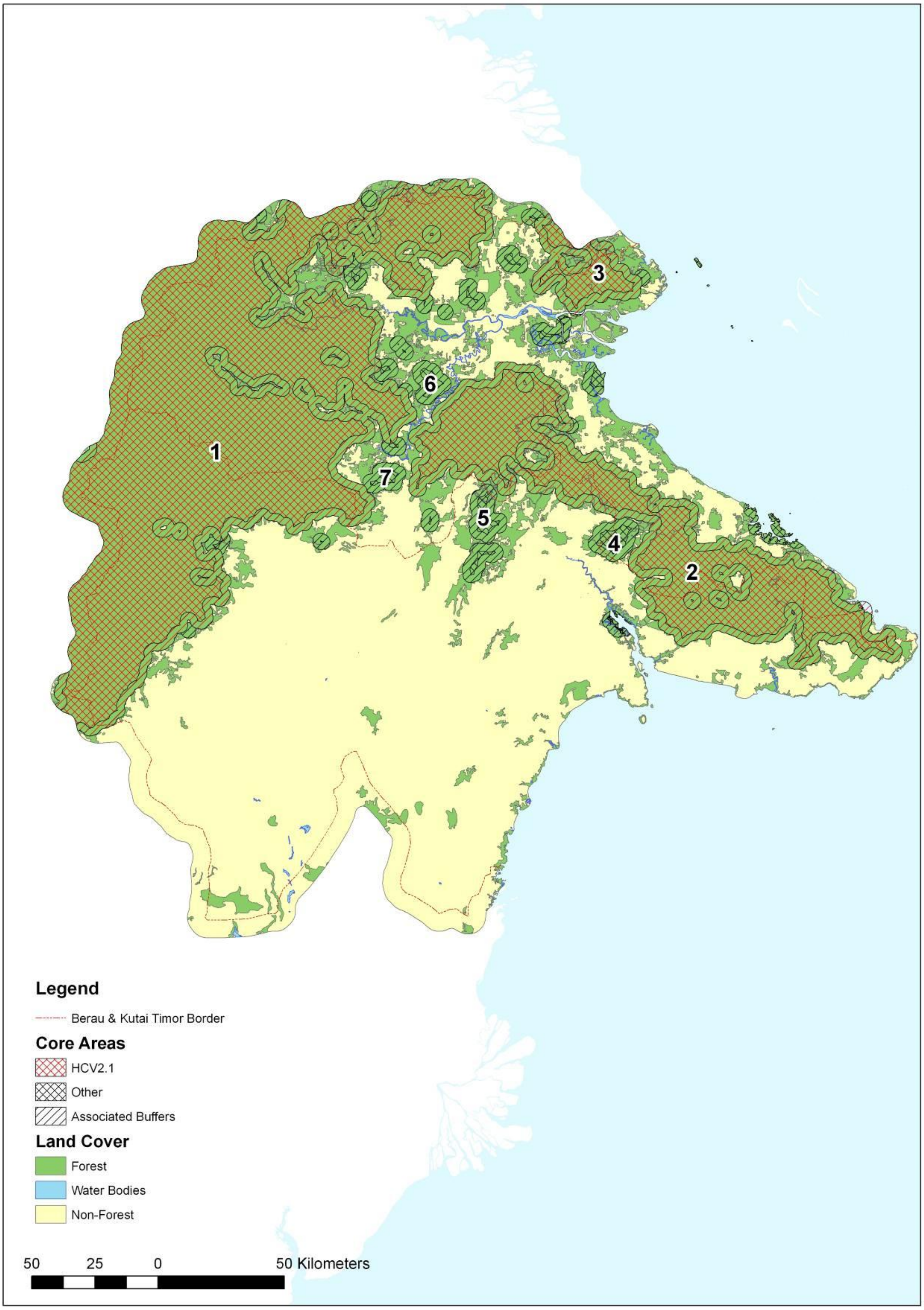


Figure 1.4.10. Three HCV 2.1 Large Landscape blocks with Core Areas greater than 20,000 ha (cross hatched red) and associated buffers (red stripes), and 59 other small cores (black cross hatched) with their associated buffers (black stripes). The numbers refer to those used in Table 1.3.2 for descriptive purposes in order of decreasing size.

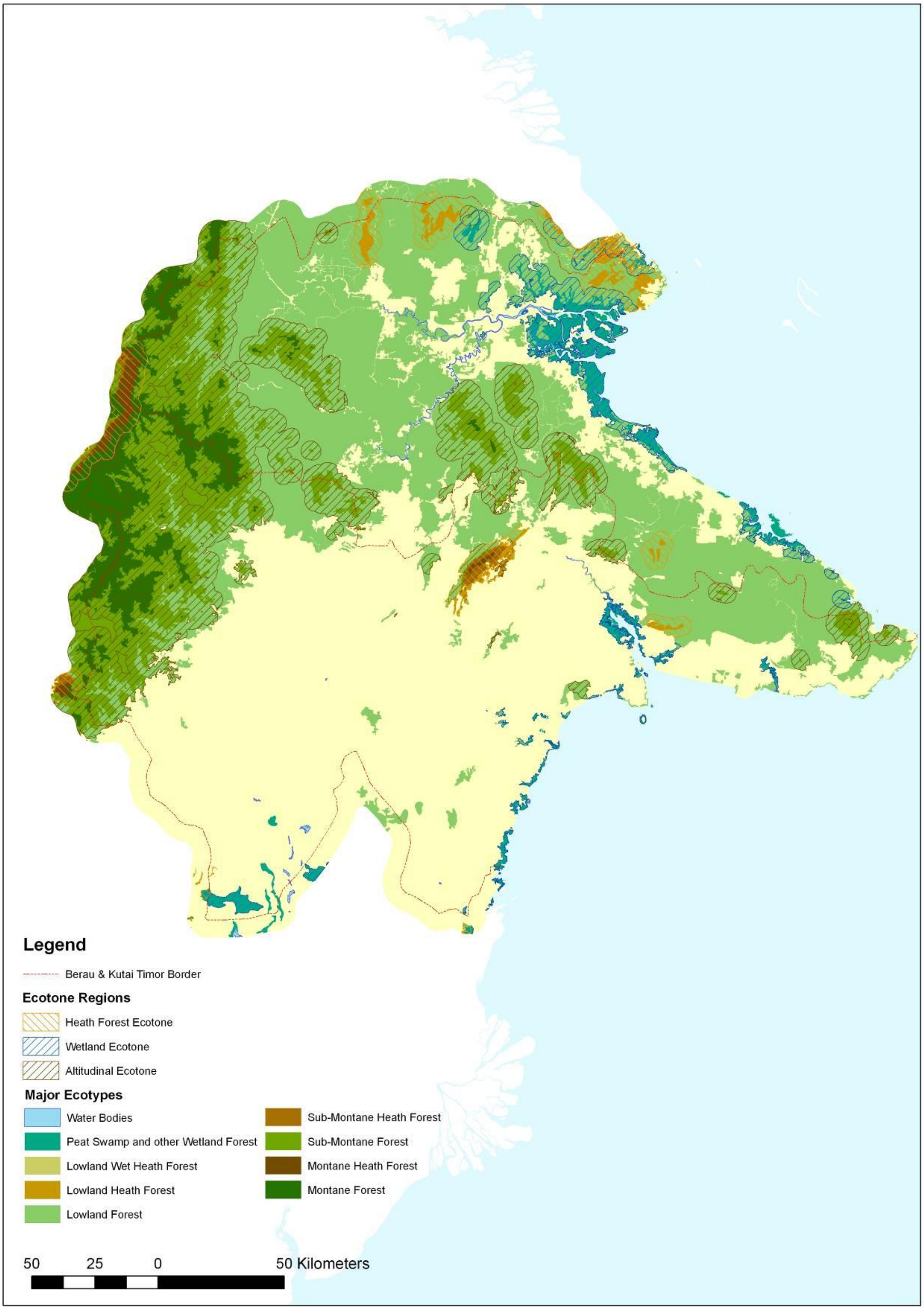


Figure 1.4.11. HCV 2.2 ecotones between major ecotypes created with a 3 km buffer either side of the transition boundaries between specified ecosystem types.

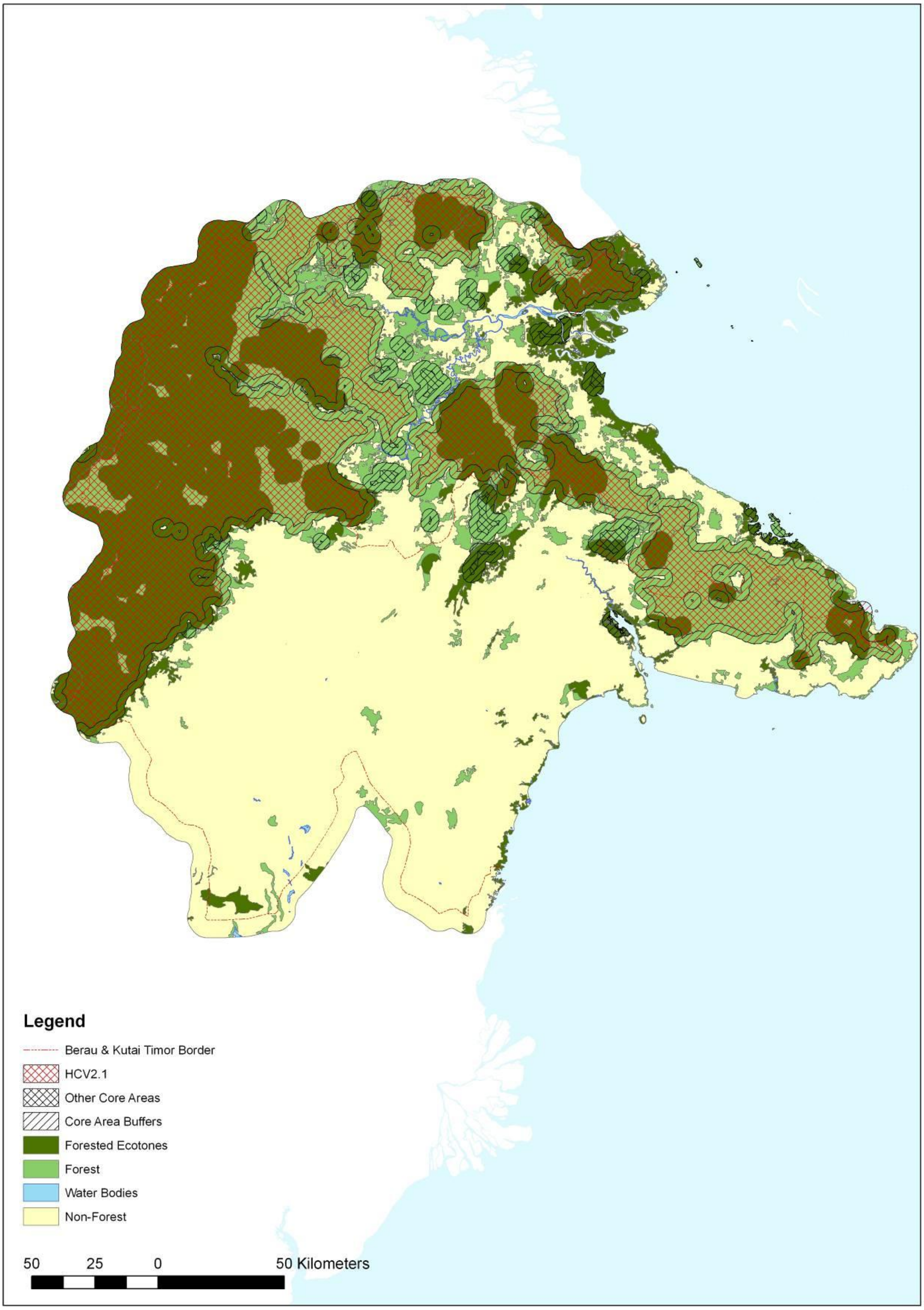


Figure 1.4.12. Landscape blocks with core areas >20,000 ha (HCV 2.1) and <20,000 ha (non-HCV 2.1) with overlay of zones of ecosystem transition (HCV 2.2).

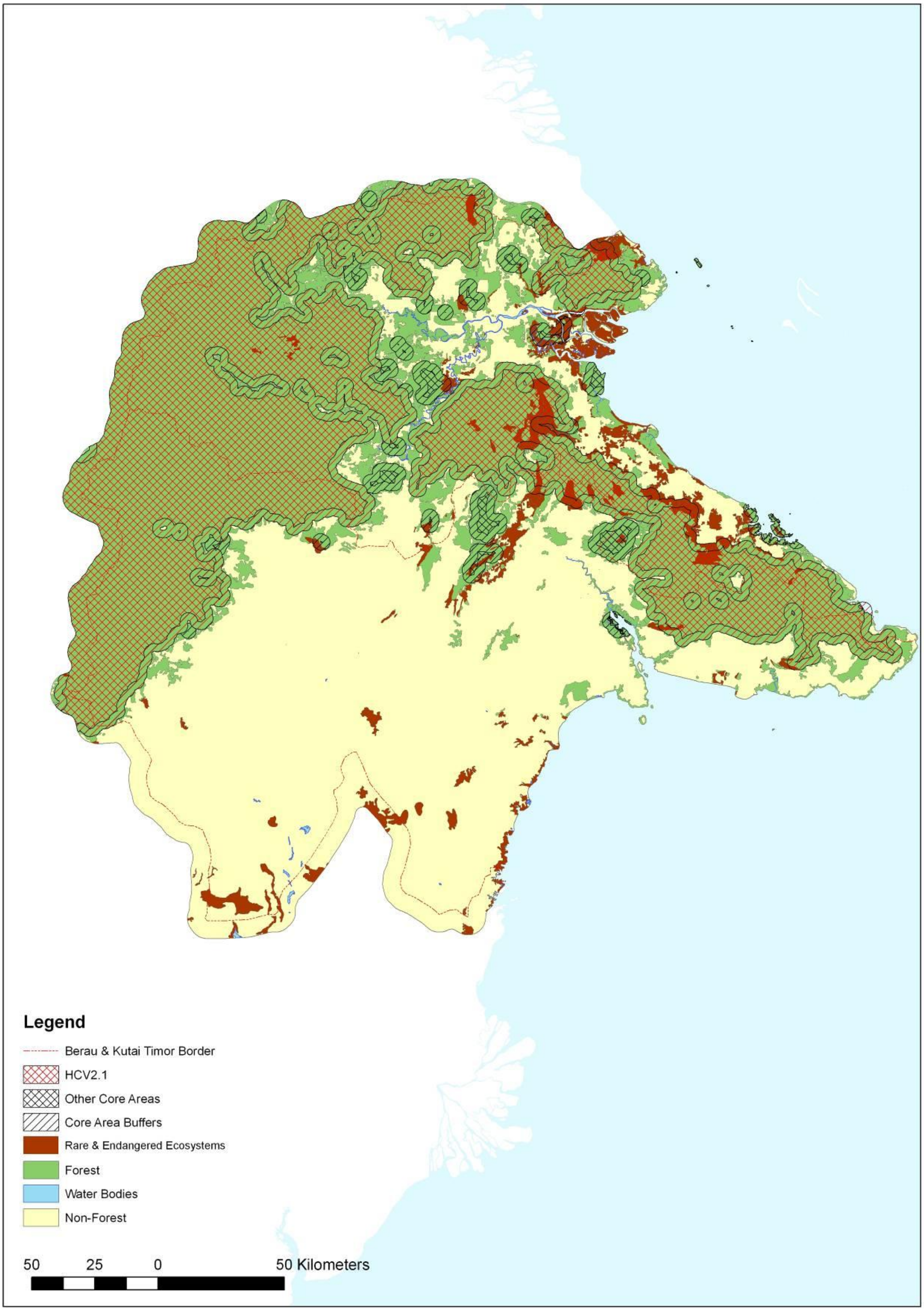


Figure 1.4.13. Landscape forest blocks with core areas >20,000 ha (HCV 2.1) and <20,000 ha (non-HCV 2.1) with overlay of Rare (<1% criterion) or Endangered ecosystems (HCV 3).

1.5. Statistics Tables

Statistic Table 1.5.1. Summary Data

Physiographic Region	Area of Region (ha)	Extent of Natural Ecosystems 1975 (ha)	Extent of Natural Ecosystems* 2009 (ha)	% Loss	Future Expected Extent of Natural Ecosystems* per RTRWP 1999	% Loss	Future Expected Extent of Natural Ecosystems* per Proposed RTRWP v.2008	% Loss	Extent of Endangered Ecosystems* still extant 2009 due to habitat loss (ha)	Extent of Endangered Ecosystems* still extant 2009 habitat loss and planning (ha)	Extent of Rare Ecosystems* still extant 2009 5% criteria (ha)	Extent of Rare Ecosystems* still extant 2009 1% criteria (ha)
Mahakam Lowlands	5,159,314	4,558,305	1,113,945	76	887,128	81	836,325	82	996,667	996,667	199,768	199,768
Northern Lowlands	3,136,770	3,009,872	2,254,245	25	1,518,506	50	1,266,547	58	22,293	385,870	522,153	119,360
Northern Mountain Ranges	7,328,301	7,285,488	7,136,785	2	6,817,045	6	6,398,731	12	0	905	409,757	197,837
Nyapa Mangkalihat Mountains and Plains	2,381,995	2,328,480	1,476,791	37	1,231,466	47	1,218,685	48	92,869	92,948	89,698	46,455
	18,006,380	17,182,145	11,981,766	30	10,454,144	39	9,720,288	43	1,111,829	1,476,390	1,221,376	563,420

Statistic Table 1.5.2. Mahakam Lowlands, red indicates extinction or near extinction (>98% loss), yellow indicates critically endangered (>90%)

Symbol	Land System Name	Area Land System (ha)	Natural Area c. 1975 (ha)	Natural Area 2009 (ha)	Future Expected Area RTRWP 1999 (ha)	Future Expected Area RTRWP v2008 (ha)	% of Natural Area in c.1975	% of Natural Area in 2009	% of Natural Area in 2009 compared to c.1975	% Lost by 2009	% Expected Loss RTRWP 1999	% Expected Loss RTRWP v2008	Presently Rare (5% criteria)	Presently Rare (1% criteria)	Endangered due to present loss	Endangered due to Current RTRWP	Endangered due to Proposed RTRWP	Endangered
BKN	BAKUNAN	39,573	22,026	3,508	1,978	1,978	0.5	0.3	0.1	84.1	91.0	91.0	Y	Y	Y	Y	Y	Y
BLI	BELITI	25,953	17,019	586	92	110	0.4	0.1	0.0	96.6	99.5	99.4	Y	Y	Y	Y	Y	Y
BRH	BARAH	21,779	20,103	36	25	25	0.4	0.0	0.0	99.8	99.9	99.9	Y	Y	Y	Y	Y	Y
BRW	BERIWIT	7,834	7,123	5,797	4,742	4,475	0.2	0.5	0.1	18.6	33.4	37.2	Y	Y	N	N	N	N
BTA	BATU AJAN	14,910	9,712	3,665	3,103	3,103	0.2	0.3	0.1	62.3	68.1	68.1	Y	Y	Y	N	N	Y
BTK	BARONG TONGKOK	91,197	38,783	17,026	11,158	10,767	0.9	1.5	0.4	56.1	71.2	72.2	Y	Y	Y	N	N	Y
GBJ	GUNUNG BAJU	899	899	135	135	116	0.0	0.0	0.0	85.0	85.0	87.1	Y	Y	Y	Y	Y	Y
GBT	GAMBUT	323,393	319,814	37,319	15,774	22,182	7.0	3.4	0.8	88.3	95.1	93.1	Y	Y	Y	Y	Y	Y
HJA	HONJA	3,182	2,760	928	928	717	0.1	0.1	0.0	66.4	66.4	74.0	Y	Y	Y	N	N	Y
KHY	KAHAYAN	75,926	47,245	7,075	2,647	2,090	1.0	0.6	0.2	85.0	94.4	95.6	Y	Y	Y	Y	Y	Y
KJP	KAJAPAH	151,680	144,182	66,735	41,534	35,007	3.2	6.0	1.5	53.7	71.2	75.7	N	N	Y	N	Y	Y
KLR	KLARU	110,940	99,891	4,483	1,291	1,291	2.2	0.4	0.1	95.5	98.7	98.7	Y	Y	Y	Y	Y	Y
KPR	KAPOR	7,522	7,183	358	81	78	0.2	0.0	0.0	95.0	98.9	98.9	Y	Y	Y	Y	Y	Y
LHI	LOHAI	69,019	60,371	15,831	14,764	13,742	1.3	1.4	0.3	73.8	75.5	77.2	Y	Y	Y	Y	Y	Y
LWW	LAWANGUWANG	887,388	737,977	102,229	77,809	66,680	16.2	9.2	2.2	86.1	89.5	91.0	N	N	Y	Y	Y	Y
MDW	MENDAWAI	73,896	69,207	6,071	2	2	1.5	0.5	0.1	91.2	100.0	100.0	Y	Y	Y	Y	Y	Y
MGH	MANGKAHO	3,807	1,500	350	0	0	0.0	0.0	0.0	76.6	100.0	100.0	Y	Y	Y	Y	Y	Y
Mon	Montane	51	51	51	51	51	0.0	0.0	0.0	0.0	0.0	0.0	Y	Y	N	N	N	N
MPT	MAPUT	666,959	629,398	242,314	215,178	208,709	13.8	21.8	5.3	61.5	65.8	66.8	N	N	Y	N	N	Y
MTL	MANTALAT	100,755	86,447	19,927	15,952	15,550	1.9	1.8	0.4	76.9	81.5	82.0	Y	Y	Y	Y	Y	Y
OKI	OKKI	3,226	3,222	1,541	1,541	1,541	0.1	0.1	0.0	52.2	52.2	52.2	Y	Y	Y	N	N	Y
PDH	PENDREH	55,460	55,287	11,224	10,881	10,890	1.2	1.0	0.2	79.7	80.3	80.3	Y	Y	Y	Y	Y	Y
PKU	PAKAU	118,531	112,790	1,774	410	348	2.5	0.2	0.0	98.4	99.6	99.7	Y	Y	Y	Y	Y	Y
PLN	PAKALUNAI	2,969	2,539	1,030	1,030	840	0.1	0.1	0.0	59.4	59.4	66.9	Y	Y	Y	N	N	Y
PMG	PAMINGGIR	1,784	1,784	1,616	1,616	1,616	0.0	0.1	0.0	9.4	9.4	9.4	Y	Y	N	N	N	N
PTG	PUTING	4,430	2,809	385	0	4	0.1	0.0	0.0	86.3	100.0	99.9	Y	Y	Y	Y	Y	Y
SBG	SEBANGAU	98,934	59,823	11,117	2,013	2,006	1.3	1.0	0.2	81.4	96.6	96.6	Y	Y	Y	Y	Y	Y
SMD	SUNGAI MEDANG	36,485	25,390	15,982	10,980	10,447	0.6	1.4	0.4	37.1	56.8	58.9	Y	Y	N	N	N	N
STB	SUNGAI TABANG	10,070	8,915	6,873	4,703	4,359	0.2	0.6	0.2	22.9	47.2	51.1	Y	Y	N	N	N	N
Sub	Submontane	13,344	13,248	12,615	12,569	12,615	0.3	1.1	0.3	4.8	5.1	4.8	Y	Y	N	N	N	N
TDR	TANDUR	8,927	8,887	7,064	3,038	2,637	0.2	0.6	0.2	20.5	65.8	70.3	Y	Y	N	N	N	N
TNJ	TANJUNG	86,868	63,134	1,369	169	8	1.4	0.1	0.0	97.8	99.7	100.0	Y	Y	Y	Y	Y	Y
TWB	TEWAI BARU	161,527	148,069	4,032	3,694	3,533	3.2	0.4	0.1	97.3	97.5	97.6	Y	Y	Y	Y	Y	Y
TWH	TEWEH	1,811,866	1,662,556	435,619	359,961	331,528	36.5	39.1	9.6	73.8	78.3	80.1	N	N	Y	Y	Y	Y
TWI	TELAWI	951	881	0	0	0	0.0	0.0	0.0	100.0	100.0	100.0	Y	Y	Y	Y	Y	Y
Lake	Lake	43,447	43,447	43,447	43,447	43,447	1.0	3.9	1.0	0.0	0.0	0.0	na	na	na	na	na	na
River	River	23,833	23,833	23,833	23,833	23,833	0.5	2.1	0.5	0.0	0.0	0.0	na	na	na	na	na	na
		5,159,314	4,558,305	1,113,945	887,128	836,325	100.0	100.0	24.4									

Statistic Table 1.5.3. Northern Lowlands, red indicates extinction or near extinction (>98% loss), yellow indicates critically endangered (>90%)

Symbol	Land System Name	Area Land System (ha)	Natural Area c. 1975 (ha)	Natural Area 2009 (ha)	Future Expected Area RTRWP 1999 (ha)	Future Expected Area RTRWP v2008 (ha)	% of Natural Area in c.1975	% of Natural Area in 2009	% of Natural Area in 2009 compared to c.1975	% Lost by 2009	% Expected Loss RTRWP 1999	% Expected Loss RTRWP v2008	Presently Rare (5% criteria)	Presently Rare (1% criteria)	Endangered due to present loss	Endangered due to Current RTRWP	Endangered due to Proposed RTRWP	Endangered
BKN	BAKUNAN	10,387	5,074	1,356	264	253	0.2	0.1	0.0	73.3	94.8	95.0	Y	Y	Y	Y	Y	Y
BLI	BELITI	6,468	3,557	1,643	1,227	1,081	0.1	0.1	0.1	53.8	65.5	69.6	Y	Y	Y	N	N	Y
BPD	BUKIT PANDAN	5,370	5,370	4,899	4,170	4,170	0.2	0.2	0.2	8.8	22.4	22.4	Y	Y	N	N	N	N
BTA	BATU AJAN	11,454	11,354	9,285	9,285	8,476	0.4	0.4	0.3	18.2	18.2	25.4	Y	Y	N	N	N	N
GBT	GAMBUT	241,112	240,858	231,341	80,854	81,640	8.0	10.3	7.7	4.0	66.4	66.1	N	N	N	N	N	N
HJA	HONJA	56,664	55,471	36,194	10,529	9,907	1.8	1.6	1.2	34.8	81.0	82.1	Y	N	N	Y	Y	Y
JLH	JULOH	12,841	12,762	12,776	7,607	7,341	0.4	0.6	0.4	-0.1	40.4	42.5	Y	Y	N	N	N	N
KHY	KAHAYAN	145,481	115,246	78,982	29,346	22,145	3.8	3.5	2.6	31.5	74.5	80.8	Y	N	N	N	Y	Y
KJP	KAJAPAH	382,326	376,977	197,291	87,377	84,109	12.5	8.8	6.6	47.7	76.8	77.7	N	N	N	Y	Y	Y
KLR	KLARU	7,392	7,342	6,090	4,883	2,527	0.2	0.3	0.2	17.0	33.5	65.6	Y	Y	N	N	N	N
KPR	KAPOR	1,767	1,583	107	107	29	0.1	0.0	0.0	93.3	93.3	98.2	Y	Y	Y	Y	Y	Y
LHI	LOHAI	13,242	12,996	11,839	9,375	3,681	0.4	0.5	0.4	8.9	27.9	71.7	Y	Y	N	N	N	N
LWW	LAWANGUWANG	304,243	280,797	180,542	123,430	85,285	9.3	8.0	6.0	35.7	56.0	69.6	N	N	N	N	N	N
MDW	MDW	55,644	55,289	49,695	25,822	19,109	1.8	2.2	1.7	10.1	53.3	65.4	Y	N	N	N	N	N
MPT	MENDAWAI	513,830	501,544	444,023	362,245	300,878	16.7	19.7	14.8	11.5	27.8	40.0	N	N	N	N	N	N
MTL	MANTALAT	20,456	20,396	13,438	10,657	7,738	0.7	0.6	0.4	34.1	47.8	62.1	Y	Y	N	N	N	N
OKI	OKKI	3,610	3,610	3,610	3,610	3,610	0.1	0.2	0.1	0.0	0.0	0.0	Y	Y	N	N	N	N
PDH	PENDREH	84,473	83,810	78,523	71,859	69,308	2.8	3.5	2.6	6.3	14.3	17.3	Y	N	N	N	N	N
PLN	PAKALUNAI	114,621	112,980	108,290	89,584	80,578	3.8	4.8	3.6	4.2	20.7	28.7	Y	N	N	N	N	N
PST	PULAU SEBATIK	93,039	89,275	51,110	24,405	4,575	3.0	2.3	1.7	42.7	72.7	94.9	Y	N	N	N	Y	Y
PTG	PUTING	7,270	6,729	4,014	2,148	2,083	0.2	0.2	0.1	40.4	68.1	69.1	Y	Y	N	N	N	N
RGK	RANGANKAU	47,302	44,541	18,332	11,298	8,637	1.5	0.8	0.6	58.8	74.6	80.6	Y	Y	Y	N	Y	Y
Sub	Submontane	17,772	17,772	17,723	17,658	17,587	0.6	0.8	0.6	0.3	0.6	1.0	Y	Y	N	N	N	N
TBA	TAMBERA	73	73	73	73	73	0.0	0.0	0.0	0.0	0.0	0.0	Y	Y	N	N	N	N
TDR	TANDUR	2,652	2,632	855	548	418	0.1	0.0	0.0	67.5	79.2	84.1	Y	Y	Y	Y	Y	Y
TWB	TEWAI BARU	17,384	16,592	13,320	9,301	7,779	0.6	0.6	0.4	19.7	43.9	53.1	Y	Y	N	N	N	N
TWH	TEWEH	908,381	873,724	627,381	469,332	382,017	29.0	27.8	20.8	28.2	46.3	56.3	N	N	N	N	N	N
Lake	Lake	2,649	2,649	2,649	2,649	2,649	0.1	0.1	0.1	0.0	0.0	0.0	na	na	na	na	na	na
River	River	48,866	48,866	48,866	48,866	48,866	1.6	2.2	1.6	0.0	0.0	0.0	na	na	na	na	na	na
		3,136,770	3,009,872	2,254,245	1,518,506	1,266,547	100.0	100.0	74.9									

Statistic Table 1.5.4. Northern Mountain Ranges, red indicates extinction or near extinction (>98% loss), yellow indicates critically endangered (>90%)

Symbol	Land System Name	Area Land System (ha)	Natural Area c. 1975 (ha)	Natural Area 2009 (ha)	Future Expected Area RTRWP 1999 (ha)	Future Expected Area RTRWP v2008 (ha)	% of Natural Area in c.1975	% of Natural Area in 2009	% of Natural Area in 2009 compared to c.1975	% Lost by 2009	% Expected Loss RTRWP 1999	% Expected Loss RTRWP v2008	Presently Rare (5% criteria)	Presently Rare (1% criteria)	Endangered due to present loss	Endangered due to Current RTRWP	Endangered due to Proposed RTRWP	Endangered
BKN	BAKUNAN	1,657	684	905	0	19	0.0	0.0	0.0	-32.3	100.0	97.2	Y	Y	N	Y	Y	Y
BPD	BUKIT PANDAN	471,020	469,697	464,083	419,138	407,446	6.4	6.5	6.4	1.2	10.8	13.3	N	N	N	N	N	N
BRW	BERIWIT	40,067	39,870	38,271	36,686	33,664	0.5	0.5	0.5	4.0	8.0	15.6	Y	Y	N	N	N	N
BTA	BATU AJAN	7,283	7,283	7,283	6,450	6,391	0.1	0.1	0.1	0.0	11.4	12.2	Y	Y	N	N	N	N
BTK	BARONG TONGKOK	8,338	8,260	7,245	3,607	4,159	0.1	0.1	0.1	12.3	56.3	49.6	Y	Y	N	N	N	N
HJA	HONJA	71,611	64,745	63,996	45,067	39,094	0.9	0.9	0.9	1.2	30.4	39.6	Y	Y	N	N	N	N
LHI	LOHAI	2,647	2,597	2,634	2,388	2,568	0.0	0.0	0.0	-1.4	8.0	1.1	Y	Y	N	N	N	N
LNG	LUANG	254	254	254	254	254	0.0	0.0	0.0	0.0	0.0	0.0	Y	Y	N	N	N	N
LPN	LIANGPRAN	26,899	26,753	26,010	25,257	25,143	0.4	0.4	0.4	2.8	5.6	6.0	Y	Y	N	N	N	N
LWW	LAWANGUWANG	959	597	549	549	549	0.0	0.0	0.0	8.1	8.1	8.1	Y	Y	N	N	N	N
Mon	Montane	1,955,977	1,955,383	1,952,354	1,931,546	1,698,790	26.8	27.4	26.8	0.2	1.2	13.1	N	N	N	N	N	N
MPT	MAPUT	99,538	97,171	94,435	85,423	81,744	1.3	1.3	1.3	2.8	12.1	15.9	Y	N	N	N	N	N
MTL	MANTALAT	8,239	7,133	6,918	5,892	5,892	0.1	0.1	0.1	3.0	17.4	17.4	Y	Y	N	N	N	N
OKI	OKKI	6,144	6,144	6,142	6,142	6,142	0.1	0.1	0.1	0.0	0.0	0.0	Y	Y	N	N	N	N
PDH	PENDREH	728,087	720,795	658,160	624,663	587,234	9.9	9.2	9.0	8.7	13.3	18.5	N	N	N	N	N	N
PLN	PAKALUNAI	127,033	123,691	117,485	93,166	85,148	1.7	1.6	1.6	5.0	24.7	31.2	Y	N	N	N	N	N
RGK	RANGANKAU	912	277	248	248	248	0.0	0.0	0.0	10.4	10.4	10.4	Y	Y	N	N	N	N
SMD	SUNGAI MEDANG	192	192	192	192	192	0.0	0.0	0.0	0.0	0.0	0.0	Y	Y	N	N	N	N
STB	SUNGAI TABANG	1,333	1,333	1,326	1,070	1,070	0.0	0.0	0.0	0.6	19.8	19.8	Y	Y	N	N	N	N
Sub	Submontane	3,728,811	3,711,487	3,649,086	3,492,548	3,377,295	50.9	51.1	50.1	1.7	5.9	9.0	N	N	N	N	N	N
TBA	TAMBERA	1,356	1,339	1,351	985	985	0.0	0.0	0.0	-0.9	26.4	26.5	Y	Y	N	N	N	N
TDR	TANDUR	271	271	269	260	260	0.0	0.0	0.0	0.8	4.0	4.0	Y	Y	N	N	N	N
TWB	TEWAI BARU	847	847	847	847	847	0.0	0.0	0.0	0.0	0.0	0.0	Y	Y	N	N	N	N
TWH	TEWEH	34,944	34,803	32,866	30,790	29,721	0.5	0.5	0.5	5.6	11.5	14.6	Y	Y	N	N	N	N
TWI	TELAWI	535	535	532	532	532	0.0	0.0	0.0	0.6	0.6	0.6	Y	Y	N	N	N	N
River	River	3,346	3,346	3,346	3,346	3,346	0.0	0.0	0.0	0.0	0.0	0.0	na	na	na	na	na	na
		7,328,301	7,285,488	7,136,785	6,817,045	6,398,731	100.0	100.0	98.0									

Statistic Table 1.5.5. Nyapa Mangkalihat Mountains and Plains, red indicates extinction or near extinction (>98% loss)

Symbol	Land System Name	Area Land System (ha)	Natural Area c. 1975 (ha)	Natural Area 2009 (ha)	Future Expected Area RTRWP 1999 (ha)	Future Expected Area RTRWP v2008 (ha)	% of Natural Area in c.1975	% of Natural Area in 2009	% of Natural Area in 2009 compared to c.1975	% Lost by 2009	% Expected Loss RTRWP 1999	% Expected Loss RTRWP v2008	Presently Rare (5% criteria)	Presently Rare (1% criteria)	Endangered due to present loss	Endangered due to Current RTRWP	Endangered due to Proposed RTRWP	Endangered
BKN	BAKUNAN	247	88	79	0	55	0.0	0.0	0.0	9.7	100.0	36.7	Y	Y	N	Y	N	Y
BRW	BERIWIT	20,848	20,848	8,473	8,365	8,365	0.9	0.6	0.4	59.4	59.9	59.9	Y	Y	Y	N	N	Y
BTA	BATU AJAN	7,897	7,897	7,700	7,700	7,700	0.3	0.5	0.3	2.5	2.5	2.5	Y	Y	N	N	N	N
GBJ	GUNUNG BAJU	180,524	175,401	103,869	72,687	81,452	7.5	7.0	4.5	40.8	58.6	53.6	N	N	N	N	N	N
KHY	KAHAYAN	2,712	1,761	1,516	1,207	1,238	0.1	0.1	0.1	13.9	31.5	29.7	Y	Y	N	N	N	N
KJP	KAJAPAH	50,481	47,484	43,243	12,899	12,202	2.0	2.9	1.9	8.9	72.8	74.3	Y	N	N	N	N	N
KPR	KAPOR	178,592	165,504	79,425	60,475	49,647	7.1	5.4	3.4	52.0	63.5	70.0	N	N	Y	N	N	Y
LHI	LOHAI	24,653	24,653	4,971	4,971	4,971	1.1	0.3	0.2	79.8	79.8	79.8	Y	Y	Y	Y	Y	Y
LPN	LIANGPRAN	816	816	809	809	809	0.0	0.1	0.0	0.9	0.9	0.9	Y	Y	N	N	N	N
LWW	LAWANGUWANG	178,955	168,528	95,984	79,526	61,858	7.2	6.5	4.1	43.0	52.8	63.3	N	N	N	N	N	N
Mon	Montane	6,390	6,390	6,379	6,379	6,379	0.3	0.4	0.3	0.2	0.2	0.2	Y	Y	N	N	N	N
MPT	MAPUT	680,793	674,754	453,768	397,128	422,688	29.0	30.7	19.5	32.8	41.1	37.4	N	N	N	N	N	N
MTL	MANTALAT	2,582	2,582	2,315	1,442	1,442	0.1	0.2	0.1	10.3	44.2	44.2	Y	Y	N	N	N	N
OKI	OKKI	153,167	153,084	93,354	79,628	80,022	6.6	6.3	4.0	39.0	48.0	47.7	N	N	N	N	N	N
PDH	PENDREH	261,986	261,927	190,451	173,874	187,032	11.2	12.9	8.2	27.3	33.6	28.6	N	N	N	N	N	N
PTG	PUTING	1,931	1,798	1,605	1,313	1,237	0.1	0.1	0.1	10.7	27.0	31.2	Y	Y	N	N	N	N
Sub	Submontane	147,627	147,627	131,927	129,260	130,678	6.3	8.9	5.7	10.6	12.4	11.5	N	N	N	N	N	N
TWB	TEWAI BARU	20,202	20,190	12,608	12,608	12,608	0.9	0.9	0.5	37.6	37.6	37.6	Y	Y	N	N	N	N
TWH	TEWEH	458,839	444,399	235,563	178,443	145,550	19.1	16.0	10.1	47.0	59.8	67.2	N	N	N	N	N	N
Lake	Lake	87	87	87	87	87	0.0	0.0	0.0	0.0	0.0	0.0	na	na	na	na	na	na
River	River	2,664	2,664	2,664	2,664	2,664	0.1	0.2	0.1	0.0	0.0	0.0	na	na	na	na	na	na
		2,381,995	2,328,480	1,476,791	1,231,466	1,218,685	100.0	100.0	63.4									

Statistic Table 1.5.6. Land system/Ecosystem Description and Status

Symbol	Name	Description	Physiographic Type	Peat Present >25cm in depth	Heath Forest Present	Total Area of Landmass within AOI (ha)	Presence of Ecosystem and Status E=Endangered R=Rare using 1% criteria N/A=Not present			
							Mahakam Lowlands	Northern Lowlands	Northern Mountain Ranges	Nyapa Mangkalihat Moutains & Plains
BKN	BAKUNAN	Minor valley floors within hills	Alluvial valleys			51,863	E, R	E, R	E, R	E, R
BLI	BELITI	Swampy floodplain of narrow valleys	Swamps			32,421	E, R	E, R	N/A	N/A
BPD	BUKIT PANDAN	Non-sedimentary mountain ridge systems	Mountains			476,390	N/A	R		N/A
BRH	BARAH	Flat, sandy terraces covered by shallow-peat	Terraces	✓	✓	21,779	E, R	N/A	N/A	N/A
BRW	BERIWIT	Mountainous sandstone cuestas with dissected dipslopes	Mountains		✓	68,749	R	N/A	R	E, R
BTA	BATU AJAN	Dissected volcanic cones	Mountains			41,544	E, R	R	R	R
BTK	BARONG TONGKOK	Moderately dissected lava flows	Plains			99,534	E, R	N/A	R	N/A
GBJ	GUNUNG BAJU	Hillocky karstic plains	Plains			181,423	E, R	N/A	N/A	
GBT	GAMBUT	Deeper peat swamps, commonly domed	Swamps	✓		564,505	E, R		N/A	N/A
HJA	HONJA	Hillocky acid igneous/metamorphic plains	Plains			131,457	E, R	E	R	N/A
JLH	JULOH	Metamorphic sub-parallel ridge systems	Hills			12,841	N/A	R	N/A	N/A
KHY	KAHAYAN	Coalescent estuarine/riverine plains	Alluvial plains			224,119	E, R	E	N/A	R
KJP	KAJAPAH	Inter-tidal mudflats under mangrove and nipah	Tidal swamp			584,487	E	E	N/A	
KLR	KLARU	Permanently waterlogged floodplains	Swamps	✓		118,332	E, R	R	N/A	N/A
KPR	KAPOR	Undulating karstic plains with hums	Plains			187,880	E, R	E, R	N/A	E
LHI	LOHAI	Steep long-sided narrow ridges	Hills			109,562	E, R	R	R	E, R
LNG	LUANG	Ultrabasic/basic mountains	Mountains			254	N/A	N/A	R	N/A
LPN	LIANGPRAN	Eroded mountainous stratovolcanoes	Mountains			27,714	N/A	N/A	R	R
LWW	LAWANGUWANG	Undulating to rolling sedimentary plains	Plains			1,371,545	E		R	
MDW	MENDAWAI	Shallower peat swamps	Swamps	✓		129,540	E, R		N/A	N/A
MGH	MANGKAHO	Wide valley floors containing hillocks, within hills	Alluvial valleys			3,807	E, R	N/A	N/A	N/A
MPT	MAPUT	Sedimentary hills, non-orientated	Hills			1,961,120	E			
MTL	MANTALAT	Linear sedimentary ridge systems with steep dipslopes	Hills		✓	132,032	E, R	R	R	R
Mon	Montane	Mountains >1000m a.s.l.	Mountains			1,962,418	R	N/A		R
OKI	OKKI	Rugged karst ridges and mountains	Mountains			166,148	E, R	R	R	
PDH	PENDREH	Sedimentary mountains, non-orientated	Mountains			1,130,007	E, R			
PKU	PAKAU	Undulating sandy terraces	Terraces		✓	118,531	E, R	N/A	N/A	N/A
PLN	PAKALUNAI	Non-sedimentary hills	Hills			244,623	E, R			N/A
PMG	PAMINGGIR	Backswamps of inland floodplains	Swamps			1,784	R	N/A	N/A	N/A
PST	PULAU SEBATIK	Marine terraces	Terraces			93,039	N/A	E	N/A	N/A
PTG	PUTING	Coastal beach ridges and swales	Beaches			13,631	E, R	R	N/A	R
RGK	RANGANKAU	Undulating to rolling non-sedimentary plains	Plains			48,214	N/A	E, R	R	N/A
SBG	SEBANGAU	Meander belt of large rivers with broad levees	Meander belts			98,934	E, R	N/A	N/A	N/A
SMD	SUNGAI MEDANG	Rolling volcanic plains	Plains			36,677	R	N/A	R	N/A
STB	SUNGAI TABANG	Hillocky basaltic plains	Plains			11,403	R	N/A	R	N/A
Sub	Sub-montane	Hills and mountains 500-1000m a.s.l.	Hills & Mountains			3,907,553	R	R		
TBA	TAMBERA	Extremely steep sided volcanic plugs	Mountains			1,429	N/A	R	R	N/A
TDR	TANDUR	Sandstone cuestas with relatively gentle dipslopes	Hills		✓	11,850	R	E, R	R	N/A
TNJ	TANJUNG	Coalescent inland riverine plains	Alluvial plains			86,868	E, R	N/A	N/A	N/A
TWB	TEWAI BARU	Hillocky sedimentary plains with steep parallel ridges	Plains			199,959	E, R	R	R	R
TWH	TEWEH	Hillocky sedimentary plains	Plains			3,214,031	E		R	
TWI	TELAWI	Granite mountain ridge systems	Mountains			1,486	E, R	N/A	R	N/A
Lake	Lake	Water bodies other than rivers	Waterbody			46,182				
River	River	Major rivers	Waterbody			78,710				

CHAPTER TWO

THREATS AND MANAGEMENT RECOMMENDATIONS

2.1. Introduction

2.1.1 The Concept of Managing HCVs

The HCV concept was developed by the FSC in the spirit of the Convention on Bio-Diversity (CBD), designed to inform and strike a balance between concerns over biodiversity, environmental services, social and cultural issues on the one hand, and economic development needs on the other.

In the Indonesian context, the identification of landscape HCVs using the HCV Toolkit for Indonesia is relatively straight forward and objective, as absolute measures are usually provided to test for presence of a value. However, the task of creating management recommendations sufficient to maintain HCVs whilst economic growth and development move forward is much more difficult, given that the country so rich in biological diversity, much of it threatened, and a variety of social and cultural dependencies that must be accommodated.

Experience of HCV assessors in Indonesia has demonstrated that wherever natural forest remains, so too will one or more HCVs be found. Such forests are, therefore, to be considered HCVF (i.e., a forest area containing one or more HCV). Conservationists sometimes maintain a position that all such HCVF must be protected, but this is a misrepresentation of the FSC's original intent for the HCV concept, which was to manage HCVF areas in a manner sufficient to maintain the HCVs, not necessarily to protect the entire forest from exploitation. Part of this divergence of opinion arises from the fact that HCV was created for application in the production forestry (non-conversion) context, but has become applied for more widely, including conversion sectors such as pulp and paper, oil palm and soy. To distinguish between forests (HCVF) or other areas (HCVA) that contain one or more HCV, and the areas required for management to maintain them, the revised HCV Toolkit for Indonesia introduced a new term, the HCV Management Area (HCVMA), now likely to be adopted by the FSC itself, to describe an area over which management prescriptions should be applied to maintain one or more HCV. Perhaps more importantly, as a practical matter in Indonesia, the position that all HCVF must be maintained in effect precludes any further conversion of forest lands, which in turn renders the HCV tool irrelevant as a spatial planning tool in Indonesia, where the government intends to convert some portion of its remaining natural forest to mono-culture industrial crops to meet the development needs of the nation and its people. Ultimately, for HCV applications in the conversion setting, compromises must be sought to determine which areas require protection and/or special management to maintain specific HCVs, and it is on this point that lively, open and transparent stakeholder engagement and debate are vital.

This report aims to support and foster such stakeholder dialogue.

The HCV Toolkit for Indonesia provides generic management objectives for each of the HCVs, but does not spell out specific management requirements. This is because when the Toolkit was revised during 2007-2008, it was agreed that detailed, sector specific guidelines for HCV management would be developed once the Toolkit for identification was completed. Such guidelines are still forthcoming.

In this report, therefore, it was necessary for the assessment team to use its own judgment for developing management recommendations to maintain landscape HCVs that were sufficiently detailed to be useful yet remain consistent with general objectives provided in the Toolkit. Conceptually, we have attempted to consider Berau and Kutai Timur as very large management units, and used the provincial spatial plan (RTRWP) and existing industrial forestry and agricultural licenses as a base line for the intended development goals (and thus threats to HCV 2 and HCV 3 areas) of those two Regencies. The official provincial spatial plan (RTRWP) is currently under revision and is not yet finalised, but we have emphasized the proposed revised version over the current one, because (a) the revised version more closely resembles what will likely become the new RTRWP, and (b) this enables the report to assist in refining the RTRWP proposal.

2.1.2 Goals of this Chapter

In Chapter 2, an in depth discussion of threats and recommended management interventions to maintain the landscape HCVs is presented. The area covered by this threat and management analysis is restricted to more focused ‘Area of Interest’ within the 18,000,000 ha mapping area, defined as the Berau and East Kutai Regencies.

The landscape identification of HCV 2.1, HCV 2.2 and HCV 3 are described in Chapter 1 of this report. Chapter 2 considers those HCVs within a more restricted Area of Interest (AOI) comprising Berau and East Kutai Regencies, threats to their maintenance, and suggests management recommendations to maintain them. The recommendations are just that, *recommendations*, and should not be treated as fixed prescriptions of what must be implemented. Some readers will undoubtedly consider the assessment team’s recommendations too restrictive and others too lenient. It must also be emphasized that other biodiversity, environmental services, and social and cultural HCVs also exist but their assessment falls outside the scope of this report. Such HCVs must be surveyed during site-level assessments to develop more detailed site-based management planning to maintain HCVs (e.g. assessment of individual logging concessions or oil palm estates). This chapter considers the three HCV 2.1 Large Landscapes identified in Chapter 1, and (in Sections 2.3 to 2.5) describes the HCV 2.2 and HCV 3 areas contained within them. The report then considers the HCV 2.2 and 3 areas that occur outside these Large Landscapes in Section 2.6.

2.1.3 General Management Objectives & Prescriptions

<u>HCV 2.1</u> Large Natural Landscapes with Capacity to Maintain Natural Ecological Processes and Dynamics

The Toolkit provides the following introductory description to this value.

“This HCV aims to identify and protect areas of a natural landscape where natural ecosystem processes occur and have the potential to persist for the long-term. The key to achieving this is the identification and protection of core area(s) within a landscape, which are essential for guaranteeing the continuation of ecological processes unperturbed by edge effects and fragmentation. The definition of a landscape with a core area is a forest block (or other natural landscape mosaic) with an internal core >20,000 ha surrounded by a natural vegetation buffer of at least 3 km from the forest edge. The management goal of HCV 2.1 is to guarantee that the core area and associated buffer zone are maintained as forest or other natural vegetation.” (Toolkit Section 3.2)

By definition HCV 2.1 exists in a forest area (or other natural landscape mosaic) where the internal core is >20,000 ha. Without regard to other HCVs, this means that in order to maintain HCV 2.1, the size and configuration of the landscape must be maintained to ensure that the core area should not fall below 20,000 ha. This implies that HCV 2.1 management does not necessarily preclude loss of portions of some large natural landscapes that contain a core area larger than this 20,000 ha minimum. It also follows that a landscape containing a very large single core area (e.g. 80,000 ha) could be altered in size or shape by conversion so that the large core area becomes fragmented into a set of smaller core areas, some of which still exceed the threshold of 20,000 ha, thereby protecting the original HCV 2.1 status of the landscape. In such a scenario, the individual remaining core areas that exceed 20,000 ha would now be required to be maintained in their own right as HCV 2.1 cores.

In reality, the management recommendations for HCV 2.1 will also require consideration be given to other HCVs that are likely to be present in the same landscape block. This is illustrated in the discussion of management recommendations for HCV 2.1 area mapped in the current study.

<u>HCV 2.2</u> Areas that Contain Two or More Contiguous Ecosystems

The Toolkit provides the following introductory description to this value.

"*Areas supporting a diversity of ecosystems support greater numbers of species and likely have higher capacity to sustain them for the long term than areas with lower ecosystem diversity. The maintenance of ecosystem types, especially those co-occurring within a single landscape, is therefore a fundamental aim of conservation planning. It guarantees the movement of species across ecosystem types and the flow of materials and energy in the face of environmental changes like fluctuating food availability, extreme weather and changing climate.*" (Toolkit Section 3.2)

HCV 2.2 aims to identify landscapes that contain multiple ecosystem types and to maintain connectivity among these types within the landscape unit. Such HCV 2.2 areas may be part of a large HCV 2.1 landscape, or they may not. A secondary aim of HCV 2.2, where possible, is to maximize the amount of such ecosystem transition zones within Core Areas of HCV 2.1 landscapes, if they exist.

The Toolkit further describes HCV 2.2 as a natural landscape containing

• *two or more contiguous ecosystems that share intact border(s), especially the transitional zone (ecotone) between various types of swamp and non-swamp, or kerangas and non-kerangas*

• *forested mountain slopes covering various types of ecosystems distributed along elevation gradients, especially those including transitions from lowland forest to submontane and montane forest, each with their distinctive floristic associations and ecological dynamics.*

Only general management guidelines are provided in the Toolkit for this HCV. Such recommendations do not preclude some conversion of ecosystem transition zones, nor does the Toolkit specify how large an area of transition and in what configuration they be maintained. Some specific recommendations are provided, however, where HCV 2.2 areas are also part of areas delineated as HCV 2.1 and HCV 3, as discussed below.

<u>HCV 3</u> Rare or Endangered Ecosystems

The Toolkit provides the following introductory description to this value.

"*The objective of HCV 3 is to identify and delineate ecosystems within a landscape that are naturally rare (e.g. karst forest) or endangered because of changes in land cover caused by humans. Management actions should ensure that natural ecological processes throughout a rare or endangered ecosystem – especially distinctive features of it – are maintained.*"(Toolkit Section 3.2)

The Toolkit elaborates further:

"*Management prescriptions for HCV 3 must be sufficient to maintain the current condition and any unique attributes of rare or endangered ecosystems within the MU or nearby and likely to be affected by off-site impacts of MU operations. The prevention of off-site impacts can be done partly by ensuring there are no changes to water courses and water quality/quantity from the MU, as well as by maintaining buffer zones where deemed necessary (e.g., where a MU is outside of but immediately adjacent to HCVA 3).*

If there are no Core Areas in the forest block (as defined in HCV 2.1) within which to delineate a management area for the ecosystem, then wherever possible a buffer zone around the HCV 3 ecosystem of at least 1 km must be delineated within which operational activities are kept to a minimum." (Toolkit Section 8.3.1.6)

This suggests, but does not state explicitly, that no conversion of rare and endangered ecosystems is permitted. In some situations, however, a more pragmatic approach may be required in legally permitted and government promoted conversion landscapes to ensure the continued survival of a rare or endangered ecosystem, whereby some losses are deemed acceptable as part of a larger landscape conservation plan that ensures long term ecosystem persistence.

Ecosystems can be identified as Endangered under the Toolkit definition either because (i) current extent shows >50% loss of historical distribution of the ecosystem within a biophysiographic zone, or (ii) planned deforestation as indicated by current provincial land use planning (RTRWP) will reduce extent of an ecosystem by >75% of its historical distribution. To assist in management decisions for HCV 3 ecosystems that fall into these two categories, we propose the following general management recommendations for three common scenarios (Table 2.1.1).

Table 2.1.1 Generalised management recommendations for HCV 3 Endangered Ecosystems

Current HCV 3 Status	Projected HCV 3 Status (under RTRWP)		
	<75% loss	75-90% loss	>90% loss
<50% loss	-	1	1
50-75% loss	1	2	3
75%-90% loss	N/A	2	3
>90% loss	N/A	N/A	3

Category 1 Some losses acceptable only if some localised gains can be achieved for the same HCV 3 area that will be reduced, such as pro-active enhanced protection, OR a conservation gain for that ecosystem type is made elsewhere and the spatial plans allow at least 25% to be maintained in its natural state (note this would require the exclusion of HTI within this 25%).

Category 2 Any further loss is unacceptable, unless it can be demonstrated that without management intervention (including partial loss) the entire patch will be eliminated due to planned or unplanned conversion, and that proposed operations will guarantee that overall losses do not exceed a stakeholder agreed upon maximum amount (and which under no circumstances may be greater than 90% of the historical extent within the physiographic region)

Category 3 Any further loss is unacceptable, with urgent need to amend spatial plans and implement conservation strategies to maintain all remaining patches in their entirety and if necessary expand the current extent through rehabilitation.

Rare ecosystems should be treated in a similar fashion to Category 2 Endangered Ecosystems.

Cross-cutting Recommendations (HCV 2.1, 2.2, & 3)

The Toolkit makes three explicit management recommendations in areas where HCV 2.1, 2.2 and 3 co-exist in the same landscape unit.

The Toolkit states in Section 8.2.2.6:

"If HCVA 2.2 occurs in a landscape that also meets criteria of HCV 2.1 – i.e., a large landscape with capacity to maintain natural ecological processes and dynamics – then at least 10,000 ha of each ecosystem, and the transitional zone(s) between them, must be maintained in the core area delimited under HCVA 2.1. If 10,000 ha of each ecosystem cannot be preserved in the core zone, because ecosystem extent is insufficient, or their spatial arrangement prevents it, then the largest possible area of each ecosystem and their transitional zone(s) must be preserved within the core area. These areas, in turn, define the High Conservation Value Management Area (HCVMA) for HCV 2.2.

If HCV 2.2 is present, and ….one or more of the ecosystems is considered rare or endangered under HCV 3 ….then sufficient areas of each ecosystem and transitional zone(s) between them must be maintained to co-manage these values.

The Toolkit explains further in Section 8.3.1.6:

"If a MU is part of a large natural landscape following criteria defined under HCV 2.1, rare and endangered ecosystems must be managed by: (1) Ensuring that a 20,000 ha area of the HCV 3 ecosystem is inside the core zone, or (2) If a 20,000 ha area does not exist, as much of the HCV 3 ecosystem as possible must be in the core zone."

The objectives and general guidelines provided in the Toolkit for HCV 2.1, HCV 2.2 and HCV 3, and described above, are the general principles used throughout this report to develop management recommendations for how these landscape values can be maintained in the Area of Interest.

2.1.4 General Description of Major Ecosystem Types Present

Background

An extremely rich diversity of vegetation types is present across the mapping area, with spatial patterning that reflects influences of soils, drainage, geology and elevation. These vegetation types differ in terms of species composition and relative abundances; ecosystem properties; value as habitat for rare, threatened or endemic species; and importance for local livelihoods of rural communities.

Throughout the report, we map ecosystem types and associated HCVs using ecosystem proxies derived from a modified land systems dataset based on RePPProT (1990), following the protocol defined in the revised HCV Toolkit for Indonesia. These land system classes (ecosystem proxies) are distinguished based on differences in geology, soils, drainage, slope, rain fall, dominant vegetation types and geographic position, factors widely known to determine ecosystem distributions in nature. Use of the modified land systems as ecosystem proxies is, therefore, reasonable, but is to be regarded at this stage as a working hypothesis. The ecosystems referred to by different RePPProT-based ecosystem proxies is not evident to those unfamiliar with the nomenclature of Indonesian land systems, so in this section we describe the broad vegetation types represented by these land systems in the study area using more familiar vegetation terminology and classes.

Mangrove Forest [7]

Mangrove is the collective term used in reference to tree vegetation that colonises sheltered muddy shores within the tidal zone. Mangrove swamps are commonly found along ocean facing coastal strips, estuarine river deltas, inland brackish water rivers and on islands. Whilst mangrove plant species are specially adapted to survive saline conditions, they may occur as far as 50 km inland along the major rivers of Borneo. In addition to adaptations for extreme saline conditions, unusual features of the root systems of mangrove plants, including aerial roots and pneumatophores, also enable gas exchange above the waterlogged, oxygen poor soils. These root structures, in turn, capture sediments brought down by rivers, leading to land formation and seaward advance of the coastline. Mangroves also often grow often in association with nipa palms (*Nypa frutescens*) that occasionally form extensive mono-specific stands, often along banks of brackish water rivers or on inland backwater swamps of the mangrove.

Mangrove ecosystems are among the world's most productive ecosystems, rich in both marine and terrestrial fauna. The marine fauna includes a variety of large crustaceans and molluscs, and is an important spawning ground and nursery for prawns and many pelagic fish of economic importance to offshore fisheries. The terrestrial fauna includes the Proboscis monkey (*Nasalis lavartus*), Silvered langur (*Trachypithecus cristatus*), monitor lizards (*Varanus* spp.), crocodiles, and more than 20 species of birds that are endemic to mangroves or highly dependent upon them.

Mangroves are a mainstay of local livelihoods for coastal communities, providing coastal protection, and sources of timber, edible molluscs and crustacea, and of course fish. However, over-harvesting of mangroves for charcoal production and conversion of to fish or shrimp ponds are a serious threat. In East Kalimantan, conversion of mangroves to fish ponds has been a major driver of mangrove loss and is the primary explanation for the mangrove dominated **KJP** land system in the Northern Lowland region (see Section 6 below) being considered endangered under HCV 3.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in mangrove forest is very low for plants and low to intermediate for animals.

In this chapter mangrove forest is represented by the **KJP** ecosystem proxy.

[7] Image credits to http://morningjoy.files.wordpress.com/2008/05/red-mangroves.jpg; http://www.sln.org.uk/geography/images/A112.JPG

Peat Swamp Forest

Peat swamp forest is a widespread terrestrial ecosystem throughout the lowlands of south, west and northern Borneo (Whitmore 1984; Wikramanayake et *al*. 2002), with a variety of distinct forms depending on peat depth, patterns of drainage and disturbance history. It is most well developed in coastal areas, but in Kalimantan also occurs inland in association with major rivers, such as the Kapuas and Barito, and seasonal wetlands such as the Sentarum and Mahakam lake systems. Though present in the mapping area, peat swamp is not a dominant feature of the Berau landscape, and the once extensive peat swamp areas in East Kutai were destroyed by El Nino related fires in 1982/83 (see chapter 1).

Peat swamp forest (PSF) structure and floristic composition vary markedly with peat depth and drainage patterns. This variation includes, on the one hand, carbon-dense, relatively diverse tall forests of 40-50 m canopy on shallow peat associated with rivers, and on the other hand stunted, floristically impoverished shrub vegetation types (<5 m tall) or even grasslands on deep peat typical of dome structures (Anderson 1983). Overall biodiversity is lower in PSF than other lowland forest types (Mirmanto et *al*. 1999; Wikramanayake et *al*. 2002; Ashton 2009), but unique biodiversity attributes are found here that merit conservation. These include a variety of aquatic vertebrates and invertebrates, some considered near habitat specialists (Ng et *al*. 1994; Page et *al*. 1997), as well as a number of globally threatened birds and large mammals, most notably the Proboscis monkey *Nasalis lavartus*, especially in areas where PSF is contiguous with lowland mineral areas or freshwater swamps. Densities of most vertebrates are lower in PSF, however, than mineral soil areas (Gaither 1994; Whitten et *al*. 2000; Quinten et *al*. 2010), reflecting the nutrient-poor status and lower productivity of this ecosystem (Mirmanto & Polosokon 1999; Nishimua et *al*. 2006; Janzen 1974). Woody plant species richness in PSF is on average less than half that of lowland forest on mineral soils (Paoli et *al*. in prep), and Critically Endangered (CR) members of the flora are especially under-represented, with only eight of Indonesia's 140 CR plants present in PSF (three as strict specialists), compared to 104 in mineral forest areas (84 as strict specialists; Paoli et *al*. in prep). Nevertheless, plant species of concern are present in PSF, including the globally threatened dipterocarps *Shorea teysmanniana*, *S. uliginosa* and *S. platycarpa*; the near threatened *Ramin* tree of commerce *Gonystylus bancanus* (CITES Appendix II); and the widespread *Jelutung* tree *Dyera costulata* (protected by Indonesian law but severely over-harvested throughout its range, especially in peat).

PSF has declined markedly in extent throughout Borneo in the last three decades, due to conversion to agriculture and fires (Holmes 2002). In Indonesia, only a limited area of intact PSF areas has full, formal protection status. A Presidential Decree issued in 1990 declared all peat lands >3 m deep as Protected Areas unsuitable for development, a fact often seen as a form of *de facto* protection, but the Ministries of Agriculture and Forestry issue licenses for oil palm and logging, respectively, on such lands.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in peat swamp is low to intermediate for plants, but intermediate to high for animals, depending on the predominance of different peat swamp Sub-types.

In this chapter peat swamp forest is represented by the **GBT**, and **MDW** ecosystem proxy.

Riparian forest and freshwater swamps

Freshwater swamp, and associated riparian vegetation types, is an important and productive terrestrial ecosystem, with numerous structural and compositional forms whose occurrence varies with local terrain features, proximity to river, frequency and duration of flooding and soil type. It is locally common through lowland Borneo, with extensive areas historically in central southern Borneo. Riparian and freshwater swamp forest are present in the mapping area, but with relatively limited distribution, concentrated in coastal areas and inland flood plains along major rivers, such as the Kelai and Segah.

Freshwater swamp is thought to have been the natural vegetation cover of approximately 7% of Kalimantan (MacKinnon & Artha, cited in MacKinnon et *al*. 1996), but most of this has been cleared for conversion to wetland rice cultivation. It is therefore considered an extremely endangered ecosystem (Wikramanayake et *al*. 2002). Freshwater swamps develop on waterlogged soils, where periodic flooding causes freshwater inundation and water logging of soils. Soils are much less acidic than peat swamps, and among the most nutrient rich topical soils due to frequent deposition of silt and associated organic matter. Forests tend to be very productive in terms of tree growth, litter fall and leaf and fruit production, with high natural rates of disturbance and canopy turn over due to frequent tree falls and gap formation. Where inundation is frequent but temporary, freshwater swamps can have tall stature (up to 35m) and standing biomass; where inundation is frequent and prolonged, forests can be stunted and dominated by only a few tree species. Compositionally, freshwater swamps share many species in common with lowland forest on mineral soils, but in general are less species rich. The most abundant tree species in this vegetation type are members of the genera *Alstonia*, *Campnosperma*, *Dyera*, *Koompassia*, *Litsea*, *Neesia*, *Saraca* and *Syzygium*.

Further inland and upstream from areas prone to frequent flooding, freshwater swamp gives way to riparian forest along slopes of gradually ascending stream channels or steep-sided ravines (both forms shown above). Riparian forest variations include small to medium stature forest along narrow, fast flowing streams, often with rapids and exposed riverbed boulders and highly specialized floristic associates, as well as tall stature forest along slowing moving meandering streams, reminiscent of lowland forest on alluvium. Riparian vegetation, and especially gulley forest, is often protected from strong wind and micro-climatic fluctuations by local physiographic features, such as sharp ridges and steep slopes, promoting formation of moist local environments. Soil moisture in riparian forest is high due to down slope movement of water from surrounding slopes and ridges, and localized occasional flooding, which can lead to formation of raised local alluvial terraces.

Some epiphytic and herbaceous plants are strict specialists in this habitat (i.e., they are absent from upper slope, ridge and plateau environments), and some trees also show increased abundance near rivers. Such trees include *Dracontomelon dao*, *Pometia pinnata*, *Hopea coriacea*, *Hopea sangal*, *Dipterocarpus oblongifolius* (pictured above) *Vatica venulosa* ssp. *venulosa* and the tengkawang or illipe nut species *Shorea macrophylla* and *Shorea palembanica*.

Remnant riparian and gulley forests are extremely important for biodiversity conservation and management of environmental services, especially in landscapes undergoing fragmentation. These habitats are important not only for conservation of specialized plant species that depend on relatively moist/humid conditions, but also to maintain key habitats required by animals for feeding and breeding, as well as connectivity among forest blocks.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in freshwater swamp and associated riparian forests is intermediate to high, second only to lowland forest on mineral soils.

In this chapter riparian and fresh water swamp are represented by the **BKN**, **BLI**, **KHY**, **KLR**, **PMG**, **SBG**, and **TNJ** ecosystem proxies.

Lowland Forest on well-drained soils

Lowland forest on well-drained mineral soils is the most species rich and tallest stature ecosystem on Borneo. It is the most extensive natural ecosystem type in the mapping area. Most lowland forests on mineral soils in the mapping areas have been logged; unlogged areas are concentrated in hilly terrain and/or interior regions.

Canopy heights of these lowland forests range from 35-50m, with emergent trees reaching >60m in height or more, and aboveground biomass values range from ca. 300-600 Mg per ha, on average 60% higher than that of the Amazon (Paoli et *al*. 2008; Slik et *al*. 2010). The floristic composition of lowland forest on mineral soils differs markedly from all forms of swamp forest described above, but on average shares more in common with freshwater swamp than with peat swamp forms. Lowland forests on mineral soils are dominated numerically and in terms of biomass by canopy trees in the species-rich family Dipterocarpaceae, hence the widely used phrase name *Lowland Dipterocarp Forest* in reference to this forest type. Most forest botanists further distinguish two further Sub-types of dipterocarp forest based on elevation, the so-called mixed dipterocarp forest (MDF) below 300-500m and hill dipterocarp forest (HDF) above this elevation and up to the point of transition into Sub-montane forest. Floristic differences between MDF and HDF are marked, especially among dipterocarps, but because the elevation cut-off between MDF and HDF is approximate and extremely variable on different mountains, here we do not separate or attempt to map these two Sub-types. Rather we distinguish a larger number of lowland Sub-types based on ecosystem proxies defined by soils, geology, landform and drainage, factors known to determine lowland forest Sub-types of Borneo (Potts et *al*. 2002; Paoli et *al*. 2006; Slik et *al*. 2009).

Historically, deforestation rates in Indonesia have been much higher in forest on mineral soils than peat, but large areas of logged and/or burned lowland forest remain, with high value for biodiversity (Meijaard et *al*. 2006; Berry et *al*. 2008, 2010). This is especially true given that bio-geographically distinct Sub-types of lowland forest on mineral soils are under-represented in Indonesia's existing protected area network (MacKinnon 1997), and many of which are under threat (Curran et *al*. 2004; Gaveau et *al*. 2009).

The density and diversity of HCV 1 plant and animal species (Threatened, Protected or Endemic) in lowland forest on mineral soils is higher than any other ecosystem type.

In this chapter lowland forest on well drained soils are represented by the **BTA**, **KPR**, **LHI**, **LWW**, **MPT**, **TWB**, and **TWH** ecosystem proxies.

Kerangas

Kerangas (or heath) forest is a distinctive forest ecosystem present throughout Borneo and well represented in the mapping area. Historically, kerangas covered several million ha across Kalimantan, but began declining in extent in the 1970s, due widespread informal logging, conversion for agriculture and wildfires. Today, kerangas is considered an endangered ecosystem in Kalimantan.

Kerangas forest develops on bleached white or brown sand soils derived from *in-situ* decomposition of coarse-textured sedimentary rock or raised inland beach deposits of Pleistocene coastline. Kerangas ranges markedly in stature in response to soil conditions, ranging from tall stature forms up to 35m in canopy height where drainage is unimpeded, to short, and stunted vegetation forms with a partially open canopy of 10m or less. The most well developed kerangas forms grow on either water-logged sandy soils with impeded drainage, or drought-prone sandy soils on ridges and plateaus. A thick root mat (up to 20 cm) and abundant, consolidated, undecomposed surface litter (humus) are typical of the forest floor in kerangas. On occasion, peat-like accumulations in the upper soil horizon may occur where drainage is poor due to localized concavities in underlying impervious rock or a cemented hard pan of clay transported downward in the soil horizon (spodic layer). Such kerangas on wet, shallow peat (typically <2 m) is often referred to as *kerapah* or *kerapot* by local communities, and shows strong floristic similarities with peat swamp forest. As with rivers draining peat swamp, rivers draining kerangas forest (especially *kerapah*) are red or black in colour, due to high concentrations of soluble tannins and other organic acids.

Despite marked structural and to a lesser degree floristic variation among kerangas forms, the following characteristics in combination can be diagnostic of most forms: (i) continuous and even canopy of long narrow tree crowns; (ii) near absence of giant emergent trees >100 cm diameter; (iii) medium to high densities of shrubs, treelets and small diameter climbing and twining plants in the understorey, especially rotan (*Calamus* spp.) and pandans (*Pandanus* spp.); (iv) high density and ground coverage of understorey mosses and bryophytes, as well as pitcher plants in the genus *Nepenthes*; (v) a distinctive form aerial termite nests; (vi) a high diversity of orchids, in a variety of growth forms but especially epiphytes; and (vii) presence of indicator species in combination such as *Hopeakerangasensis, Gymnostoma nobilis, Shorea coriacea*, *S. retusa*, *S. sagittata* and (in West and northern Central Kalimantan) *S. peltata*.

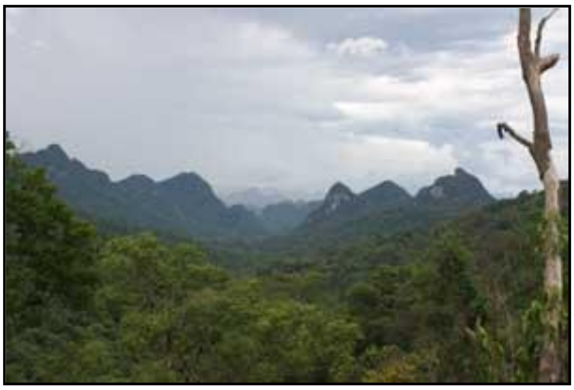
Kerangas supports lower plant and animal diversity than lowland forests on well-drained soils, but harbours a large number of endemic (or near endemic) plants (Ashton 2010), especially understorey and epiphytic woody or herbaceous species. Common woody plants of kerangas include *Vaccinium lauriflorum*, *Rhodomyrtus tomentosus*, *Tristianopsis whiteana*, *Gymnostoma nobile*, *Shorea retusa*, *Hopea kerangasensis, Hopea dryobalanoides*, *Swintoniaglauca*, *Combretocarpus rotundatus*, *Cratoxylum glaucum* and a rich assemblage of species in the genus *Syzygium*. Many plant species have specialized adaptations to the low nutrient conditions typical of kerangas, including the epiphytic myrmecophytes (ant plants) *Myrmecodia* and *Hydnophytum*, and the carnivorous pitcher plants (*Nepenthes*), sundews (*Drosera*) and bladderworts (*Utricularia*); and understorey and epiphytic orchids including the protected black orchid (*Coelogyne pandurata*). In comparison to other forest types on Borneo, kerangas forests contain a relatively high density of plants of Australasian origin, including the families Myrtaceae and Casuarinaceae, and gymnosperms of the southern hemisphere, including *Agathis*, *Podocarpus* and *Dacrydium*.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in kerangas is low to intermediate overall, but most of the HCV 1 species present are near endemics.

In this chapter Kerangas Forest are represented by the **BRH,BRW**, **MTL**, **PKU**, **PST**, and **TDR** ecosystem proxies.

Karst Forest [8]

The Mangkalihat Peninsula has the most extensive area of forest on limestone on the island of Borneo. In this report we use a narrower interpretation of forest on limestone that includes only 'tower' and 'cockpit' types. That is, steep sided highly weathered formations (tower) and conical or hemispherical limestone hills with more gentle slopes (cockpit). These limestone types are approximated by the **OKI** and **GBJ** land systems, respectively, which we term Karst forest.



The karst forest areas thus defined typically have shallow soils or bare rock surfaces on steeper slopes and cliffs that support small trees and shrubs. On the gentler lowland slopes the forest is higher and mainly dominated by dipterocarp trees in the canopy, often with high stocking density of commercial timber. The summits of limestone hills may be covered in a deep mat of peat-like humus and supports a low stature forest, sharing some species more typical of heath forest than lowland mineral forest areas, most notably with few dipterocarps.

On montane limestone areas, no dipterocarps are present, and small trees are interspersed with shrubs and an abundance of bryophytes. On the deep humus layers, calcifuges are found that include shrub rhododendrons and conifers. Although few detailed systematic studies have been made in Kalimantan's limestone areas, studies performed to date suggest they support a rich flora with many limestone endemics, though relatively poor in tree species overall. In 2006, TNC conducted a major biodiversity expedition in the Mangkalihat Peninsula, and confirmed the rich biodiversity potential of the area (Salas 2005).

Karst areas are extremely important habitat for certain fauna, especially bats, crustacea, molluscs and insects associated with the often extensive network of cave systems present. Though primates, including the orangutan (*Pongo pygmaeus*) may also present in karst, they generally occur at lower densities than other ecosystems (Husson et *al*. 2009; Marshall et *al*. 2007). A number of plant species are also endemic to, or markedly more abundant in, karst areas, including herbaceous species such as members of Begoniaceae, as well as shrubs in the Ericaeacae. Many plant species in these limestone areas are also draught tolerant. During droughts, karst forests are locally susceptible to fire.

In this chapter karst forest are represented by the **GBJ** and **OKI** ecosystem proxies.

[8] Karst images credited to www.wildlifeextra.com and www.travel.mongabay.com. All other images in this section are credited to Gary Paoli.

Sub-montane forest [9]

Unlike the peat, kerangas and karst ecosystems described above, whose distribution is driven by substrate, and elevation causes important changes in vegetation structure and composition across Borneo. Such changes are best exemplified in Borneo on Mount Kinabalu, which shows distinct zonation of vegetation types with elevation, spanning lowland forest, Sub-montane forest, montane forest, cloud forest, high elevation shrub lands, grass land, and bryophyte dominated crevice communities lining bare rock. At over 4100m a.s.l., Mount Kinabalu is exceptional on Borneo, with the majority of mountain peaks on the island <2000 m. As a result, most Bornean mountains show vegetation changes with elevation that extend from lowland rain forest at low elevations to Sub-montane, montane and possibly cloud forest near summits and along ridges and exposed plateaus; true montane grasslands and heathlands are uncommon.

The proximal causes of tropical vegetation change with elevation are complex, and have a long history of scientific inquiry and debate. Underlying this complexity is a phenomenon referred to as the *Massenerhebung* effect, wherein vegetation zones are compressed on coastal mountains compared to larger, more inland ones, a result of transitions from one vegetation type to another occurring at lower elevations on smaller mountains. Such patterning with elevation appears to reflect the joint influences of climate, especially temperature, which decreases more slowly with elevation on larger mountains (lower 'temperature lapse rates'), as well as soil drainage and water holding capacity. This means that mountains of the same size but different geographic locations, underlying geologies, and local climate or wind patterns can have very different zones of transition from lowland to Sub-montane to montane forest, making vegetation zonation mapping across large mountainous areas very difficult without field work or high resolution aerial photography.

For practical purposes, however, it is necessary to define transition boundaries for elevation zones, and the revised HCV Toolkit recommends an upper limit of 500m a.s.l. for true lowland forest on most mountains, beyond which the forest is better described as Sub-montane. In turn, the Toolkit recommends that Sub-montane forest extends up to an

9 http://lurid.chuvashia.info/Premium%20Wallpapers%20%202007%20Collection%201/; http://www.farawayholidays.co.uk/faraway/borneo/Borneo-Peaks_of_Mountain_Kinabalu_Borneo_Island.jpg; Agathis credited to Dr Kamarudin Mat-Salleh.

approximate elevation of 1000m a.s.l., beyond which forest on most mountains is better described as montane. We have followed these recommendations throughout this report.

Generally speaking, the transition from lowland to Sub-montane forest is more gradual, subtle and cumulative than transitions from lower montane to montane, and requires systematic floristic sampling to define. The transition has practical conservation importance, however, because shifts in dominant lowland to Sub-montane flora has an impact on habitat quality, with lower fruit productivity and consequently frugivore densities in Sub-montane and especially montane forest compared to the lowlands (e.g. Marshall 2009; summaries in Whitmore 1984). Higher elevation forests still have a role to play as potential 'keystone habitats', however, providing food during periods of low fruit availability in the lowlands (Cannon et *al*. 2007a,b), and in the future may function increasingly as refuge habitat for lowland species in response to changing climate (e.g., Illan et *al*. 2010).

The main structural and floristic differences between lowland and Sub-montane vegetation include the following. Tree densities are higher in Sub-montane, but maximum tree size and canopy height are lower, reflecting a marked decline in abundance and maximum size of canopy and emergent trees in the Dipterocarpaceae. The canopy of Sub-montane forest shows more uniform texture and crown diameter than lowland forest, but not the highly uniform canopy texture diagnostic of montane forest in aerial images. Floristically the dominant plant families of Sub-montane forest show affinities with those of temperate climates, especially members of the Fagaceae (*Castonopsis*, *Lithocarpus* and *Quercus*), Ericaceae, Myrtaceae (*Leptospermum*) and cone-bearing tropical gymnosperms, including *Dacrydium*, *Gymnostoma*, *Podocarpus*, *Phyllocladus* and the large emergent tree *Agathis borneensis* (see right). Figs and fruit bearing lianas are less abundant than in the lowlands, but tree ferns and understorey palms increase in density through Sub-montane and especially in montane forest.

In HCV terms, the density and diversity of HCV 1 species (Threatened, Protected or Endemic Species) in Sub-montane vegetation is low to intermediate compared to lowland habitats, but as noted above likely provides important habitat support functions during periods of low fruit availability in the lowlands.

In this chapter Sub-montane forest is represented by the **Sub** ecosystem proxy.

Montane Forest [10]

On mountains of sufficient height and suitable climatic and soil, Sub-montane vegetation is replaced by structurally and floristically distinct montane forest. In contrast to the gradual nature of transition from lowland to Sub-montane forest, that of Sub-montane to montane forest is usually abrupt, and marked by the onset of persistent cloud formation and presence of superficial peat. The elevation at which montane vegetation occurs varies markedly across Borneo, from 650m on the island of Pulau Karimata to 1200m on Bukit Baka in central Borneo, to 2200m on Mount Kinabalu in Sabah. As noted, this reflects differences in temperature lapse rates and soils on mountains of different maximum height and proximity to the coast – an example of the so-called *Massenerhebung* effect (Whitmore 1984).

Ecological dynamics of montane forest are much slower than at lower elevations, reflecting cooler temperatures, lower solar insulation and nutrient limitations of growth, especially nitrogen, resulting from temperature and moisture limitations on decomposition. Well-developed montane forest shares much in common with heath forest (kerangas) in terms of structure (stem diameter, tree height and canopy texture), physiognomy (stem shape, leaf size and leaf thickness) and floristics (especially abundance of understorey and epiphytic orchids and *Nepenthes* pitcher plants). This had lead some to suggest that ecological factors causing the replacement of Sub-montane vegetation by montane forest may be similar to those causing formation of kerangas, including tolerance to nutrient scarcity and wide fluctuations in water availability (both water logging and periodic drought). Detailed studies to differentiate between the relative importance of these factors have not been performed (but see Pendry & Proctor 1996 for review).

Floristically, montane forests are relatively species poor compared to lowland and Sub-montane forest, but support a number of habitat endemic plants, especially ferns (including tree ferns), palms, orchids, carnivorous plants, and myrmecophytic epiphytes.
Under conditions of wet, near constant cloud cover, a Sub-type of montane vegetation referred to as cloud forest or moss forest develops, and is characterized by a dense, even canopy of small diameter trees with twisted and moss covered stems. Here, species in the Myrtaceae, Clusiaceae, Theaceae, Fagaceae and various gymnosperm families are especially common.

[10] Image credits to http://lh3.ggpht.com/_1dFSb3K8HmI/SkjlSkq4WNI/AAAAAAAAAVg/Tzlu40wIvgw/s160/Montane_Rainforest,_Mount_Kinabalu_National_Park,_Borneo.jpg; http://farm1.static.flickr.com/147/436375506_21f3e87419.jpg; http://wpcontent.answers.com/wikipedia/commons/thumb/8/83/Cloud_forest_mount_kinabalu.jpg/

The occurrence of HCV 1 species (Threatened, Protected or Endemic Species) in montane forest is low.

In this chapter montane forest is represented by the **Mon** ecosystem proxy.

Disturbed Vegetation Types

The mapping area has experienced a variety of disturbance histories, including low to high intensity commercial logging, small-scale swidden agricultural, wild fires and forest conversion to fibre or oil palm plantations. This has produced large areas of disturbed primary (i.e. logged or damaged by wild fires but never cleared) and secondary forest types (*sensu* Corlett 1995) of varying structure, floristic composition and value as habitat for native flora and fauna. In the landscape HCV study reported here, a forest/non-forest maps was produced, but no attempt was made to distinguish disturbed primary vegetation types (so-called degradation classes) or the fine scale mosaic of secondary vegetation types (see methods described in chapter 1).

The spatial distribution of forest degradation classes and secondary vegetation types is, however, being mapped for Berau Regency by ICRAF (Dewi et *al*. 2010).

2.2. Area of Interest and Landscape Units

The Area of Interest (AOI) covered in this Chapter includes Berau, East Kutai and a small portion extending slightly north of Berau border with Melinau and Bulungan (**Fig. 2.2.1**).

Three large landscape blocks, representing HCV 2.1 forest areas, are present in the AOI (**Fig. 2.2.2**). These include:

1. Hulu Kelai-Telan Block
2. Mangkalihat Peninsula
3. Tanjung Btu Peninsula

In the three sections that follow, these blocks are discussed in turn, describing basic physical attributes, HCVs present, current and future threats to these HCVs, and management recommendations.

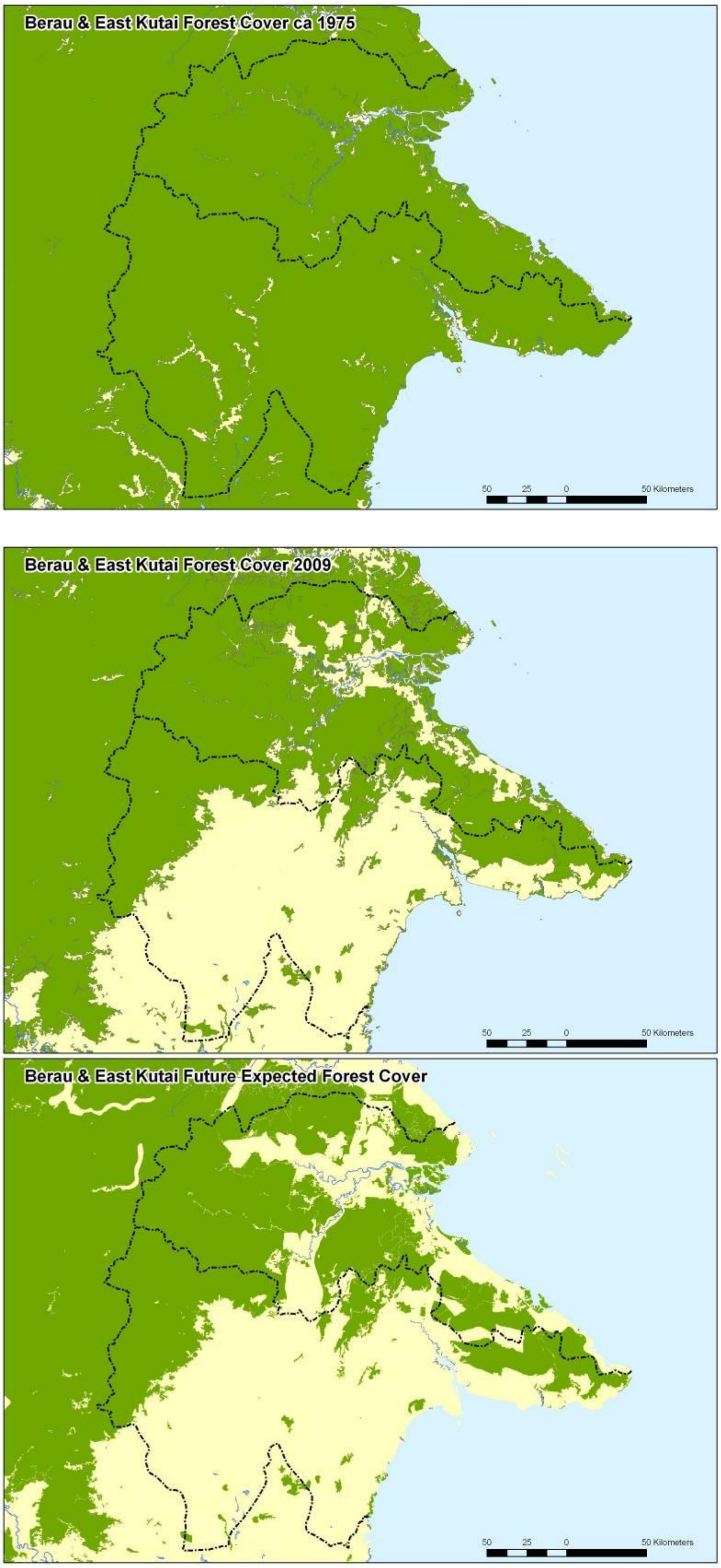


Figure 2.2.1 A map of past (c. 1975) and present (2009) and future expected forest cover in the Area of Interest.

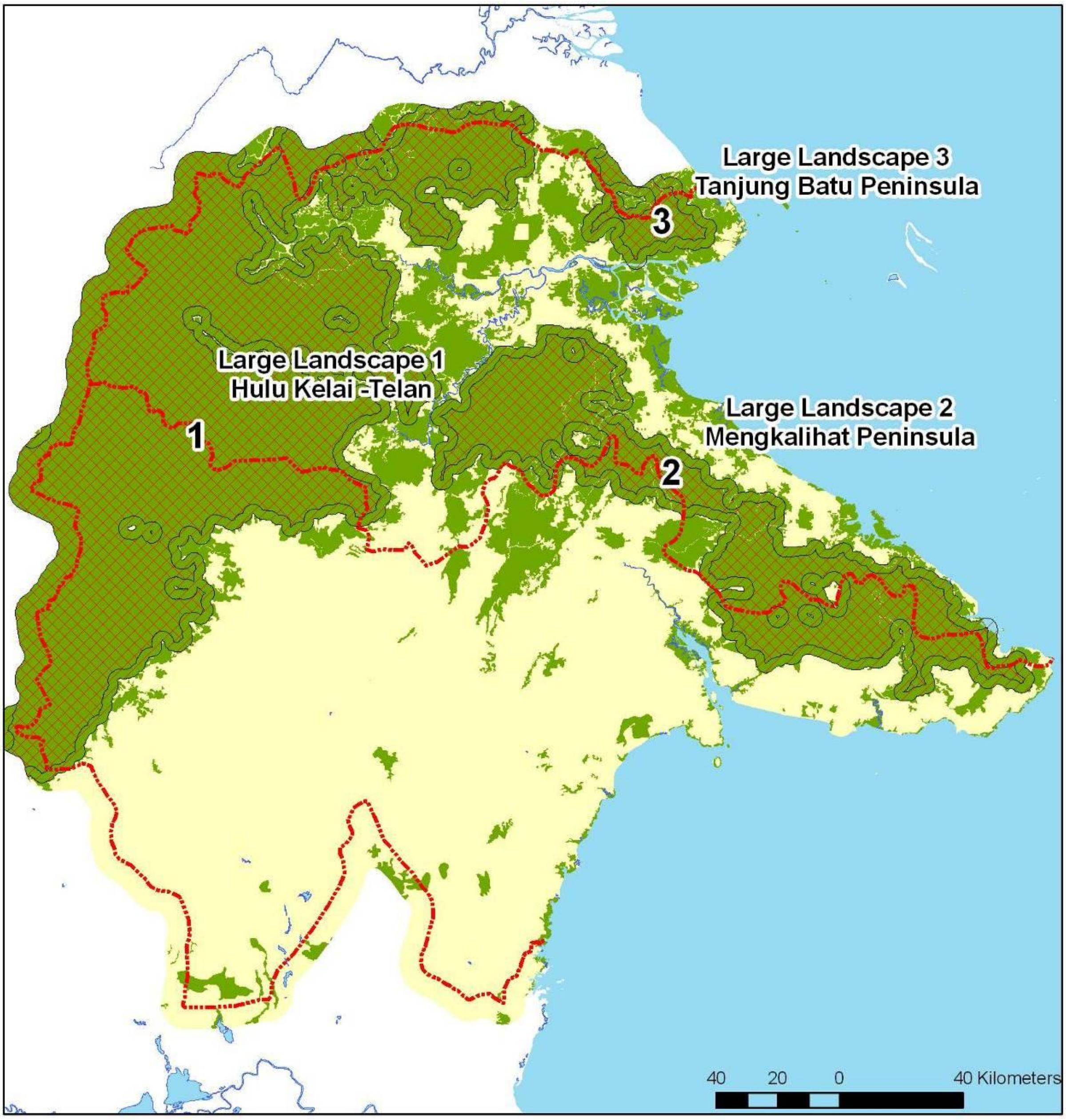


Figure 2.2.2 A map of Large Landscape units (HCV 2.1) discussed in this report.

2.3. HCV 2.1 - Large Landscape 1 – Hulu Kelai-Telan

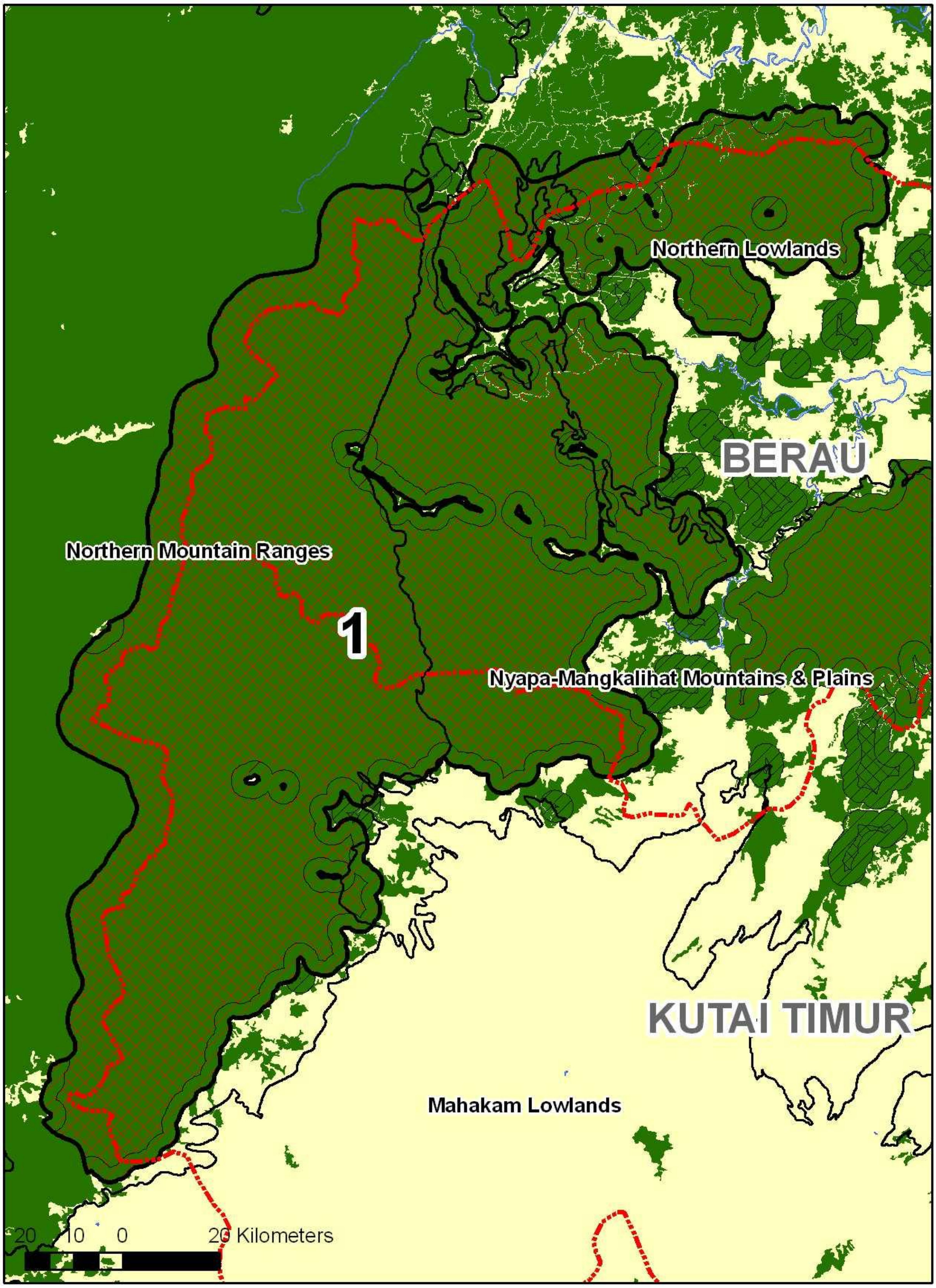


Figure 2.3.1. Large Landscape 1 - Hulu Kelai-Telan

2.3.1 General Description

Large Landscape 1, Hulu Kelai-Telan, covers c. 1,686,500 ha, with a Core Area (>3km from forest edge) of c. 1,346,000 ha in size. This area is only a small part of (contiguous with) a much larger block of forest that covers much of the central region of the Island of Borneo. It also remains connected in parts to Large Landscape 2, Mangkalihat Peninsular, along the S. Kelai and its tributaries.

Physiographic Regions

Large Landscape 1 covers parts of three physiographic regions: Northern Lowlands (c. 337,000 ha), Nyapa-Mangkalihat Peninsula (c. 435,000 ha), and Northern Mountain Ranges (c. 914,000 ha) (**Fig. 2.3.1**). The Landscape encompasses parts of both Berau and East Kutai.

Past and Present Forest Cover

The area delineated as Large Landscape 1 today was in c.1975 part of a 'Super Landscape' that covered much of East Kalimantan, as shown in**Fig.2.2.1**. The current landscape unit of c. 1,686,500 ha became separated (fragmented in terms of HCV 2.1 definitions) from Large Landscape 2 as a result of forest clearance along the Kelai River and its tributaries (although remains connected physically by forest that is less that 3 km from the forest edge) (**Fig. 2.3.1**). Connectivity with Landscape 3 was lost entirely sometime after 2000 due to land clearance along the road built between Tanjung Redeb and Tanjung Selar and the Tanjung Redeb Hutani HTI concession.

Land Use Types

The provincial land use plan (RTRWP) for East Kalimantan distinguishes areas considered as protection forest, production forest (logging or HTI), and areas that may be used for non-forest uses such agriculture (e.g. oil palm) or other purposes. The sum of protected and production forest areas represents the total official extent of Forest Land, with forest areas outside this considered at risk for conversion to non-forest uses. According to RTRWP 1999, land use within Landscape 1 is 97% Forest Lands, of which c. 563,792 ha is protected forest, c. 1,072,526 is production forest, and 3% (c. 50,216 ha) is classified as non-forest lands (Table 2.3.1). The proposed RTRWP v.2008 marginally reduces the total amount of Forest Land from 97% to 95%, reducing production forest to 660,290 ha, but increasing protected forest to c. 944,379 ha. Generally between lowland, Sub-montane, and montane forest land is planned to be re-allocated from production forest to protection forest, however almost all of the increase c. 30,000 ha of non-forest land has occurred at the expense of lowlands.

Slope and Altitudinal Distribution of Forest

Only 22% of Landscape 1 is flat to undulating (0-10% slope), with the remaining area more hilly (c. 22%) and mountainous (56%) as you move west (Table 2.3.2, **Fig. 2.3.2**). Correspondingly the zones of Sub-montane (c. 500-1000m) and Montane (>1000m) vegetation are concentrated in the eastern half of the Landscape (**Fig. 2.3.3**). Overall, 51% of the area is Lowland (<500m), 31% Sub-montane (c. 500-1000m) and 18% montane (>1000m).

Major Ecosystem Types

Mixed Lowland Forest (mixed dipterocarp forest on a variety of mineral soil types) accounts for 50% of the major ecosystem types, followed by Sub-montane forest (30%), and Montane forest (16%). The remaining 4% is made up of Karst (Lowland & Sub-montane) and Heath forest (Lowland, Sub-montane, & Montane), Table 2.3.1 and **Fig. 2.3.4**). See Section 2.1.4 for descriptions of general ecosystem types.

Table 2.3.1 Major forest types in Large Landscape 1 and their land use status under current (1999) and proposed future (version 2008) provincial land use plans (RTRWP) for East Kalimantan.

Major Ecosystem Types	Area	RTRWP 1999			Proposed RTRWP v2008			RePPProT Classes
		Protected	Production Forest	Other	Protected	Production Forest	Other	
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	
Lowlands (<500m)								
Karst Forest	6,471	0	6,471	0	0	6,471	0	OKI, GBJ
Heath Forest	15,141	58	15,084	0	58	15,084	0	BRW
Peat Swamp Forest	0	0	0	0	0	0	0	
Mangrove	0	0	0	0	0	0	0	
Other Lowland Forest	845,847	140,024	658,275	47,548	285,566	481,079	79,203	BTA, LWW, MPT, PDH, TWH
Non-Forest	3,036	183	2,312	540	281	2,136	619	
Total	**870,495**	**140,265**	**682,142**	**48,088**	**285,904**	**504,769**	**79,822**	
Sub-Montane								
Karst Forest	202	0	202	0	0	202	0	OKI
Heath Forest	6,131	1,276	4,855	0	1,276	4,855	0	BRW
Peat Swamp Forest	0	0	0	0	0	0	0	
Other Sub-Montane Forest	511,887	237,583	272,278	2,025	409,982	99,964	1,941	BPD, BTA, MPT, PDH, SMD, TWH
Non-Forest	0	0	0	0	0	0	0	
Total	**518,220**	**238,860**	**277,335**	**2,025**	**411,258**	**105,020**	**1,941**	
Montane								
Karst Forest	0	0	0	0	0	0	0	
Heath Forest	22,495	14,618	7,875	2	14,618	7,875	2	BRW
Peat Swamp Forest	0	0	0	0	0	0	0	
Other Montane Forest	275,325	170,050	105,174	100	232,599	42,625	100	BPD, BTA, MPT, PDH, SMD, TWH
Non-Forest	0	0	0	0	0	0	0	
Total	**297,820**	**184,668**	**113,049**	**103**	**247,217**	**50,500**	**103**	
Water Bodies	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
	1,686,535	**563,792**	**1,072,526**	**50,216**	**944,379**	**660,290**	**81,866**	

Table 2.3.2 Slope classes of Large Landscape 1, Hulu Kelai-Telan.

Slope Class %	% of Area
0-10	22
10-15	11
15-20	11
20-40	38
>40	18
	100

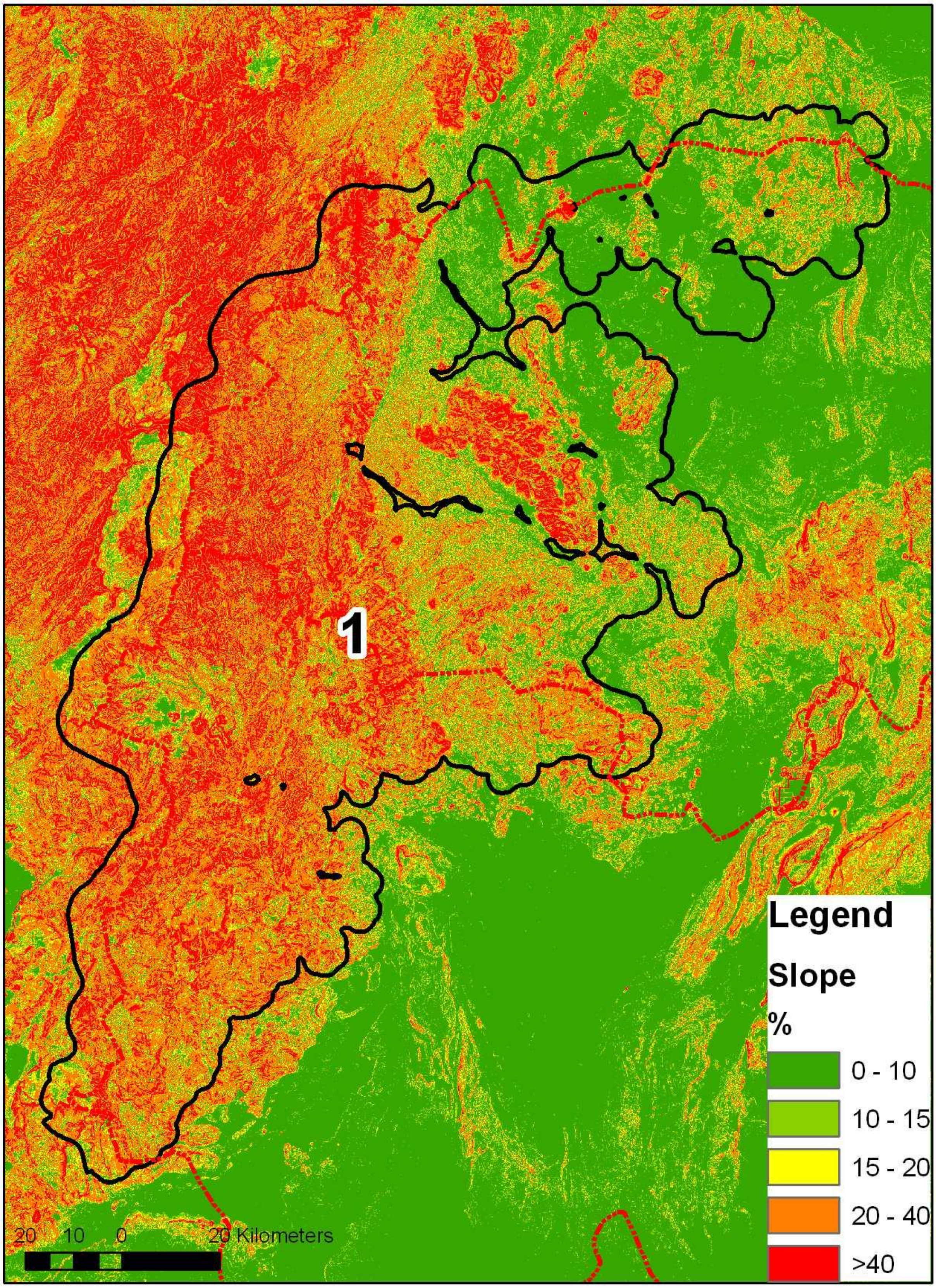


Figure 2.3.2 Map of slope classes within Large Landscape 1, Hulu Kelai-Telan.

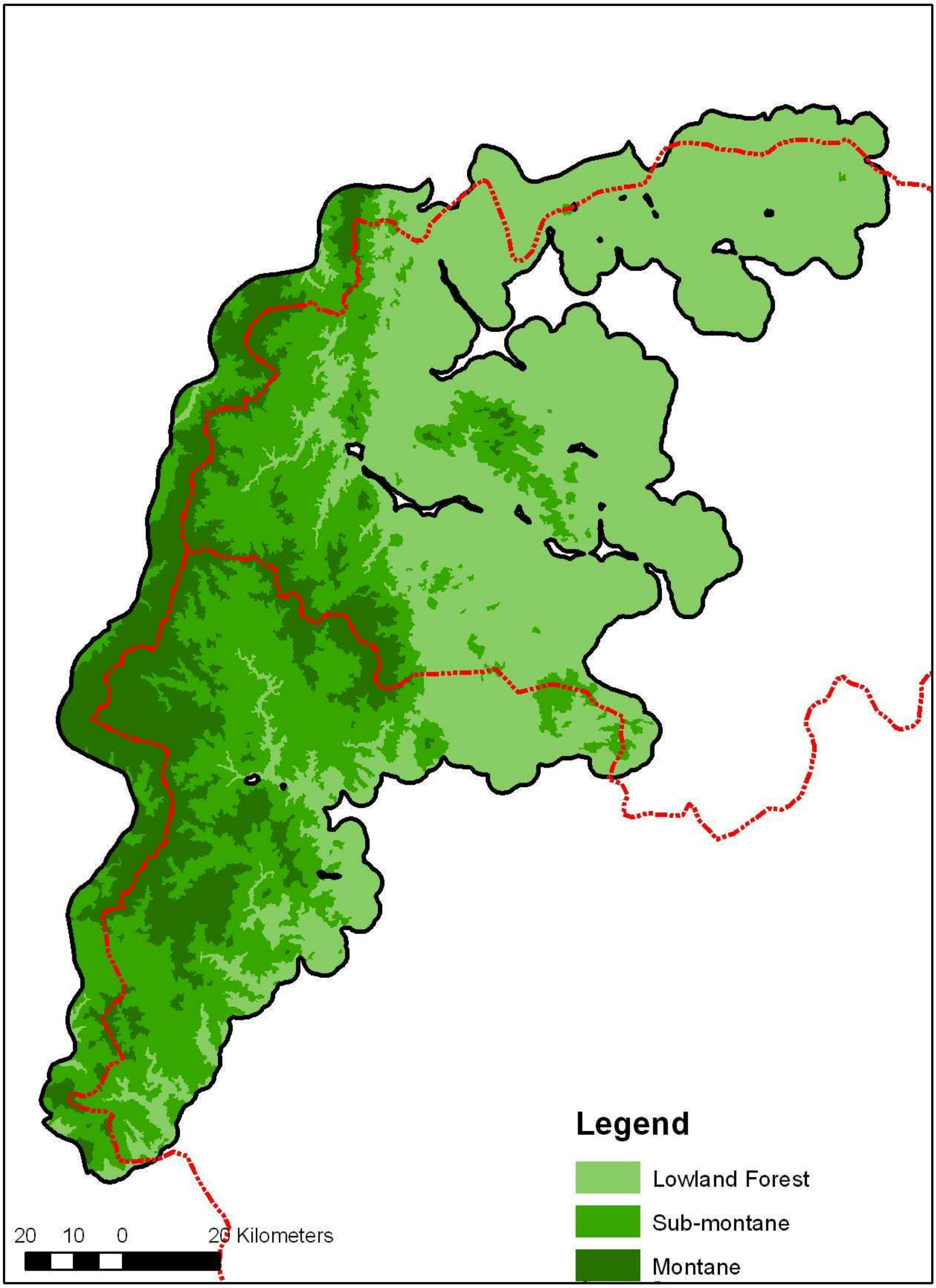


Figure 2.3.3 Map of lowland, Sub-montane and Montane vegetation zones of Large Landscape 1, Hulu Kelai-Telen.

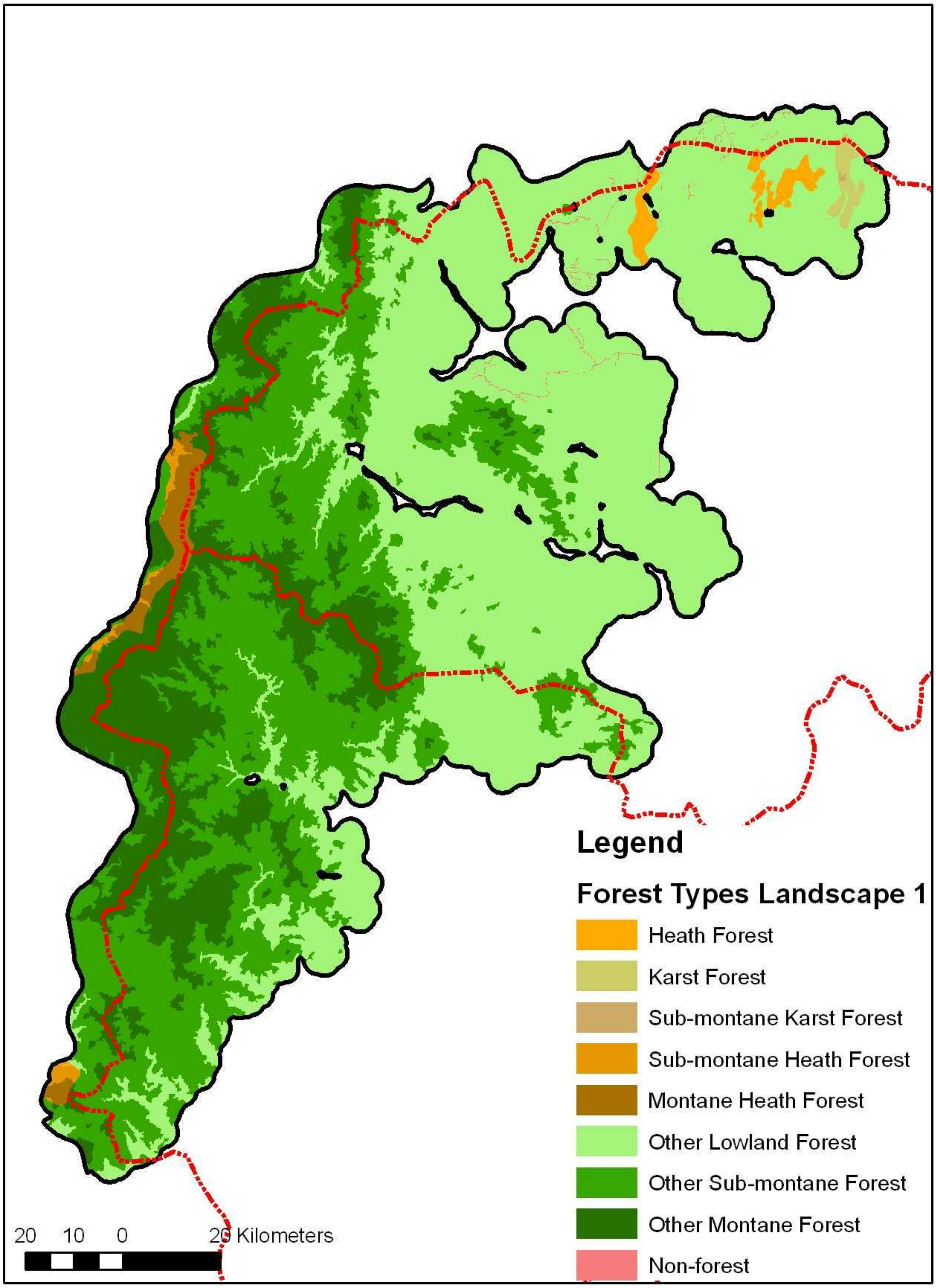


Figure 2.3.4 Map of major ecosystem types present in Large Landscape 1, Hulu Kelai-Telan (inferred from modified RePPProT classification; see revised HCV Toolkit for Indonesia).

2.3.2 Description of HCV 2.2 - Areas that Contain Two or More Contiguous Ecosystems

Two different HCV 2.2 zones of transition among ecosystem types described in the Toolkit are present within Landscape 1:

1. Ecoclines spanning vegetation types distributed along elevational gradients, including lowland, Sub-montane and/or montane areas
2. Kerangas and non-kerangas forest areas

Large Landscape 1 rises from about 20m above sea level to over 2000m, supporting five large areas of ecoclinal transition from lowland to montane areas totalling c. 1,066,000 ha in extent, or 63% of Landscape 1 (**Fig. 2.3.5**). The altitudinal transition occupies most of the western half of Landscape 1 as the area moves from lowland through to montane in a geometrically complex manner.

As noted, small areas of heath forest are also found in Landscape 1. Where present, heath forest is contiguous with non-heath lowland forest on mineral soils (**Fig. 2.3.5**), which the Toolkit also distinguishes as HCV 2.2. The total area of heath to non-heath transitions is 126,147 ha, approximately 7% of Landscape 1. Some of the transition areas between heath and non-heath forest also overlap with the altitudinal transitions described.

Transitions between karst and other non-karst forest types are not included within the Toolkit as an HCV 2.2 transition. Yet, there may also be important ecological reasons for maintaining connectivity between karst and non-karst forest types. In the present case, the elevational transitions present in Landscape 1 overlap with some transitions between karst and non-karst, which effectively gives some of these karst to non-karst transitions HCV 2.2 treatment.

To map HCV 2.2 areas, a 3km buffer either side of the transition boundary was used, with borders between types as described by the modified RePPProT ecosystem proxy map (Fig**. 2.3.5**). This is considered a conservative estimate of distance required for most normal ecological processes to be maintained at that interface (e.g. vertebrate foraging patterns across habitat boundaries).

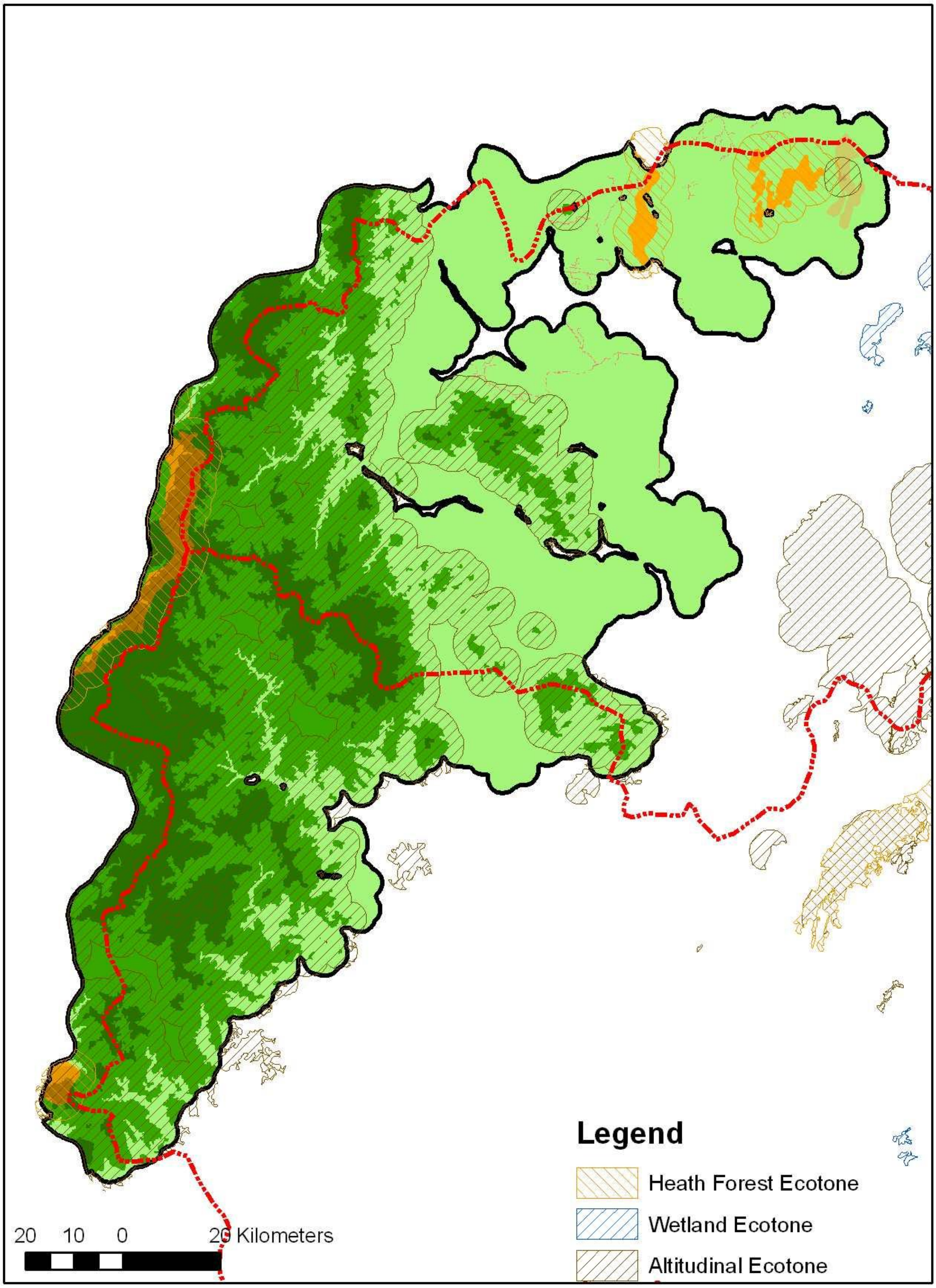


Figure 2.3.5 Zones of ecosystem transition (HCV 2.2) in Large Landscape 1, Hulu Kelai-Telan.

2.3.3 Description of HCV 3 - Rare and Endangered Ecosystems

Rare Ecosystems

Within Large Landscape 1, a total of four rare ecosystems are present, based on the 1% criterion (Table 2.3.3; **Fig. 2.3.6**). Individually these range in extent from 30 to c. 4000 ha. Together they cover c. 7,000 ha of the Landscape (< 0.5%).

Within the Northern Lowlands **OKI** (Rugged karst ridges and mountains) are rare with 3,812 ha of its total extent of 21,333 ha (18%) found within Landscape 1. Within the Nyapa-Mangkalihat Mountains and Plains region, **Mon** (montane areas) is very rare, with only 6,379 ha present, of which 2,604 ha (41%) are found with Landscape 1. In the Northern Mountain Ranges region, the **BRW** class (Heath forest on mountainous sandstone cuestas with dissected dipslopes) is rare, with 38,271 ha, of which only 1% (304 ha) is present in the Landscape 1. Finally, the rare **BTA** class (Forest on dissected volcanic cones), with a total extent in Kalimantan of 7,283 ha is also present, but extremely rare in Landscape 1, with an estimated 30 ha. All of these rare ecosystems are within areas designated as Forest Lands (Table 2.3.3).

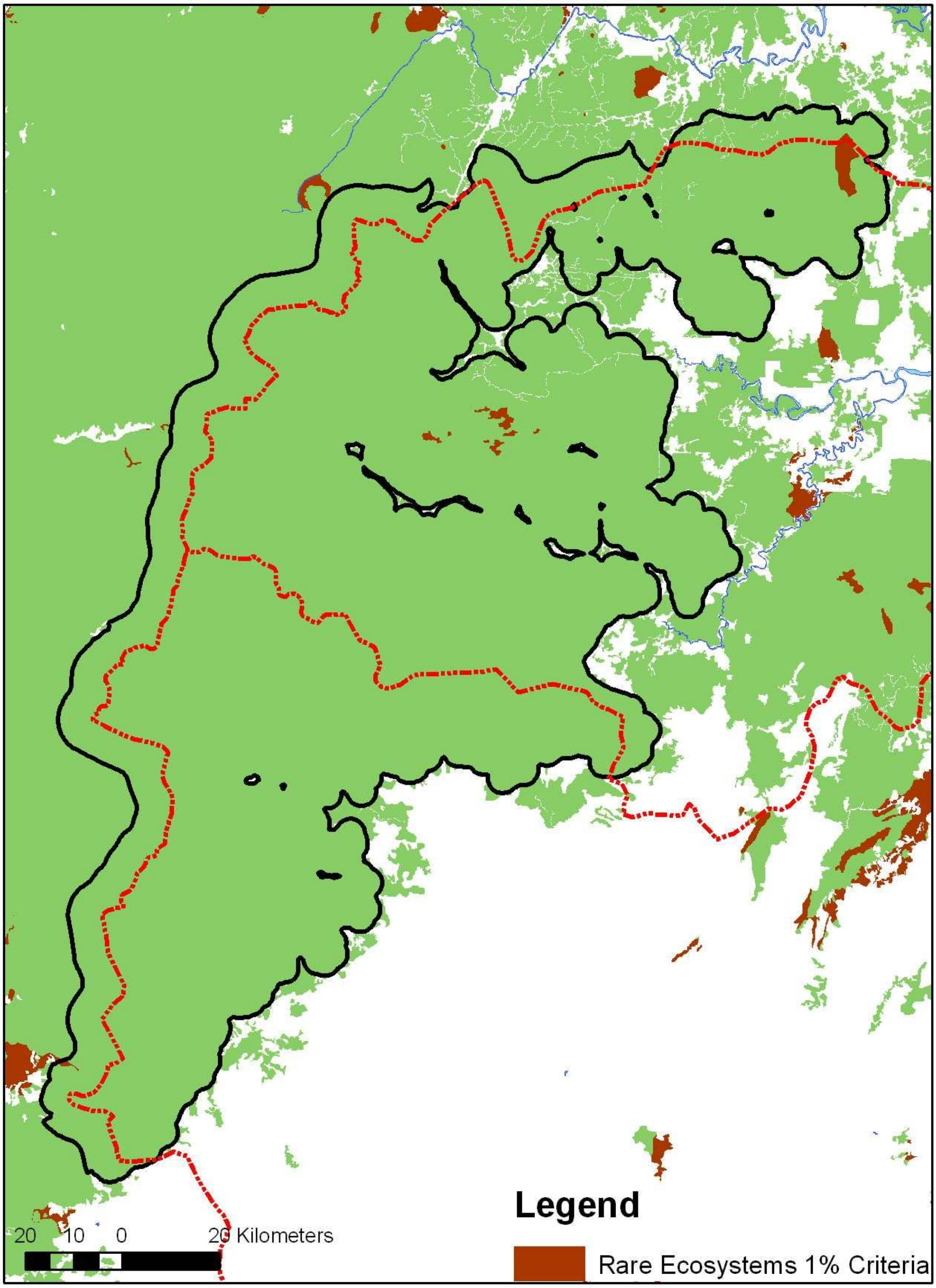


Figure 2.3.6. Map of Rare ecosystems (HCV 3) in Large Landscape 1, Hulu Kelai-Telan.

Table 2.3.3. Rare ecosystems (HCV 3) in Large Landscape 2, Hulu Kelai-Telan.

Ecosystem Proxies	Description	Total Extant Remaining in Physiographic Region (ha)	Total in Landscape Region 2 (ha)	% of Total Extant	Status Per Proposed RTRWP v2008 Protected (ha)	Production (ha)	Other (ha)
Northern Lowlands							
OKI	Rugged karst ridges and mountains	21333	3812	18	0	3812	0
Nyapa-Mangkalihat Mountains & Plains							
Mon	Montane	6,379	2604	41	2604	0	0
Northern Mountain Ranges							
BRW	Mountainous sandstone cuestas with dissected dipslopes	38,271	304	1	58	247	0
BTA	Dissected volcanic cones	7,283	30	0	0	30	0
			6750				

Endangered due to current forest loss

No ecosystem proxies are identified as currently Endangered due to >50% loss of past extent since c. 1975.

Endangered due to planned deforestation from RTRWP

No ecosystems within Landscape 1 meet the criteria for Endangered (HCV 3) as a result of future expected (planned) deforestation causing a decline of >75% of past extent.

2.3.4 Threats

This section provides a sketch of planned and/or unplanned deforestation or degradation that threatens persistence of landscape HCVs present in Landscape 1.

Spatial Plans

The proposed RTRWP v2008 leaves a majority of the current core area intact, however it threatens to fragment Landscape 1 into 11 smaller fragments with Core Areas, only two of which would remain greater than 20,000 ha (the criterion Large Landscapes under HCV 2.1): one representing 68% of the previous core area (c. 1,144,000 ha) and the other in the north-eastern corner (c. 77,000 ha) (**Fig. 2.3.7**).

The effect of legalized conversion under RTRWP v2008 on Ecosystem Transition zones under HCV 2.2 is relatively small. However, one of the heath forest transition zones in the north-eastern corner (27,000 ha) which currently exists largely outside the core but within the buffer will be reduced in extent, and so will the amount within the Core (**Fig. 2.3.8**). None of the HCV 3 rare ecosystems will be affected.

Conversion permitted under RTRWP v2008 also threatens the limited remaining connectivity between Large Landscape 1 & Large Landscape 2, with (a) plans to convert now forested lands along the Kelai River and (b) the development of a road to connect Kecamatan Kele and Tanjung Redeb. The RTRWP delineates a 500m buffer either side of the road as non-Forest lands (1 km width in total). For most wildlife, a 1-km wide non-forest zone would likely function as a barrier if it were brought under intensive agriculture.

Industrial Timber Estates (HTI) is often but not exclusively planned for production forest that has become exhausted of its commercial timber. Any forestry area, with the exception of protected forest, could thus become targeted for HTI development by the MoF. In East Kalimantan, provincial spatial plans only recognise Production Forest as a broad category, and do not make any further specification as to what Production forest lands would be eligible for HTI and what lands must remain forest. Consequently, only a recommendation from the Bupati would be required without any further reference to the Provincial and Regency spatial plans for conversion to HTI. This presents a fundamental problem for the identification of rare and endangered ecosystems in Indonesia, as the ecological function of the natural forests currently expected to remain as ‘forest’ under RTRWP could, in fact, be lost by conversion to fast growing fibre or other monoculture tree species. Further, it is not possible to predict where and to what extent this may occur from the spatial plans. We would recommend producing a variation of the currently proposed spatial plans for East Kalimantan Province and the Regencies to delineate those Forest Areas eligible for HTI, and those that are not. This would greatly assist in assessing threats and planning for maintaining HCVs and other conservation targets.

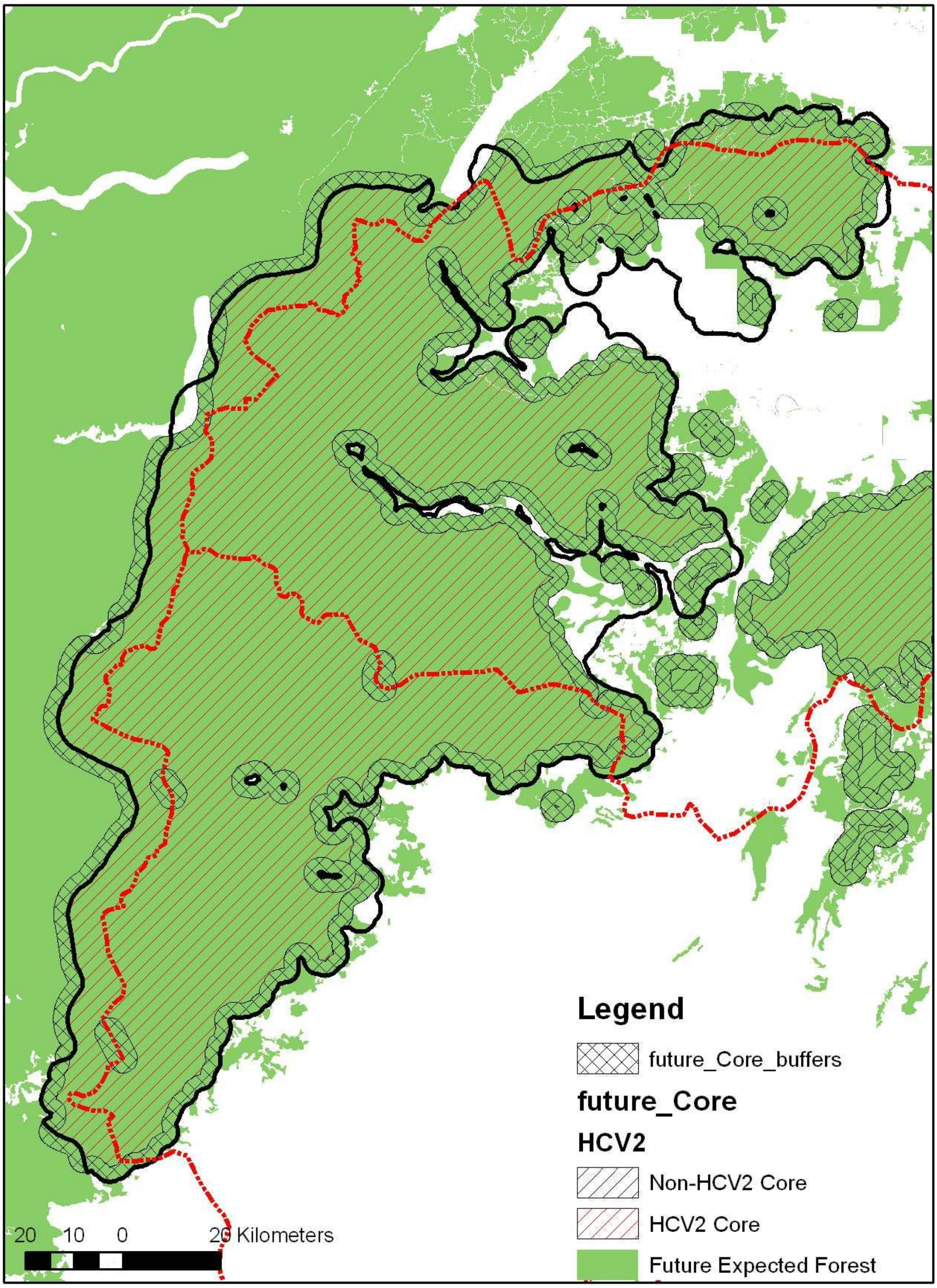


Figure 2.3.7 Future projected fragmentation of Large Landscape 1, resulting from planned deforestation under RTRWP ver. 2008.

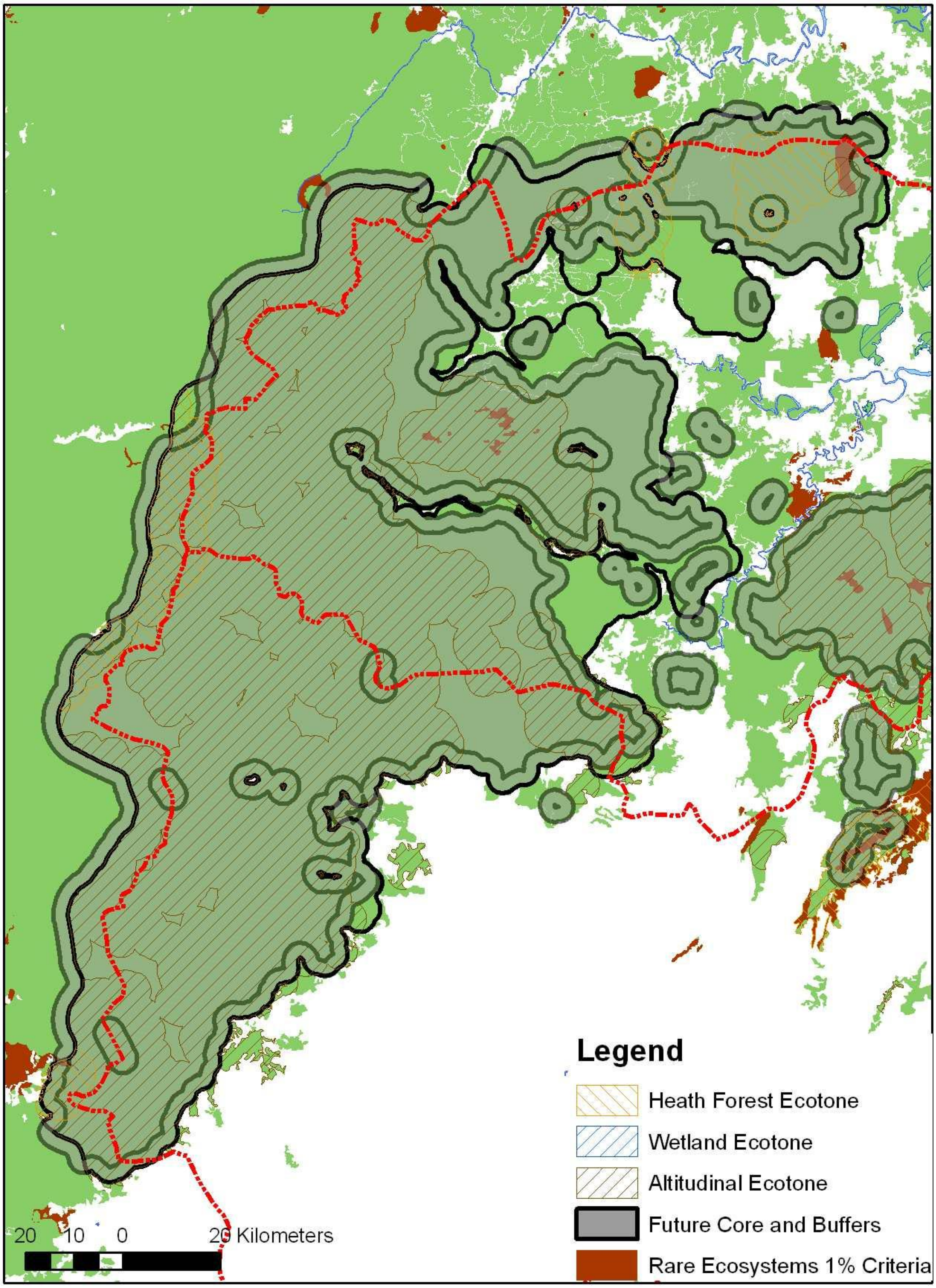


Figure 2.3.8 Future projected fragmentation of Large Landscape 1 resulting from planned deforestation under proposed RTRWP ver. 2008, showing the effect on Ecosystem Transition Zones and Rare Ecosystems.

Oil Palm

Oil palm development can occur in areas classified as Non-forest lands per the RTRWP and TGHK. However, just less than 50% of the area in Landscape 1 is unsuitable for Oil Palm being greater than 500m a.s.l., and much of the remaining area is likely to be too hilly (**Fig. 2.3.2**). In addition to this, only a small portion of the area under the current RTRWP and the proposed RTRWP are eligible for conversion (c. 50,000 ha and c. 80,000 ha respectively). At present, known licence areas are restricted to the periphery of Landscape 1 and do not present a threat to its integrity (**Fig. 2.3.9**). However, the area licensed to PT Anugrah Agung Prima Abadi lies between Landscape 1 and Landscape 2, and retains a small area of forest that forms a potentially critical link between the two Landscapes (**Fig. 2.3.9**). In the future if the proposed RTRWP plans are accepted, it is expected that most of the areas reclassified as non-Forest Lands will be converted to Oil Palm.

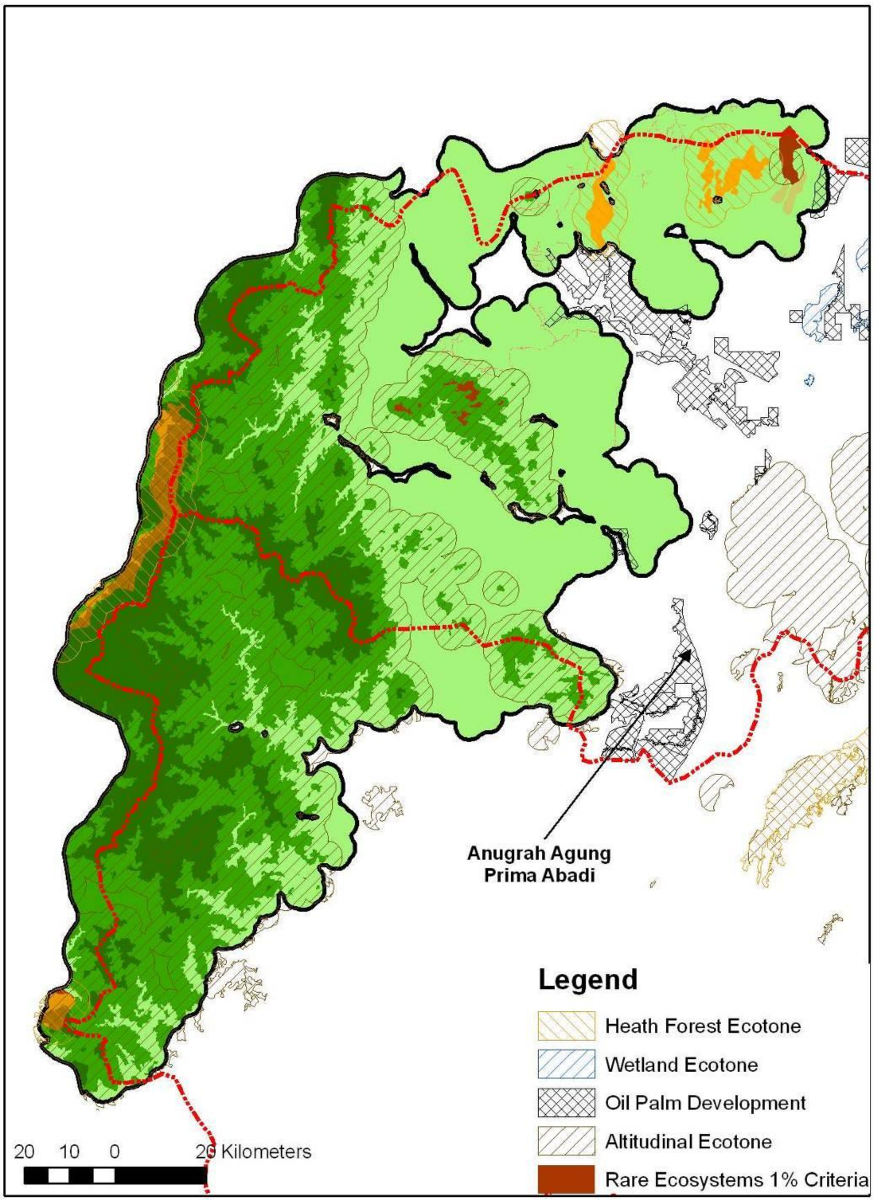


Figure 2.3.9 Planned oil palm development in and bordering Large Landscape 1 (Hulu Kelai-Telan), within Berau Regency there appears to be no threat to HCV 2.2 and HCV 3 areas.

Industrial Timber Estates (HTI)

As noted above, it is possible for HTI to be developed on any Production Forest area provided a recommendation is obtained from the Bupati and the Ministry of Forestry approves. At present, the production forest in Landscape 1 allocated to HTI is restricted to the periphery (**Fig. 2.3.10**), but in strict legal terms all the production forest could potentially become HTI (c. 50% of the Landscape, approximated by the lowland forest in **Fig. 2.3.10**). This would potentially threaten the HCV 2.2 heath to non-heath forest transition areas in the north-eastern section, and displace the rare **OKI** ecosystem (Forest on rugged karst ridges and mountains) from the interior Core Area of Landscape 1. It should be noted, however, that ecological conditions of the heath forest and karst areas would make them unlikely candidates for conversion to HTI, despite legal permissions to do so.

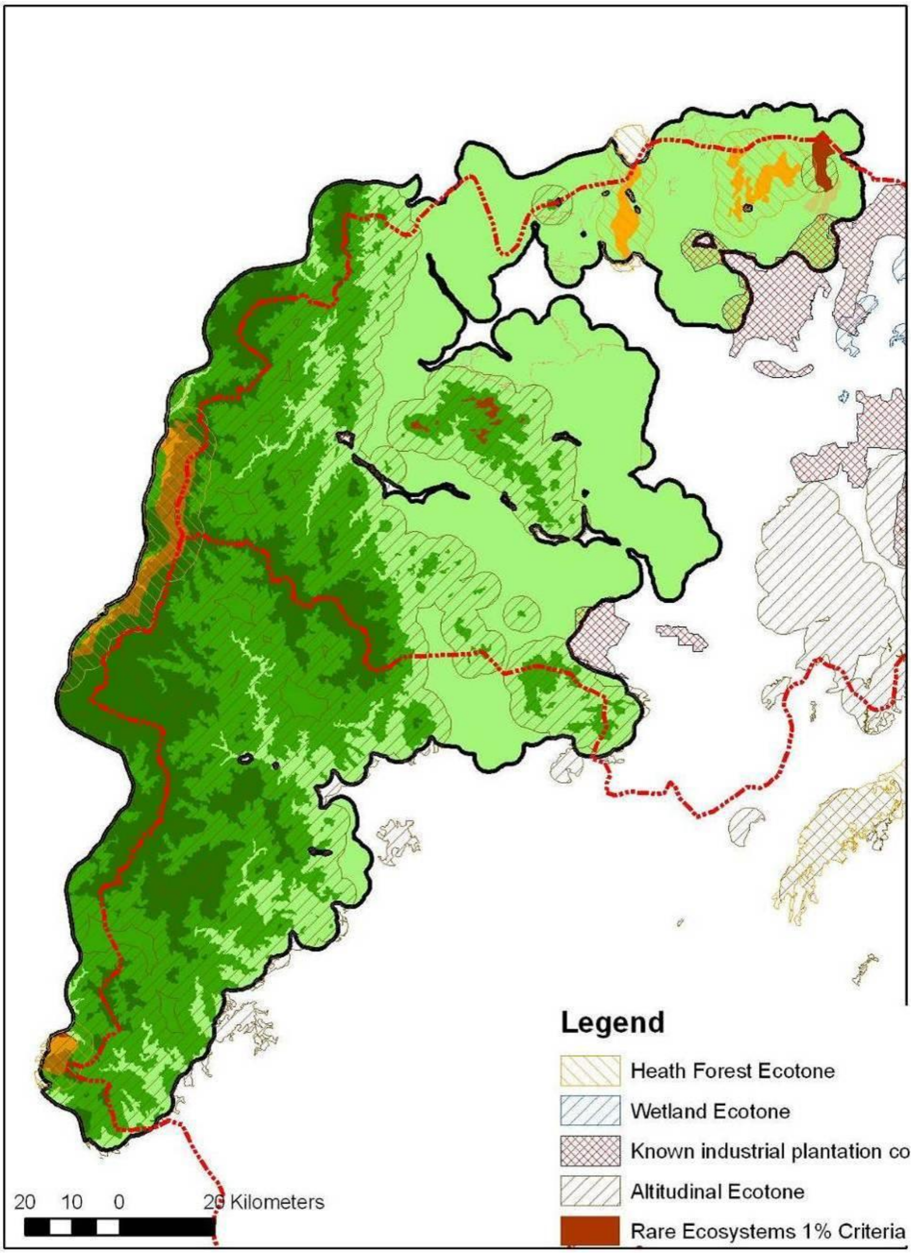


Figure 2.3.10 Known industrial plantation concessions in Large Landscape 1 (Hulu Kelai-Telan).

HPH

As noted, approximately 660,000 ha of Landscape 1 is allocated as Production Forest in the proposed RTRWP and thus legally permitted for selective timber harvesting (as well as conversion to HTI). A total of nine active HPH occur within the Berau portion of the Landscape (**Fig. 2.3.11**); HPH data for East Kutai are not available. These HPH occupy the vast majority of lowland areas in Landscape 1, in the central eastern portion of the block. Logging has a number of effects on forested areas that can be generalised as:

- Associated damage from extraction, skid trails, logging roads. This alters the structure and composition of the forest, alters the microclimate, and exposes and compresses the soil. These effects can be noticeable for up to many decades.
- Increased access. The logging roads make the area more accessible potentially leading to increased hunting pressure, and agricultural expansion by small holders.
- Increased fire risk and susceptibility to drought. Degradation of forest due to over harvesting in poorly managed concessions can increase the risk of catastrophic fires c.f. causes of 1982/83 fire linked to ENSO droughts.
- Silvicultural practices impact biodiversity. Use of enrichment planting such as TPTJ or TPTII reduces the biodiversity value of logged forest. This technique creates large elongate and interconnected gaps in the canopy during strip clearing and could potentially greatly increase the risk of forest fires in years immediately after trees have been planted until the canopy closes as trees mature.

The occurrence of such a large area of HPH in Landscape 1 represents a serious threat to maintain landscape HCVs, but also a real opportunity to protect them, if proper forest management were implemented. This would also lower risk of conversion to plantation. The net effect on landscape HCVs clearly depends on management.

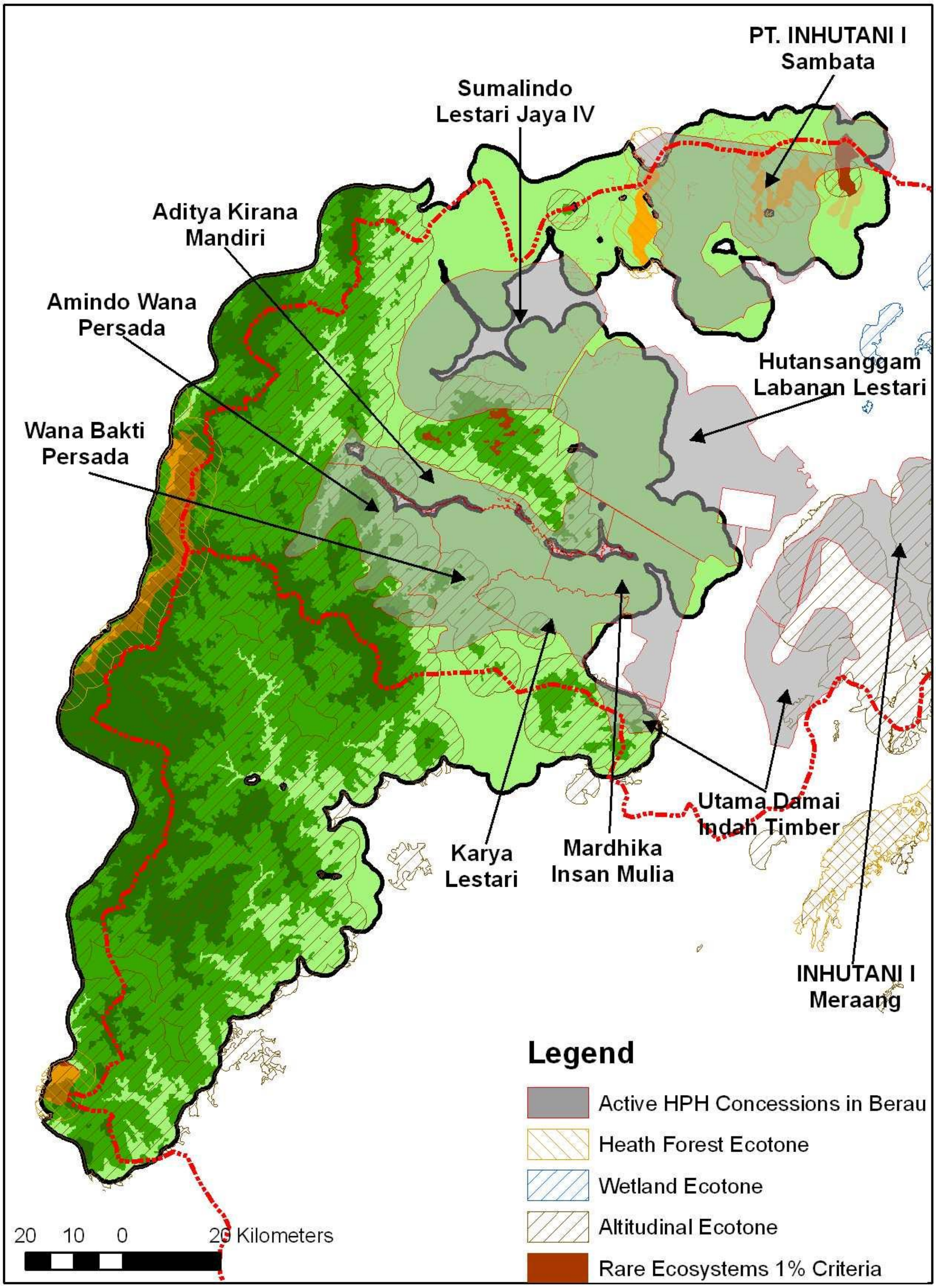


Figure 2.3.11 Known natural forest logging concessions (HPH) in Landscape 1 (Hulu Kelai-Telan) and its overlap with mapped HCV 2.2 and HCV 3 areas.

Agricultural Demand

Development of Berau and Kutai Timur will stimulate population growth, especially from economic migration. Combined with improved access due to plantation and HTI development, this will increase demand for agricultural land and push the agricultural frontier into regions previously considered inaccessible. The eastern side of Large Landscape 1 is relatively flat (<10% of slope, c. 439,000 ha; **Fig. 2.3.2**) and suitable for agriculture. Access is relatively good on the eastern side due to numerous existing logging roads, especially in the flatter areas, and from rivers (**Fig. 2.3.12**). Consequently, even areas classified as Forest Lands are likely to come under pressure. Government regulation and enforcement to prevent small-holder encroachment is generally weak and considered a severe political challenge. As such, threats from future unplanned deforestation along roads, especially in lowland areas, are considered high.

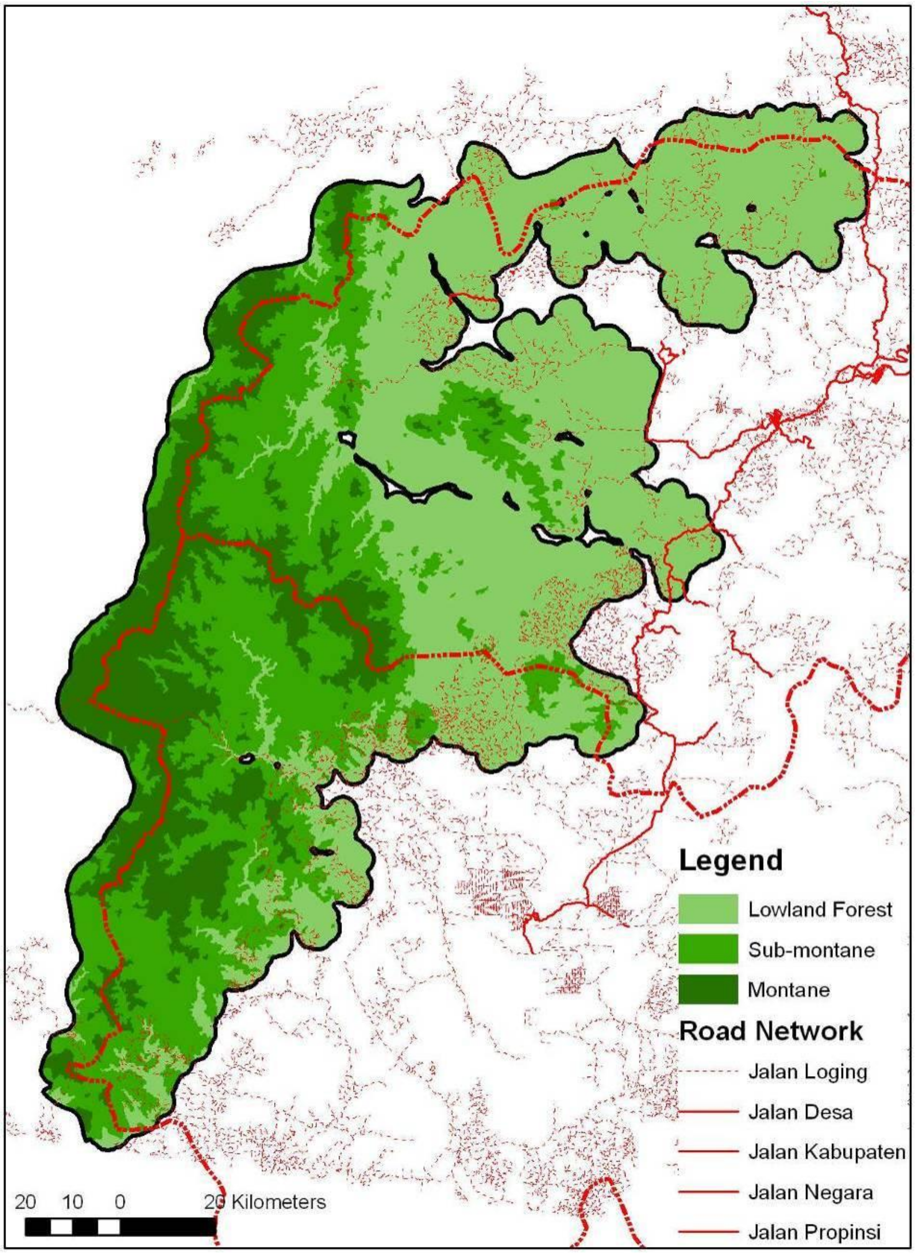


Figure 2.3.12 Existing road network and elevation vegetation zones indicating areas of higher risk for agricultural expansion in Landscape 1 (Hulu Kelai-Telan).

Degradation

Degradation of forest will occur to an extent in HPH. It is especially pronounced in poorly managed ones, and lower in certified timber concessions. Uncontrolled illegal logging can also be a major source of degradation, where access is good via roads, trails, and rivers. In such areas, forest 'thinning' arising from low temperature ground fires caused by small scale shifting cultivation is also a degradation threat.

Degradation mapping of the Berau portion of Landscape 1 was performed by ICRAF (Dewi et *al*. 2010). Approximately 36% of the forested area is logged (c 300,000 ha) over 525,000 ha (62% of the area) is considered to have experienced no logging (Table 2.3.4). Such areas are generally in hills or on mountainous terrain (**Fig. 2.3.13**), with 92% of Sub-montane and Montane areas classified as unlogged. The logged areas will include varying levels of degradation. It is likely that a similar distribution of degradation exists within the Kutai Timur portions of Landscape 1.

Ecological impacts of medium to severe degradation that affect HCVs include

- Altered forest structure and species composition
- Reduced population sizes for numerous Critically Endangered tree species in the Dipterocarpaceae, which are normally targeted for logging
- Reduced soil fertility causing slowing the growth and recovery of disturbed areas
- Increased severity of drought and surface ground temperatures, due to reduced shade and local humidity
- Increased risk of fires especially in comparison to non-degraded forest, which under natural conditions can be highly fire resistant.

Even medium to severely degraded forest can recover if targeted management interventions are applied. The short term economic value of such forest is low, however, providing a strong incentive to convert such forests to either HTI or non-forest agricultural uses. This is another indirect negative impact of degradation.

Table 2.3.4 Degradation class mapping for Berau Regency portions of Landscape 1, using data from ICRAF (Dewi et *al*. 2009).

Class	Area (ha)	% Classified
Highly Degraded	16,850	2
Logged	299,669	36
Unlogged	525,550	62
No Data	24,316	N/A

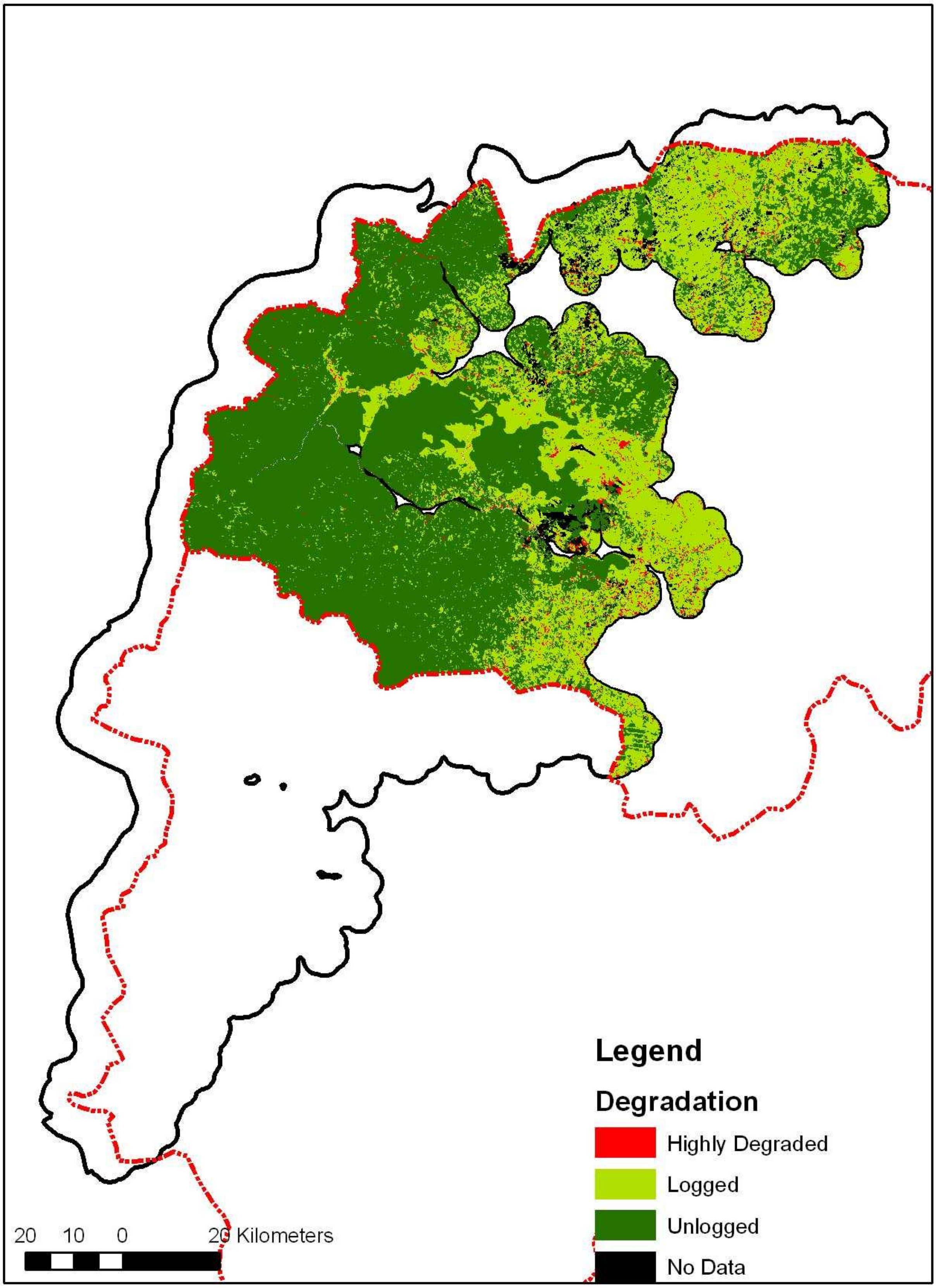


Figure 2.3.13 Forest degradation map (2005 & 2008 composite) in Landscape 1 (Hulu Kelai-Telan), using data from ICRAF (Dewi et *al* 2010).

Fire

There has been a long history of fire in the region with two catastrophic events in recent history, following extended dry periods of the 1982/83 and 1997/98 ENSO events. These two events affected an estimated 2.7 million ha (Schindele *et al.* 1989) and 5.2 million ha (Hoffmann *et al.* 1999), respectively. Much of the forest destroyed during these episodes were contiguous with what is now Landscape 1 in the southern part of the Nyapa-Mangkalihat Mountains and Hills and in the Mahakam Lowlands immediately to the east of the southern half of the landscape (see Chapter 1). At present Landscape 1 has been resistant to large fires but three attributes of Landscape 1 make it potentially combustible during an extended dry season: (i) forest degradation combined with (ii) presence (albeit limited) karst forest and (iii) surface coal seams on its periphery, as indicated in geological maps (**Fig. 2.3.14&Fig. 2.3.15**). The region most at risk is the north-eastern corner where all three of these attributes are concentrated. Fire is a commonly used method of land clearing by small holders (and by irresponsible plantation owners despite laws prohibiting it). When combined with the above factors, this could lead to further catastrophic fires. A majority of the lowland areas of Large Landscape 1 is considered to be at risk for fire given its current condition.

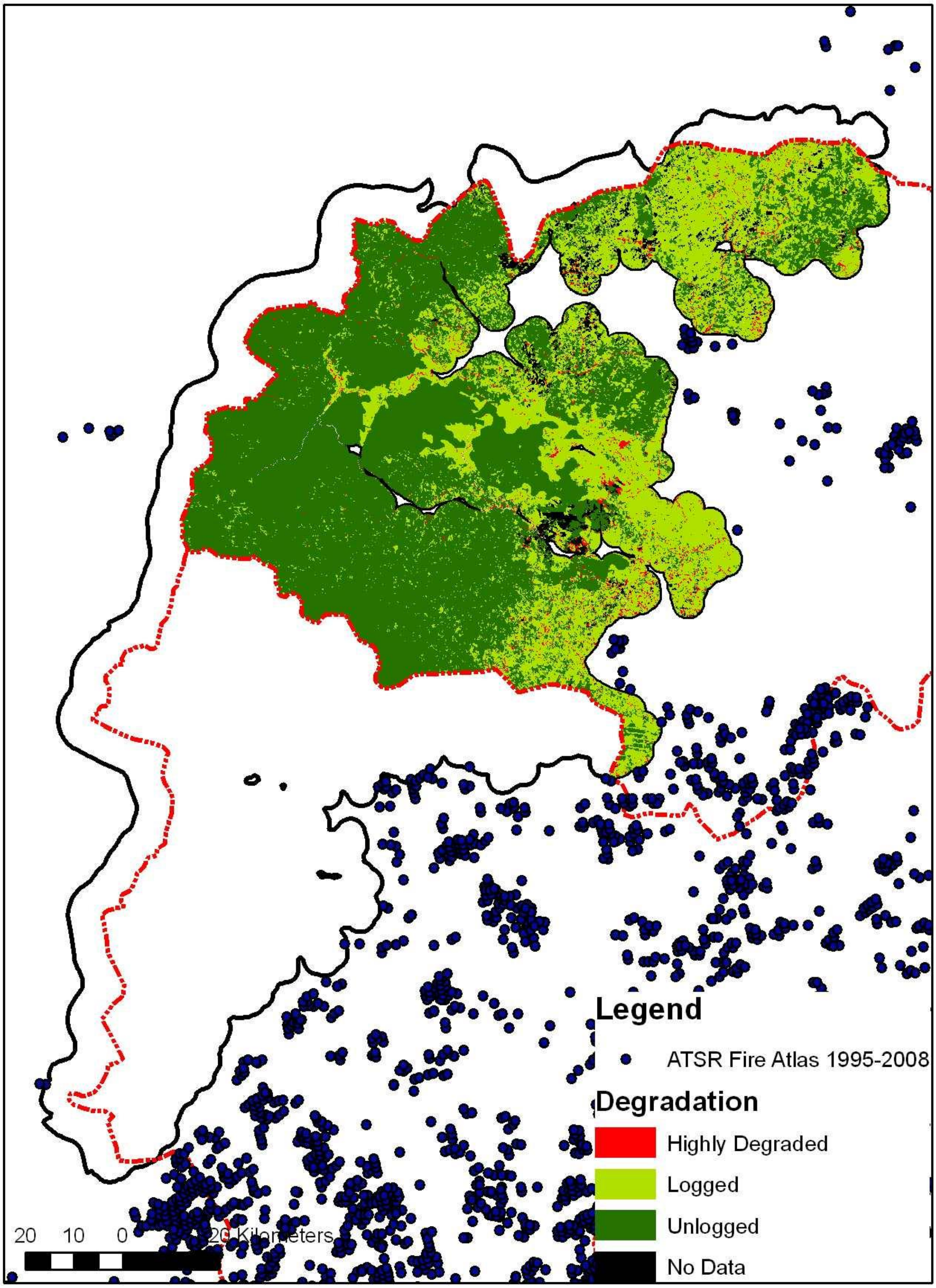


Figure 2.3.14 Fire history (1995-2008) in Landscape 1 (Hulu Kelai-Telan) using ATSR online database.

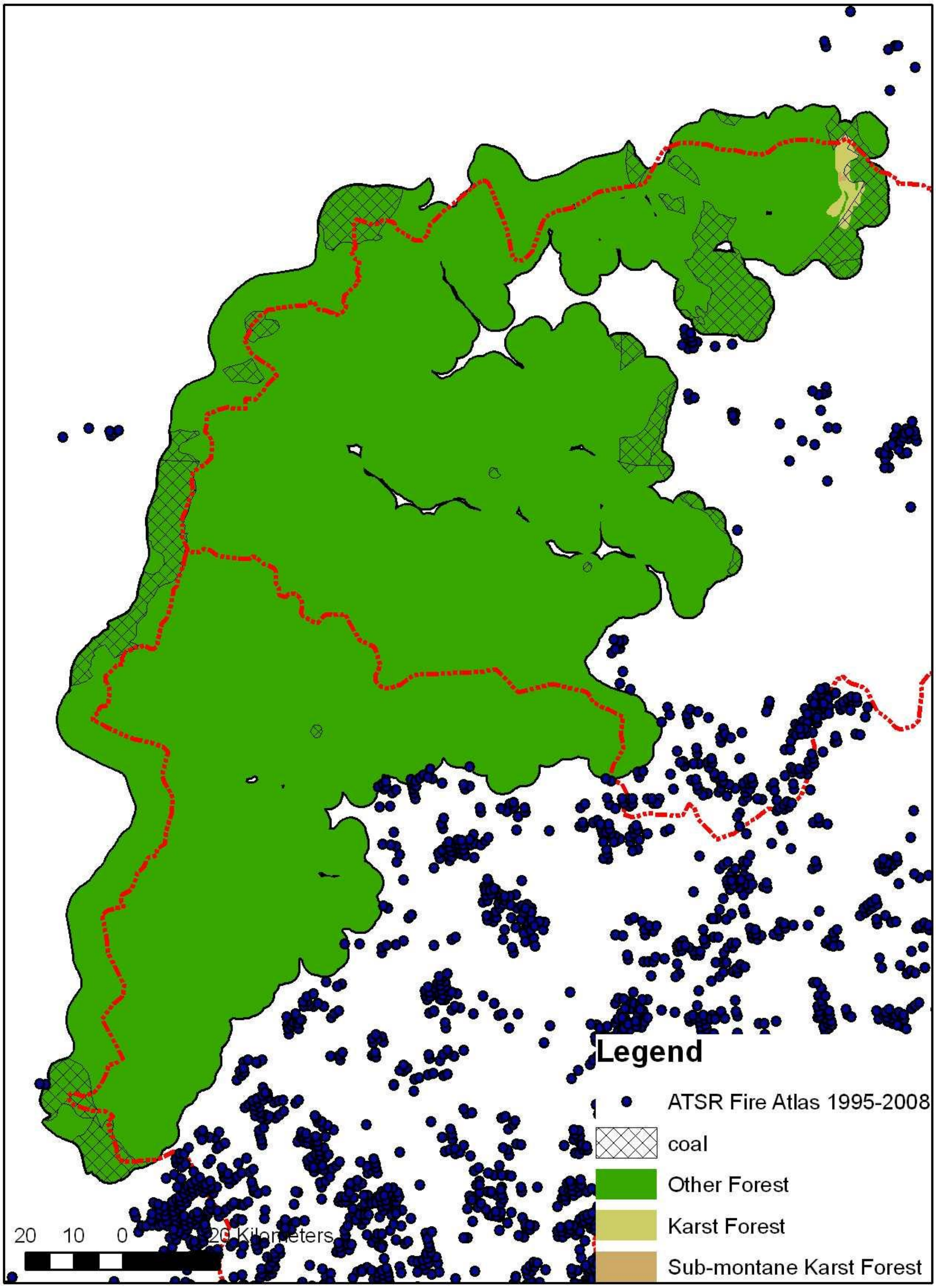


Figure 2.3.15 Map of potential coal seams and known karst areas that under conditions of drought and/or mismanagement may function as sources of ground fire in Landscape 1 (Hulu Kelai-Telan).

2.3.5 Management Recommendations

General Recommendations

As with the other two Large Landscapes described in this report, the HCV management recommendations provided below all carry a potential cost of forgone conventional economic development for Berau and East Kutai Regencies. The Berau Forest Carbon Project (BFCP) currently under development by TNC and partners, however, provides an opportunity for carbon finance through REDD to offset these costs in part or in whole, or even to provide net income streams in excess of conventional alternative land uses (e.g. REDD versus oil palm on high carbon, low productivity soils). Although carbon finance revenues under REDD are generated by avoided GHG emissions, considerable biodiversity co-benefits can be accrued through systematic evaluation of alternative sites where those interventions are undertaken. Results of the landscape HCV mapping exercise described herein can be used to guide such strategic site selection.

Locations of for candidate site interventions that would carry co-benefits of promoting HCV maintenance in Landscape 1 are depicted in **Fig. 2.3.16**.

Rare Ecosystems. For rare HCV 3 ecosystems using the 1% criterion, it is recommended zero loss through conversion be permitted. None of these rare ecosystems are likely to be a target for conversion either because of their inaccessibility, terrain or soil types. These include the **Mon** ecosystem proxy (Montane forest) in the Nyapa-Mangkalihat Mountains and Plains; as well as the **OKI** ecosystem proxy (Forest on rugged karst ridges and mountains), **BTA** (Forest on dissected volcanic cones), and **BRW** (Forest on mountainous sandstone cuestas with dissected dipslopes). However, they may be indirectly threatened by 'removal' from a Core Area, if nearby Buffer Zone areas are cleared, thus making them more susceptible to disturbance and fire. The **OKI** ecosystem proxy in the north-eastern corner is most likely to be threatened, given its proximity to lands currently under development and being prone to fire, followed by the **BRW** ecosystem proxy which already largely exists within the buffer (not Core Area) due to nearby agricultural expansion. The Toolkit provides general management guidelines that up to 20,000 ha of a rare or endangered HCV 3 ecosystem should be maintained within a Core where possible. Given that all the rare ecosystems are less than 20,000 ha in extent, it will therefore be required to maintain these areas in current state.

Endangered Ecosystems. None known to be present

Ecosystem Transitions. The Toolkit recommends that when HCV 2.2 ecosystem transition areas are present within a HCV 2.1 landscape, 10,000 ha of each ecosystem and the transitional area between them should be maintained (total c. 20,000 ha in size). Ideally, this would be located within a Core Area of a large HCV 2.1 landscape, where possible. In Large Landscape 1, the large areas of contiguous altitudinal transition zones could be reduced in extent without violating Toolkits requirements (**Fig. 2.3.16**). However, for the other small HCV 2.2 areas, the management objective should be to maintain them in their entirety, as they are less than or close to 20,000 ha in extent. Those most at risk are the two heath to non-heath forest transition zones and the small altitudinal transition zones in the north-eastern corner of Landscape 1.

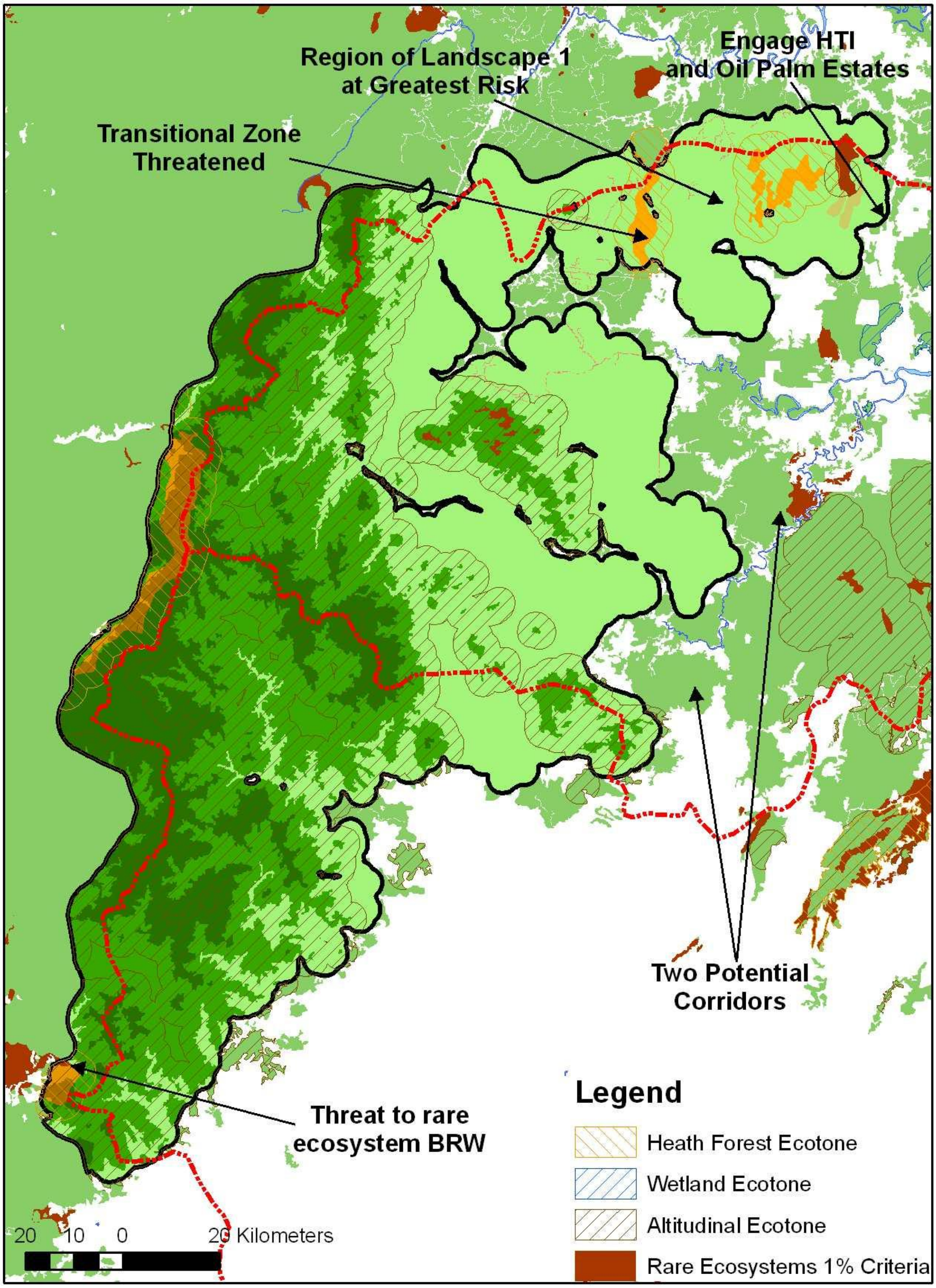


Figure 2.3.16. Possible site interventions recommended for consideration to maintain HCVs in Landscape 1, as discussed in Section 3.4 and below.

Land use planning

The current RTRWP and RTRWK would be greatly improved by differentiating between production forest areas that are considered eligible for conversion to HTI and those that are not. This would enable more strategic planning for HTI development to meet future expected needs or industry targets whilst maintaining HCVs. This would also carry the advantage that pulp and paper companies whose corporate policies require the maintenance of HCVs are not allocated (or do not seek) concessions where large HCV areas have already been identified, and their maintenance within plantation mosaic would be difficult to achieve.

Existing land use plans will fragment Large Landscape 1 into smaller blocks, 11 with Core Areas, two of which would satisfy the HCV 2.1 criterion of >20,000 ha in size. Most of the deforestation and fragmentation would occur along the periphery, however, keeping most of the current Core Area intact. By some interpretations, such fragmentation would be permitted by the Toolkit given the HCV 2.1 requirements alone, but when HCV 2.2 (Ecosystem transitions) is considered as well, current spatial plans would create losses of some parts of HCV 2.2 areas noted above, that must be maintained (**Fig. 2.3.16**). To prevent this loss, spatial plans will require minor modification.

At present, Large Landscapes 1 and 2 maintain tenuous forest connectivity (though insufficient to form a Core as defined under HCV 2.1) that nevertheless provides an important linkage to the Mangkalihat Peninsula (Large Landscape 2). This connectivity is threatened along the Kelai River due to a planned provincial road from Tanjung Redeb to Kelay (**Fig. 2.3.16**). It is recommended that a corridor at least 5 km in width be maintained at either or both of these points to connect Large Landscape 1 and 2. This could be achieved either by maintaining connections between the INHUTANI I Meraang and Hutan Sanggan Labuan Lestari HPHs or between the two divisions of Utama Damai Indah Timber HPH via the proposed protection forest (**Fig. 2.3.16**). The planned road will attract settlers even if the land either side of it is classified as Forest Land. Further consideration must be given to how forest along this road could be maintained. The connectivity of the southern potential corridor is at present threatened by PT Anugrah Agung Prima Abadi Estate that contains some forest required to maintain this connection within its licence area. This company should be engaged as a matter of urgency.

HPH

The nine known active logging concessions within Landscape 1 should be engaged with the following generic recommendations:

1. Those that are not certified through FSC or LEI should be mentored to assist them to improve management practices. This could be encouraged either by direct funding from a REDD program tied to IFM incentives, local tax relief for those that obtain certification or simply by making a persuasive case for cost control benefits through better management.
2. RIL should be practiced.
3. Pilot project silvicultural practices such as TPTJ and especially TPTII should be minimized, especially in hilly terrain and in areas close to the forest edge to avoid potential for increased susceptibility to fire from external sources.
4. Encroachment by small holders into the concession areas should be minimized by developing political support that provides alternative areas for small holder development, support for eviction if required, control of logging roads, and the

development of community based agro-forestry projects to stabilise the forest edge and provide direct benefits to local communities.

5. Concerted effort (including ground surveys) should be made to identify areas that are most severely degraded within these HPH for setting rehabilitation and replanting priorities, preferably with fast growing native species.
6. Site level HCV assessment should be conducted to identify areas of special importance for maintaining HCV 1 and other HCVs not covered in this study.
7. Seek intercompany support to maintain connectivity across HPH borders, control access, and coordinate fire fighting preparations and preventative measures.

HTI

The area of PT Tanjung Redeb Hutani (TRH) fibre concession that lies partly within Landscape 1 should be a priority for management interventions. The concession does not pose a direct threat to HCV 2.1, HCV 2.2 and HCV 3 areas, and could potentially serve a beneficial long term management purpose for Landscape 1 by acting as an additional buffer to stabilize the forest edge and control fire risks. This form of benefit could be optimised by engaging all HTI concessions neighbouring this landscape (beginning with TRH) and encouraging them to undertake HCV assessments within their own concessions (or where applicable use the results provided here) to assist in the implementation of MoF required Makro and Mikro Delineation of conservation zones and management plans.

Oil Palm Estates

In conjunction with a revision of the proposed RTRWP as outlined above, the planned oil palm estates in the vicinity of Landscape 1 should be engaged. As with HTI, oil palm plantations have the potential to stabilize forest edges if they provide meaningful benefits to local communities and restrict access to the forest, at least for commercial scale timber extraction and excessive hunting. Better managed estates tend to be run by companies working towards RSPO certification. Effort should be made to determine first if the one existing oil palm company near Landscape 1 (PT Anugrah Agung Prima Abadi) is an RSPO member and if not then encourage them to join the RSPO and work actively toward certification, first by respecting and protecting their borders with Landscape 1. When the new RTRWP is approved, the lands that become allocated for non-Forestry purposes are likely to be allocated to Oil Palm estates. At this time, a careful watch over new applications should be maintained, and TNC and partners should engage those companies that pose risk to Landscape 1. In the short term, PT Anugrah Agung Prima Abadi should be engaged as a matter of urgency, given that it contains some forest within its licence area required to maintain a potential corridor between Large Landscapes 1 & 2.

2.4. HCV 2.1 - Large Landscape 2 - Mangkalihat Peninsula

Figure 2.4.1. Large Landscape 2 – Mangkalihat Peninsula.

2.4.1 General Description

Large Landscape 2 covers 660,500 ha, with a Core Area (>3 km from forest edge) of c. 400,000 ha in size. Also known as the Sangkulirang Peninsula, the area has been recognized previously for its exceptional biodiversity conservation value (Moore et *al*. 2006, Birdlife 2010), and was a focus of scientific expeditions by TNC in 2005 (Salas 2005). Salas (2005) found high levels of diversity and endemism within and around the karst massifs amongst fish, snails, bats and cave arthropods surveyed.

Physiographic Regions

Large Landscape 2 lies almost entirely within the Nyapa-Mangkalihat Mountains and Plains Region (c. 657,000 ha), with a small fraction in the Northern Lowlands (c. 3,500 ha). The Landscape spans the Regency borders of Berau and East Kutai along its full length, but falls primarily within Berau.

Past and Present Forest Cover

The area delineated as Large Landscape 2 today was in c.1975 part of a 'Super Landscape' that covered much of East Kalimantan, as shown in**Fig.2.2.1**. The current landscape unit of c. 660,500 ha is separated (fragmented) from Large Landscape 1 as a result of forest clearance along the Kelai River and its tributaries, and from Landscape 3 by clearance of forest in the vicinity of Tanjung Redeb and the flat low lying areas between Landscape 1 and the coast to the north (**Fig. 2.4.1**).

Land Use Types

The provincial land use plan (RTRWP) for East Kalimantan distinguishes areas considered as protection forest, production forest (logging or HTI), and areas that may be used for non-forest uses such agriculture (e.g. oil palm) or other purposes. The sum of protected and production forest areas represents the total official extent of Forest Land, with forest areas outside this considered at risk for conversion to non-forest uses. According to RTRWP 1999, land use within Landscape 2 is 86% Forest Lands, of which c. 109,000 ha is protected forest, c. 460,000 is production forest, and 14% (c. 92,000 ha) is classified as non-forest lands (Table 2.4.1). The proposed RTRWP v.2008 marginally reduces the total amount of Forest Land from 86% to 84%, reducing production forest from c. 460,000 to 363,000 ha, but increasing protected forest from c. 109,000 to 190,000 ha.

Slope and Altitudinal Distribution of Forest

More than half (55%) of Landscape 2 is flat to undulating (0-10% slope), with the remaining area becoming hilly and in parts mountainous. The hilly areas tend to be concentrated in the northwest and the southeast (**Fig. 2.4.2**), where Sub-montane and montane zones are also concentrated (**Fig. 2.4.3**). More than 89% of the area, however, is below 500m, with only 10% considered Sub-montane (500-1000m) and 1% montane (>1000m).

Major Forest Types

The major forest types considered present within Landscape 2 are mangrove, heath forest, karst forest, lowland forest on well-drained soils, sub-montane, and montane forest (**Fig. 2.4.4**). Peat swamp forest appears not to be present in Landscape 2. See Section 2.1.4 for more detailed description of major forest types.

The Mangkalihat Peninsula supports the most extensive area of limestone on Borneo, covering c. 206,000 ha. Of this, c. 168,000 ha are lowland (<500m), 38000 ha are Sub-montane and c. 450 ha are montane. Most of the karst areas not previously destroyed by fires in the area occur within the Core Area of Landscape 2, accounting for 31% of its extent (c. 125,000 ha), most of which is lowland.

Heath forest covers an estimated 1,418 ha, in two separate localities in the central south.

Mangrove is present, covering only 8 ha of Landscape 2 as delineated. This mangrove area within Landscape 2, however, is part of and contiguous with a larger area of mangrove toward to coastline (which was excluded from the buffer of Landscape 2 based on shape features).

Forest on well-drained mineral soils (excluding forest on limestone), span lowland to montane vegetation zones, including c. 417500 ha of lowlands (<500 m) on a variety of soil and geology types, c. 30470 ha of Sub-montane vegetation and c. 1200 ha of montane areas (>1000m).

Table 2.4.1. Major forest types in Large Landscape 2 and their land use status under current (1999) and proposed future (version 2008) provincial land use plans (RTRWP) for East Kalimantan.

Major Ecosystem Types	Area	RTRWP 1999			Proposed RTRWP v2008			RePPProT Classes
		Protected	Production Forest	Other	Protected	Production Forest	Other	
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	
Lowlands (<500m)								
Karst Forest	168,230	24,303	110,536	33,390	45,959	98,486	23,785	GBJ, OKI
Heath Forest	1,418		1,206	212		1,206	212	MTL
Peat Swamp Forest	0							
Mangrove	8		2	6		2	6	KJP
Other Lowland Forest	417,511	50,325	311,755	55,430	81,642	254,203	81,666	BKN, BTA, KPR, LHI, LPN, LWW, MPT, PDH, TWB, TWH
Non-Forest	3,142	516	2,366	259	578	2,056	508	
Total	**590,308**	**75,144**	**425,865**	**89,299**	**128,179**	**355,952**	**106,177**	
Sub-Montane								
Karst Forest	37,997	13,769	23,157	1,071	34,447	3,293	257	GBJ, OKI
Heath Forest								
Peat Swamp Forest								
Other Sub-Montane Forest	30,470	18,377	10,831	1,263	26,217	3,511	742	BTA, KPR, LWW, MPT, PDH, TWH
Non-Forest	50							
Total	**68,517**	**32,146**	**33,988**	**2,333**	**60,664**	**6,804**	**999**	
Montane								
Karst Forest	455	455			455			OKI
Heath Forest	0							
Peat Swamp Forest	0							
Other Montane Forest	1,209	1,103	106		1,209			PDH, MPT
Non-Forest	0							
Total	**1,664**	**1,558**	**106**	**0**	**1,664**	**0**	**0**	
Water Bodies	**29**			**29**			**29**	
	660,518	**108,848**	**459,959**	**91,661**	**190,507**	**362,756**	**107,205**	

Table 2.4.2. Slope classes of Large Landscape 2, Mangkalihat Peninsula.

Slope Class %	% of Area
0-10	55
10-15	15
15-20	10
20-40	17
>40	4
	100

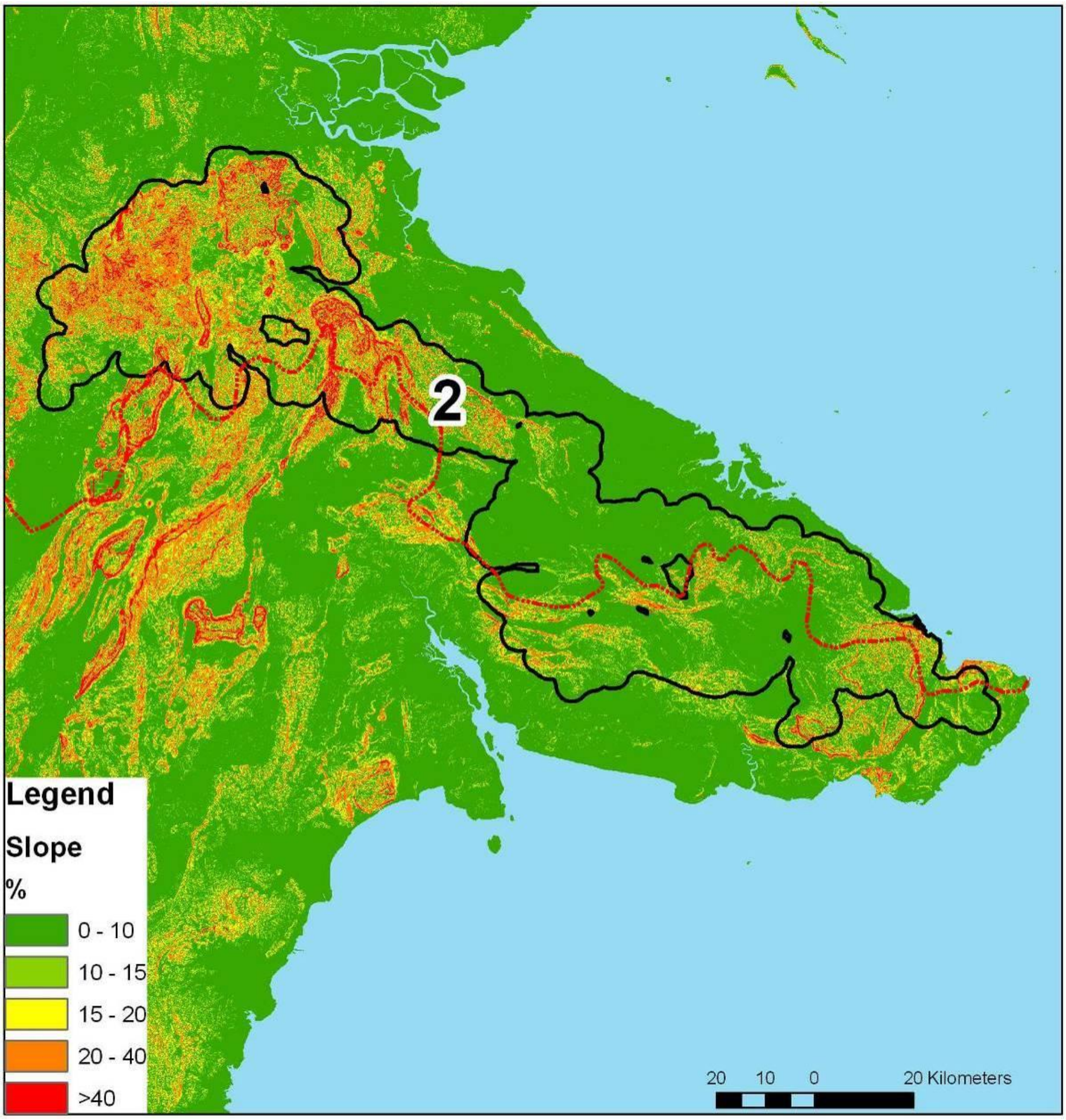


Figure 2.4.2 Map of slope classes within Large Landscape 2, Mangkalihat Peninsula.

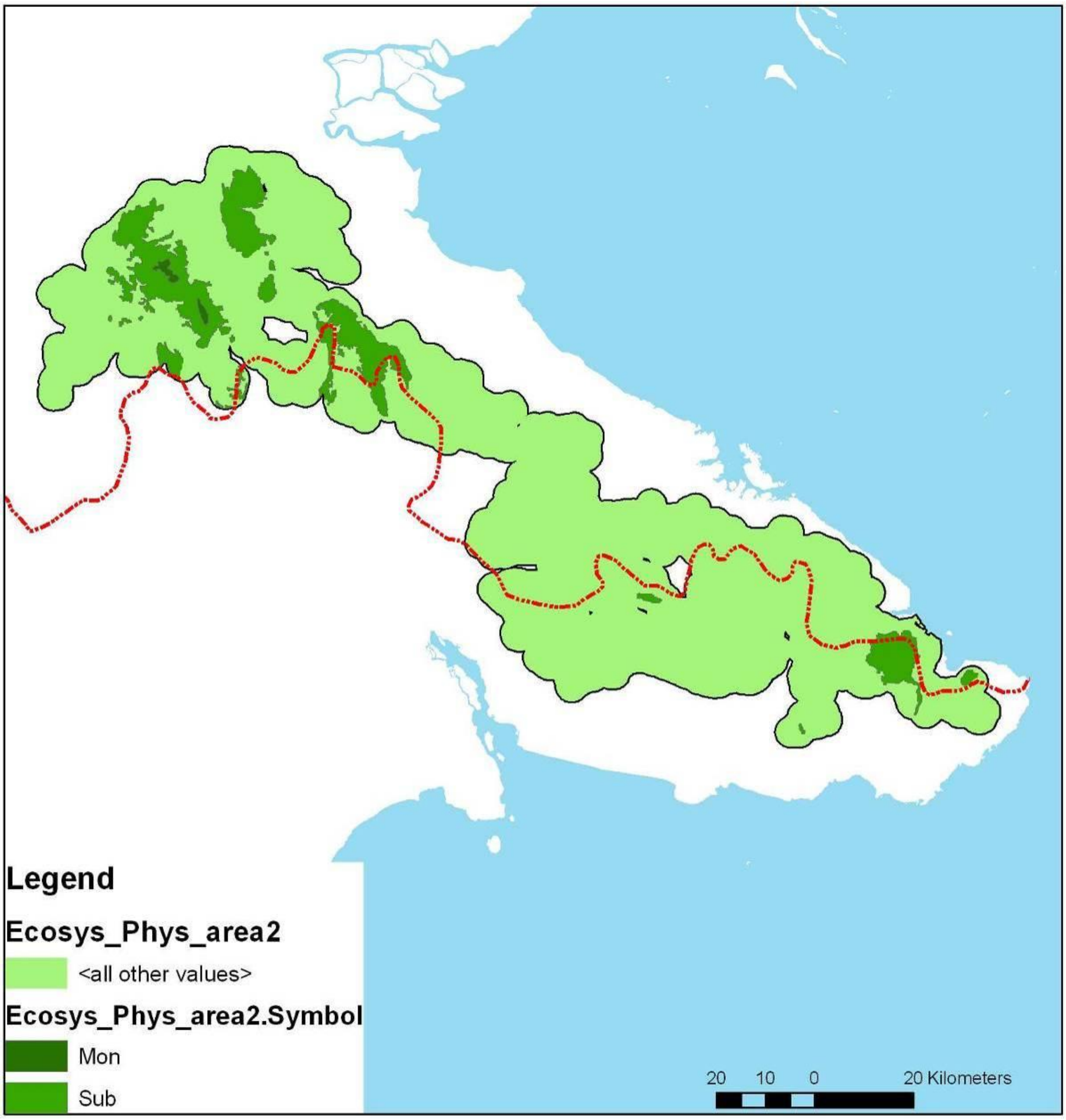


Figure 2.4.3 Map of lowland, Sub-montane and Montane vegetation zones of Large Landscape 2, Mangkalihat Peninsula.

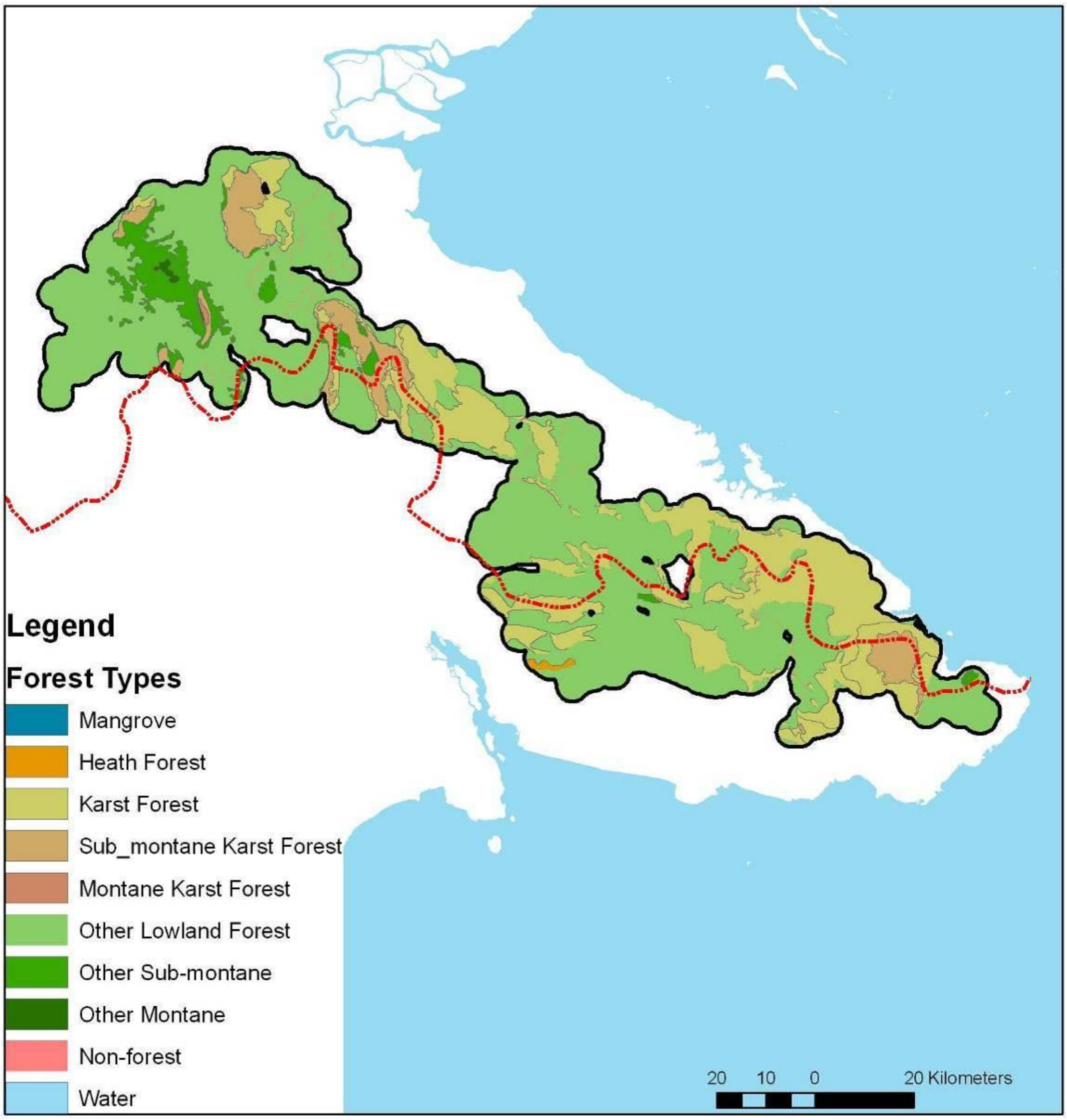


Figure 2.4.4 Map of major ecosystem types present in Large Landscape 2, Mangkalihat Peninsula.

2.4.2 Description of HCV 2.2 - Areas Containing Two or More Contiguous Ecosystems

Three different HCV 2.2 zones of transition among ecosystem types described in the Toolkit are present within Landscape 2:

1. Ecoclines spanning vegetation types distributed along elevational gradients, including lowland, Sub-montane and/or montane areas
2. Wetlands and non-wetlands
3. Kerangas and non-kerangas forest areas

Large Landscape 2 rises from sea level to over 1000m, supporting containing at least five areas of ecoclinal transition from lowland to montane areas (**Fig. 2.4.5**). Three very large such areas are concentrated in the western portion, two of which also include montane karst forests. A small area of transition from lowland to Sub-montane occurs in the central section. In the east is an exceptional zone of HCV 2.2 ecoclinal transition, spanning mangrove swamp, through lowland karst forest up to montane forest. In modern day Kalimantan, such a ‘reefs to ridges’ connectivity is rare to find in a single contiguous block of forest.

As noted above, small areas of heath forest are also found in Landscape 2. Where present, heath forest is contiguous with non-heath lowland forest on mineral soils (**Fig. 2.4.5**), which the Toolkit also distinguishes as HCV 2.2.

Transitions between karst and other non-karst forest types are not included within the Toolkit as an HCV 2.2 transition. Yet, there may also be important ecological reasons for maintaining connectivity between karst and non-karst forest types, which at present are not considered HCV. In the present case, the elevational transitions present in Landscape 2 overlap with most transitions between karst and non-karst, which effectively gives many of these karst to non-karst transitions HCV 2.2 treatment.

To map HCV 2.2 areas, a 3 km buffer either side of the transition boundary was used, as described by the modified RePPProT ecosystem proxy map (**Fig. 2.4.5**). This is considered a conservative estimate of distance required for most normal ecological processes to be maintained at that interface (e.g. vertebrate foraging patterns across habitat boundaries).

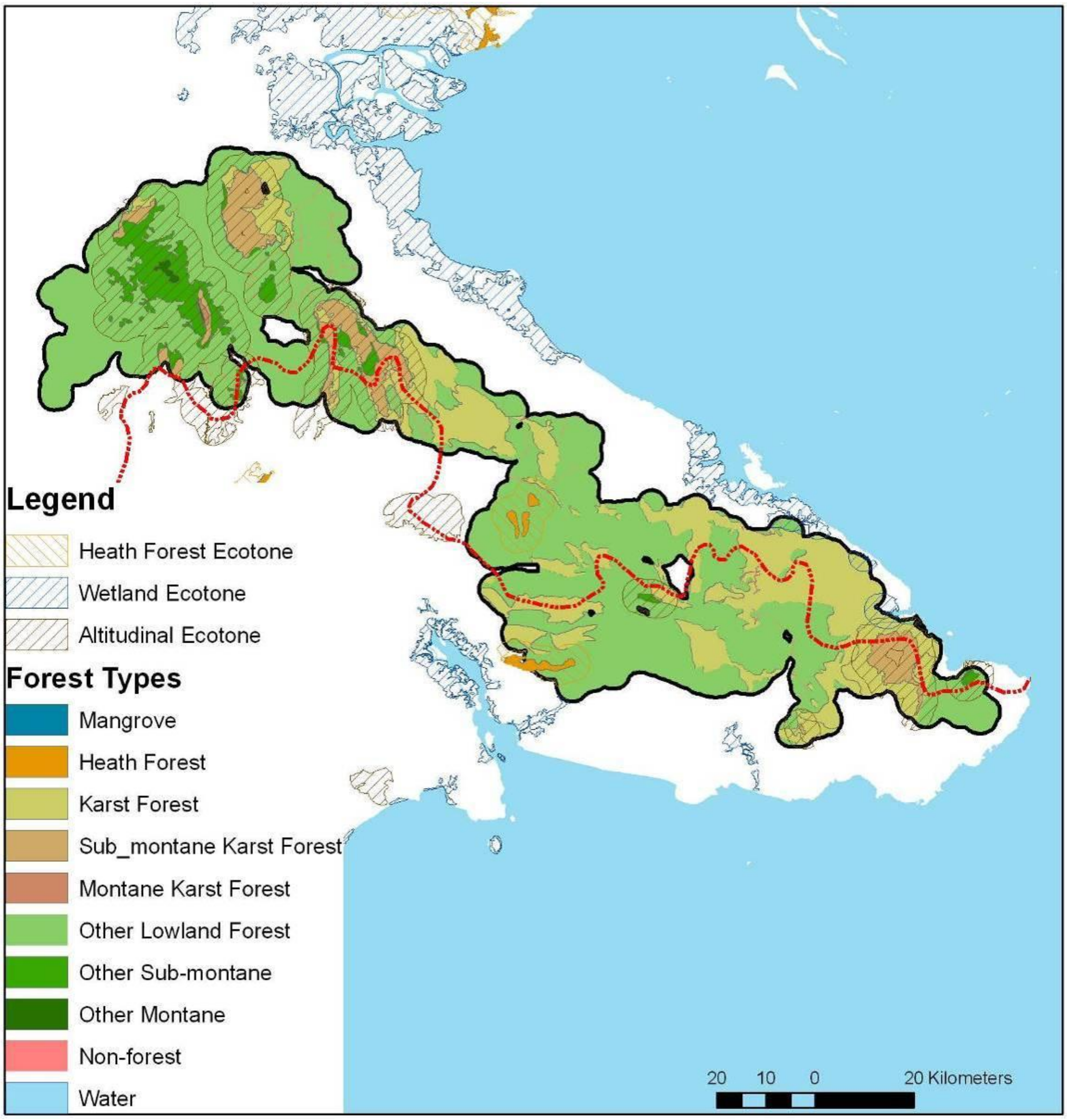


Figure 2.4.5 Zones of ecosystem transition (HCV 2.2) in Large Landscape 2, Mangkalihat Peninsula.

2.4.3 Description of HCV 3 - Rare and Endangered Ecosystems

Rare Ecosystems

Within Large Landscape 2, a total of eight rare ecosystems are present, based on the 1% criterion (Table 2.4.3; **Fig. 2.4.6**). Individually these range in extent from 79 to c. 13000 ha. Together they cover c. 16500 ha of the Landscape (c. 2.5%).

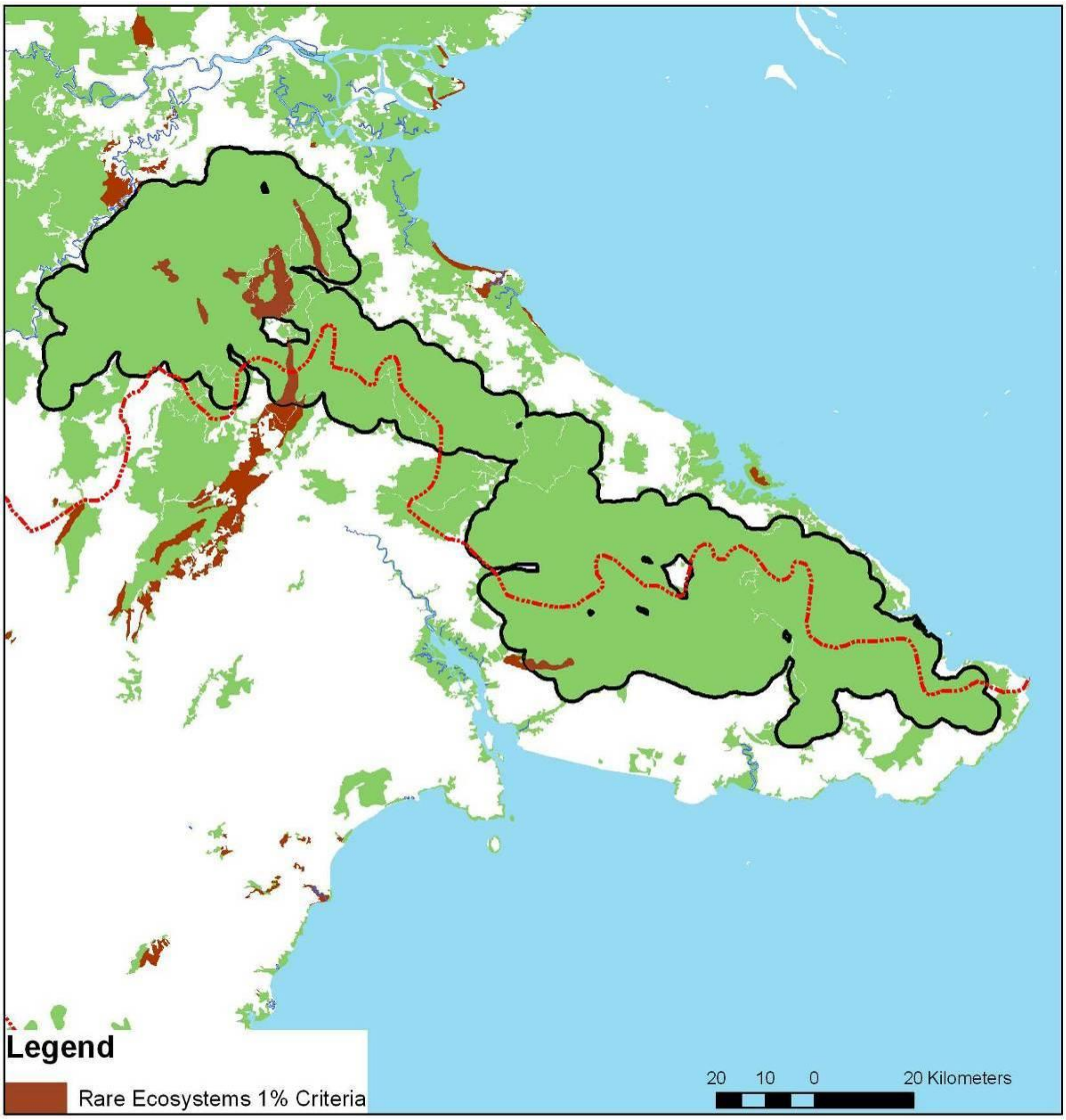


Figure 2.4.6. Map of Rare ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula.

These are mainly found in the north-western part of the Landscape, except the **MTL** ecosystem (Forest on linear sedimentary ridges), which occurs in the south (**Fig. 2.4.6**). Significantly, 100% of the very rare LPN (Forest on eroded mountainous stratovolcanoes) and nearly 100% of **BTA** (Forest on dissected volcanic cones) are contained within this Landscape. A majority of **MTL** and nearly half of **LHI** (Steep long-sided narrow ridges) are also within this Landscape. Almost all of the ecosystem proxies are within legally defined Forest Areas (i.e. non-conversion), with the majority of **BTA** and all of **Mon** (Montane forest) in Protection Forest, and the majority of other classes in Production Forest.

Table 2.4.3. Rare ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula.

Ecosystem Proxies	Description	Total Extant Remaining in Physiographic Region (ha)	Total in Landscape Region 2 (ha)	% of Total Extant	Status Per Proposed RTRWP v2008		
					Protected (ha)	Production (ha)	Other (ha)
Northern Lowlands							
BKN	Minor valley floors within hills	1356	43	3	15	1	27
Nyapa-Mangkalihat Mountains & Plains							
BKN	Minor valley floors within hills	79	21	27		21	
TWB	Hillocky sedimentary plains with steep parallel ridges	13320	8	0		8	
BTA	Dissected volcanic cones	7700	7668	100	7409	259	
LHI	Steep long-sided narrow ridges	4971	2243	45		2243	
LPN	Eroded mountainous stratovolcanoes	809	809	100		809	
MTL	Linear sedimentary ridge systems with steep dipslopes	2315	1418	61		1206	212
Mon	Montain	6379	1664	26	1664		
TWB	Hillocky sedimentary plains with steep parallel ridges	12608	2642	21	482	2160	
			16516				

Endangered due to current forest loss

Three ecosystem proxies are identified as currently Endangered due to >50% loss of past extent since c. 1975 (Table 2.4.4; **Fig. 2.4.7**). These include **BKN** (Forest on minor valley floors within hills), **KPR** (Forest on undulating karstic plains with hums) and **LHI** (Forest on steep long-sided narrow ridges).

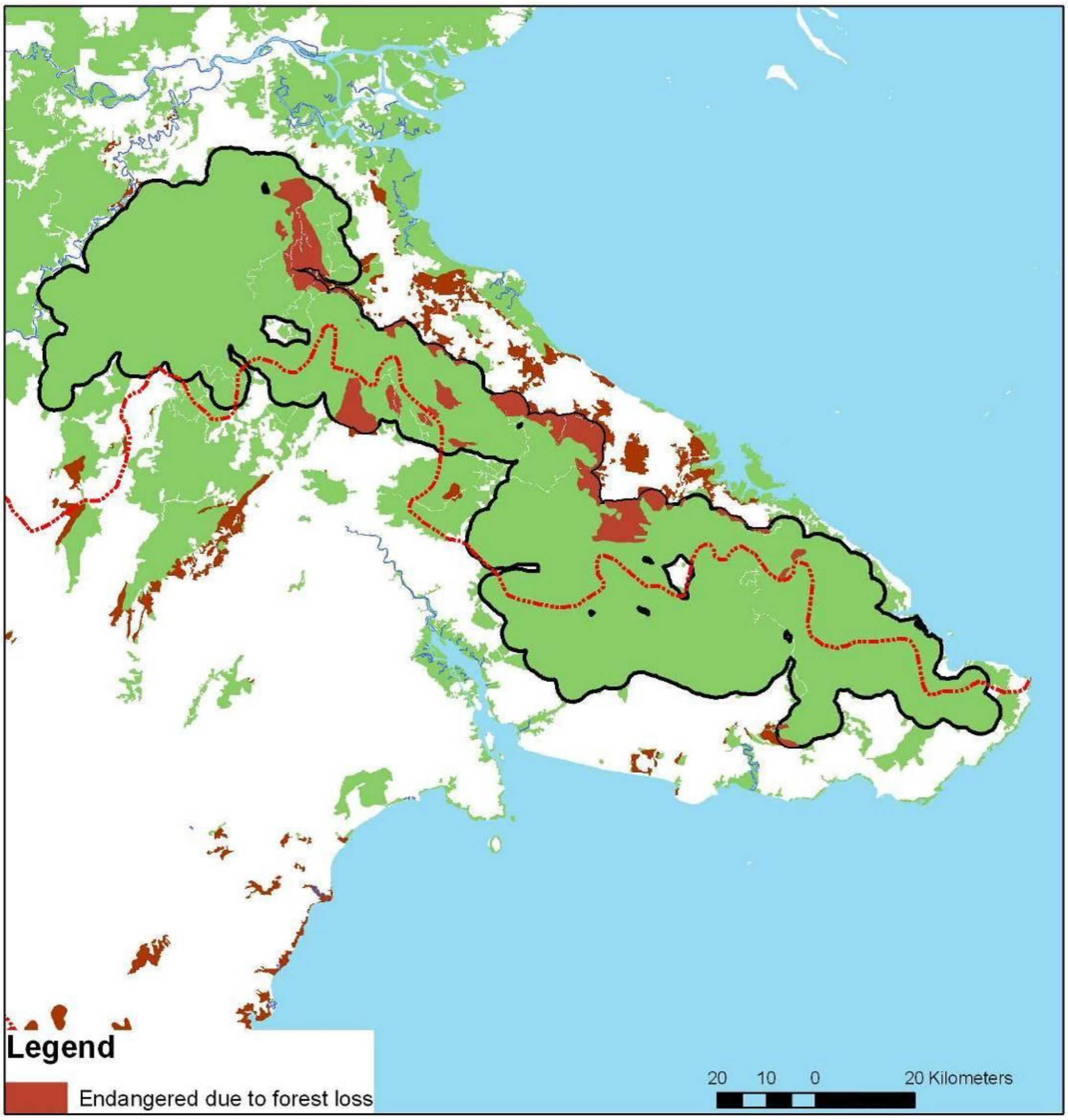


Figure 2.4.7 Map of Endangered ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula, based on the current loss criterion of HCV 3, i.e. <50% of the original extent remains.

BKN has lost 73% of its past extent in the Northern Lowlands Biophysiographic region, and is expected to lose 95% according to the proposed RTRWP, rendering it likely to become critically Endangered (i.e. <10% of its original extent). The extent of **BKN** remaining is very small (43 ha), although through detailed mapping of the region maybe more of this ecosystem could be identified. **KPR** is the Endangered ecosystem of greatest extent with 43,564 ha remaining, representing 55% of the total remaining area of this ecosystem within the Nyapa-Mangkalihat Mountains & Plains. Future loss is expected to rise to 70%, although this could be far greater if plans for HTI development within Landscape 2 are carried out (see below, Industrial Timber Estates, HTI). **LHI** has declined in extent by 80% compared to the past, and covers a relatively small area today of 2243 ha in Landscape 2. This amounts to 45% of the total remaining area of this ecosystem in the Nyapa-Mangkalihat Mountains & Plains. **LHI**, also a rare ecosystem (see above), is not expected to decline any further from planned conversion to non-forest in the RTRWP, but like **KPR** is also threatened by proposed HTI (see below).

Table 2.4.4 Endangered ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula, based on current forest loss criterion, i.e. <50% of the original extent remains.

Ecosystem Proxies	Description	Total Extant Remaining in Physiographic Region (ha)	Total in Landscape Region 2 (ha)	% of Total Extant	% Loss since C.1975	% Expected loss	Status Per Proposed RTRWP v2008 Protected (ha)	Production (ha)	Other (ha)	Management Level per Table 1.1
Northern Lowlands										
BKN	Minor valley floors within hills	1,356	43	3	73	95	15	1	27	**3**
Nyapa-Mangkalihat Mountains & Plains										
KPR	Undulating karstic plains with hums	79,425	43,564	55	52	70	3,916	31,411	8,237	**2**
LHI	Steep long-sided narrow ridges	4,971	2,243	45	80	80	0	2,243	0	**2**
			45,851							

Endangered due to planned deforestation from RTRWP

All ecosystems within Landscape 2 that meet the criteria for Endangered (HCV 3) as a result of future expected deforestation causing a decline of >75% of past extent are already considered Endangered based on the current loss criterion of >50% (Table 2.4.5: **Fig. 2.4.8**). **BKN** under the proposed RTRWP is expected to lose 95% of its past extent c. 1975 (making it Critically Endangered), and **LHI** will lose 80%.

Figure 2.4.8 Map of Endangered ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula, based on the future expected loss criterion of HCV 3, i.e. <75% of the original extent is expected to remain given current land use plans.

Table 2.4.1 Endangered ecosystems (HCV 3) in Large Landscape 2, Mangkalihat Peninsula, based on the future expected loss criterion of HCV 3, i.e. <75% of the original extent is expected to remain given current land use plans.

Ecosystem Proxies	Description	Total Extant Remaining in Physiographic Region (ha)	Total in Landscape Region 2 (ha)	% of Total Extant	% Loss since C.1975	% Expected loss	Status Per Proposed RTRWP v2008: Protected (ha)	Production (ha)	Other (ha)	Management Level per Table 1.1
Northern Lowlands										
BKN	Minor valley floors within hills	1,356	43	3	73	95	15	1	27	**3**
Nyapa-Mangkalihat Mountains & Plains										
LHI	Steep long-sided narrow ridges	4,971	2,243	45	80	80	0	2,243	0	**2**
			2,286							

2.4.4 Threats

This section provides a sketch of planned and/or unplanned deforestation or degradation that threatens persistence of the HCVs in Landscape 2.

Spatial Plans

The proposed RTRWP v2008 threatens to fragment Landscape 2 into 13 smaller fragments with core areas, two of which will remain greater than 20000 ha (the criterion for HCV 2.1): one in the northwest (c. 133000 ha) and the other in the southeast (c. 95000 ha) (**Fig. 2.4.9**). In addition to fragmentation of the now contiguous Landscape 2, large areas of currently endangered ecosystems (HCV 3) contained within the current Core Area and Buffer of will either (i) be lost from planned deforestation, or (ii) no longer exist within a Core (the management objective to preserve ecological buffering for this value, as defined in the Toolkit). A similar situation will result for a number of Ecosystem Transition zones currently mapped as HCV 2.2 (**Fig.2.4.10**).

The RTRWP v2008 also threatens the limited remaining connectivity between Large Landscape 1 & 2 with a plan to convert now forested lands along the Kelai River and the development of a road to connect Kecamatan Kele and Tanjung Redeb. The RTRWP delineates a 500m buffer either side of the road as non-Forest lands that for much wildlife would likely function as a barrier were it brought under intensive agriculture.

As noted above in discussions of Landscape 1, Industrial Timber Estates (HTI) are often but not exclusively planned for production forest that has become exhausted of its commercial timber. Any Forest Area, with the exception of protected forest, could thus become targeted for HTI development by the MoF. As discussed in greater detail above, we recommend producing a variation of the currently proposed spatial plans for East Kalimantan Province and the Regencies to delineate those Forest Areas eligible for HTI, and those that are not. This would greatly assist in assessing threats and planning for maintaining HCVs and other conservation targets.

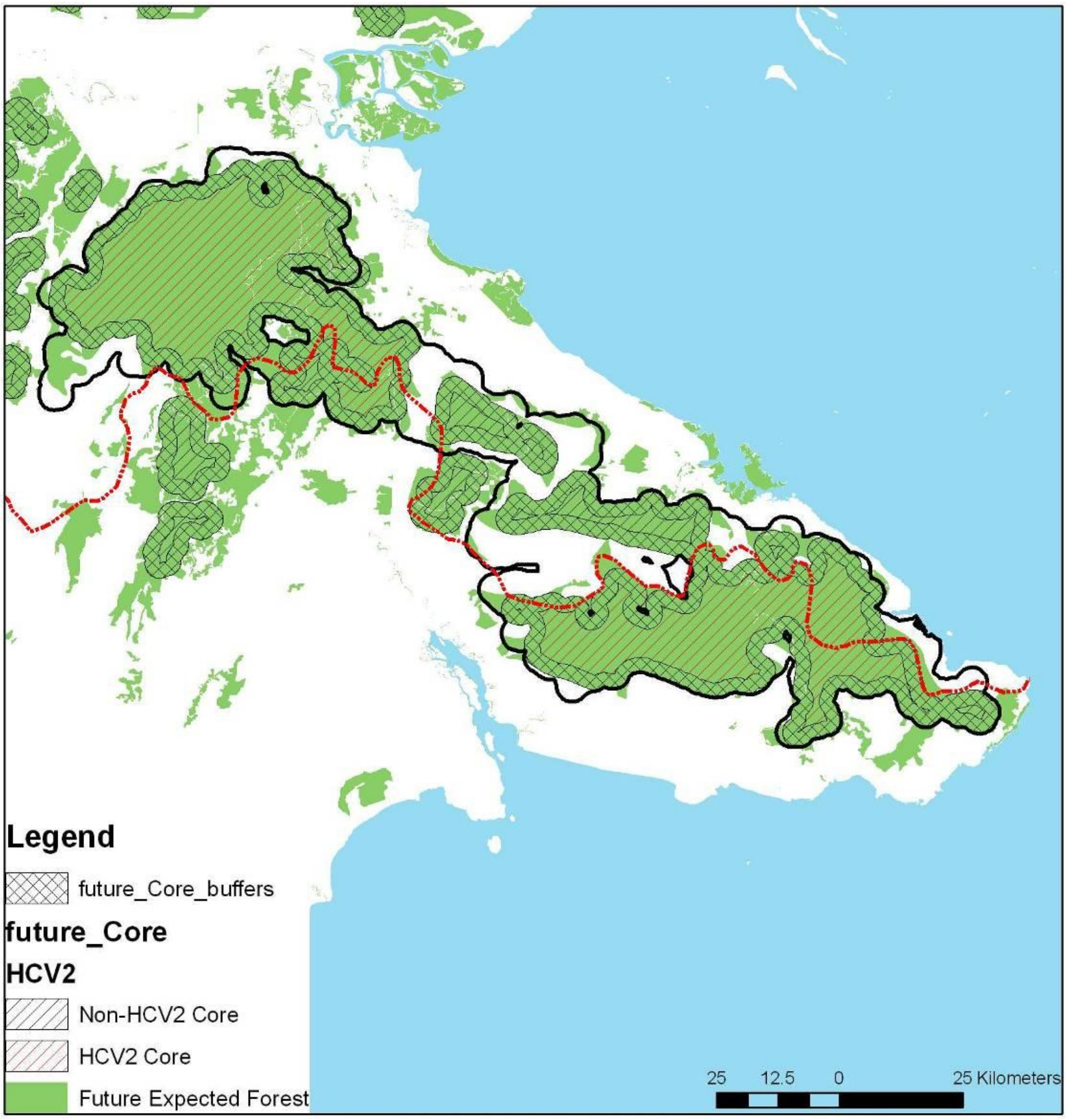


Figure 2.4.9 Future projected fragmentation of Large Landscape 2, resulting from planned deforestation under RTRWP ver2008.

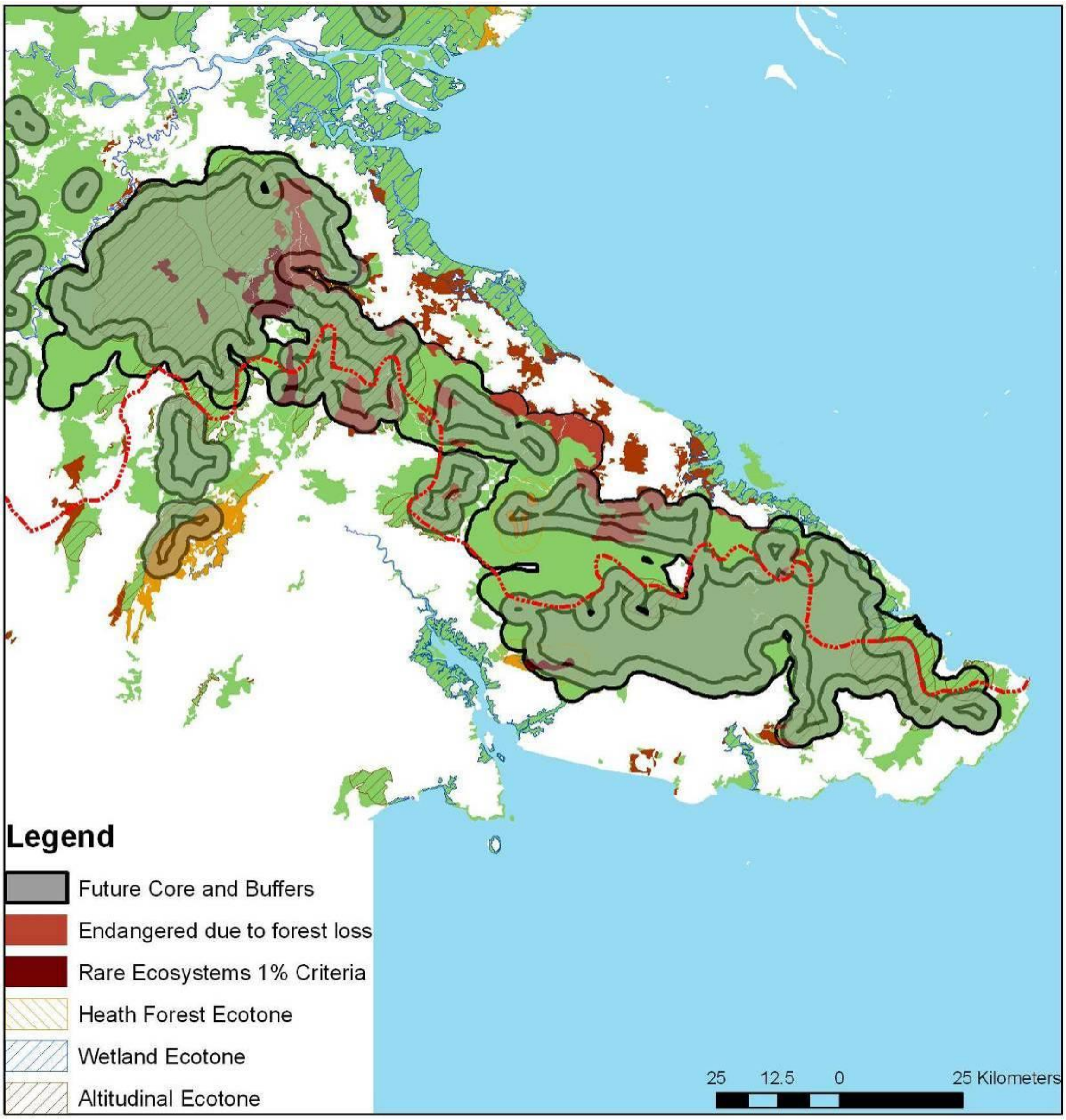


Figure 2.4.10 Future projected fragmentation of Large Landscape 2, and consequent elimination of Ecosystem Transition Zones, resulting from planned deforestation under RTRWP ver 2008.

Oil Palm

Oil palm development can occur in areas classified as Non-forest lands per the RTRWP and TGHK. It is one of the most likely drivers of forest cover change in areas of Landscape 2 that are legally permitted for conversion.

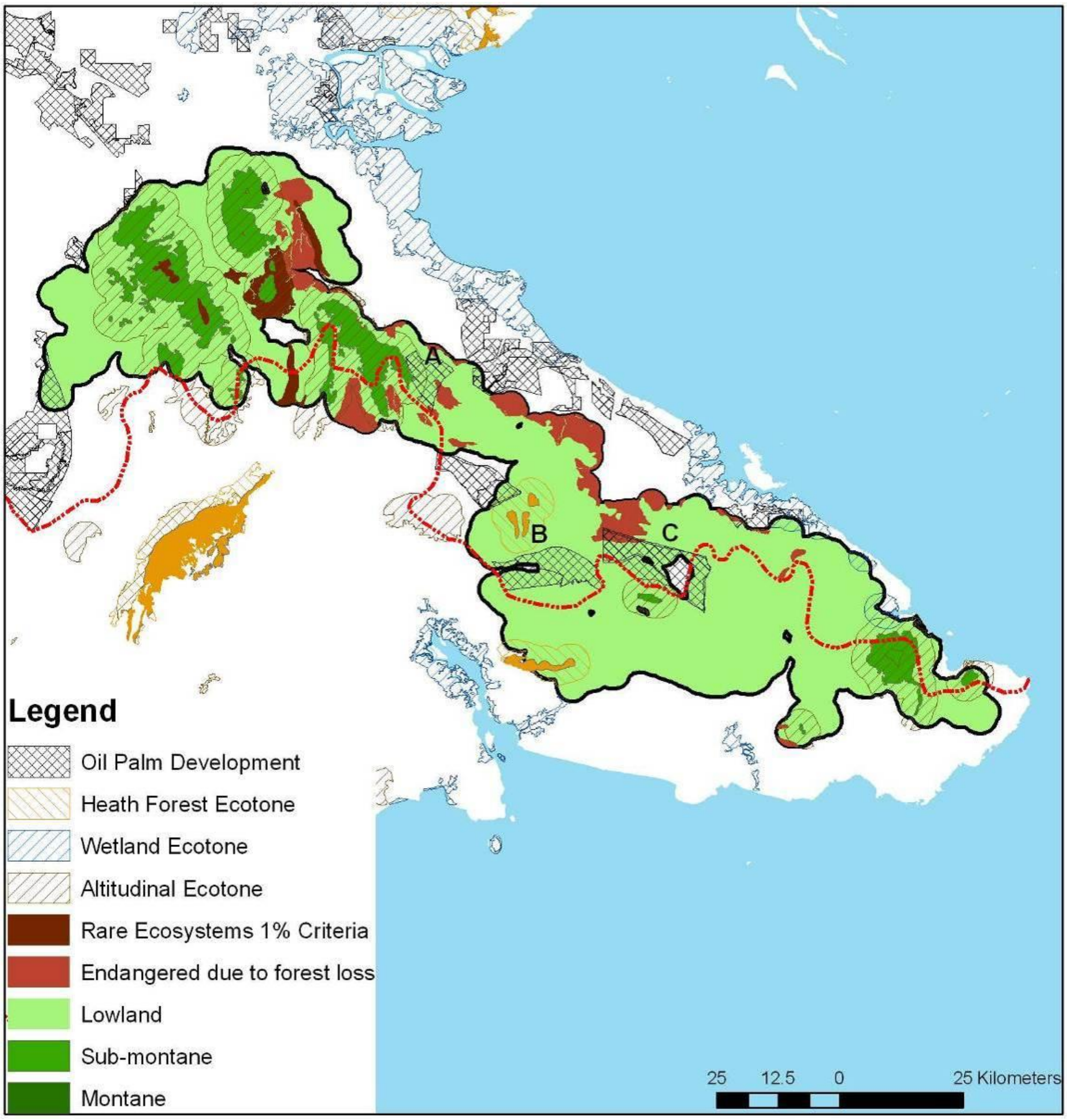


Figure 2.4.11 Planned oil palm development (A-C) in Large Landscape 2 (Mangkalihat Peninsula) and its overlap with mapped HCV 2.2 and HCV 3 areas.

A number of oil palm licences have already been issued within and near Landscape 2 (**Fig. 2.4.11**). Three of these -- licence areas A, B and C -- pose the greatest threat to HCV maintenance within Landscape 2, as they will effectively fragment the Landscape.

From examination of Landsat 7 imagery (28/08/2009), license areas B and C appear to have already started development, but A as yet shows no sign of forest clearance. These estates either directly threaten parts of endangered HCV 3 ecosystems (estate C) or reduce the amount of such ecosystems that will remain contained within a Core Area of the Landscape.

In the future if the proposed RTRWP plans are accepted, it is expected that most of the areas reclassified as non-Forest Lands will be converted to Oil Palm.

Industrial Timber Estates (HTI)

As noted above, it is possible for HTI to be developed on any Production Forest area provided a recommendation is obtained from the Bupati and the Ministry of Forestry approves. Conversion of remaining natural forest to a monoculture of fast growing tree crops would potentially further threaten rare and endangered ecosystems (HCV 3), reduce or fragment Core Areas of the existing Landscape (HCV 2.1), and destroy or reduce the effectiveness of current ecotone transitions (HCV 2.2)(**Fig. 2.4.12**).

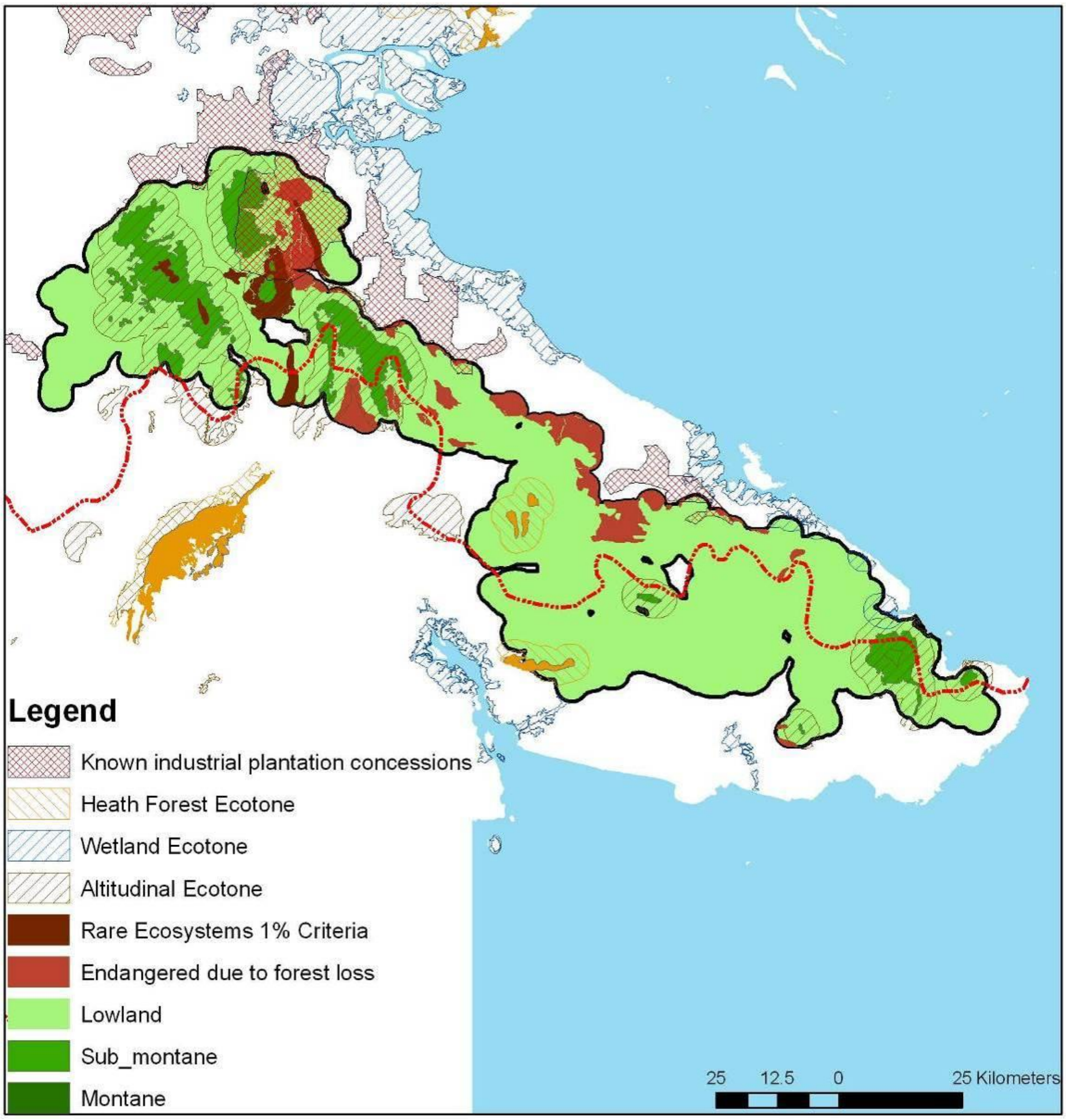


Figure 2.4.12 Known industrial plantation concessions in Large Landscape 2 (Mangkalihat Peninsula) and its overlap with mapped HCV 2.2 and HCV 3 areas.

From the currently known distribution of HTI concessions, c. 40000 ha are planned for development within the Core Area of Landscape 2 in the north-western section. Much of this is hilly or mountainous, suggesting it may be unsuitable for HTI, creating problems for timber extraction, erosion prevention and access roads. The flatter areas of this concession cover c. 15,000 ha of the currently endangered **KPR** ecosystem, as well as the rare **LHI** and **BTA** (c. 2000 ha of each) in some of the mountainous areas. This would also destroy an important area of altitudinal ecotone transition (HCV 2.2).

HPH (Natural Forest Logging Concessions)

As noted, the approximately 460,000 ha of Landscape 2 is Production Forest legally permitted for selective timber harvesting. A total of four active HPH occur within the Berau portion of the Landscape (**Fig. 2.4.13**). HPH data for East Kutai are not available.

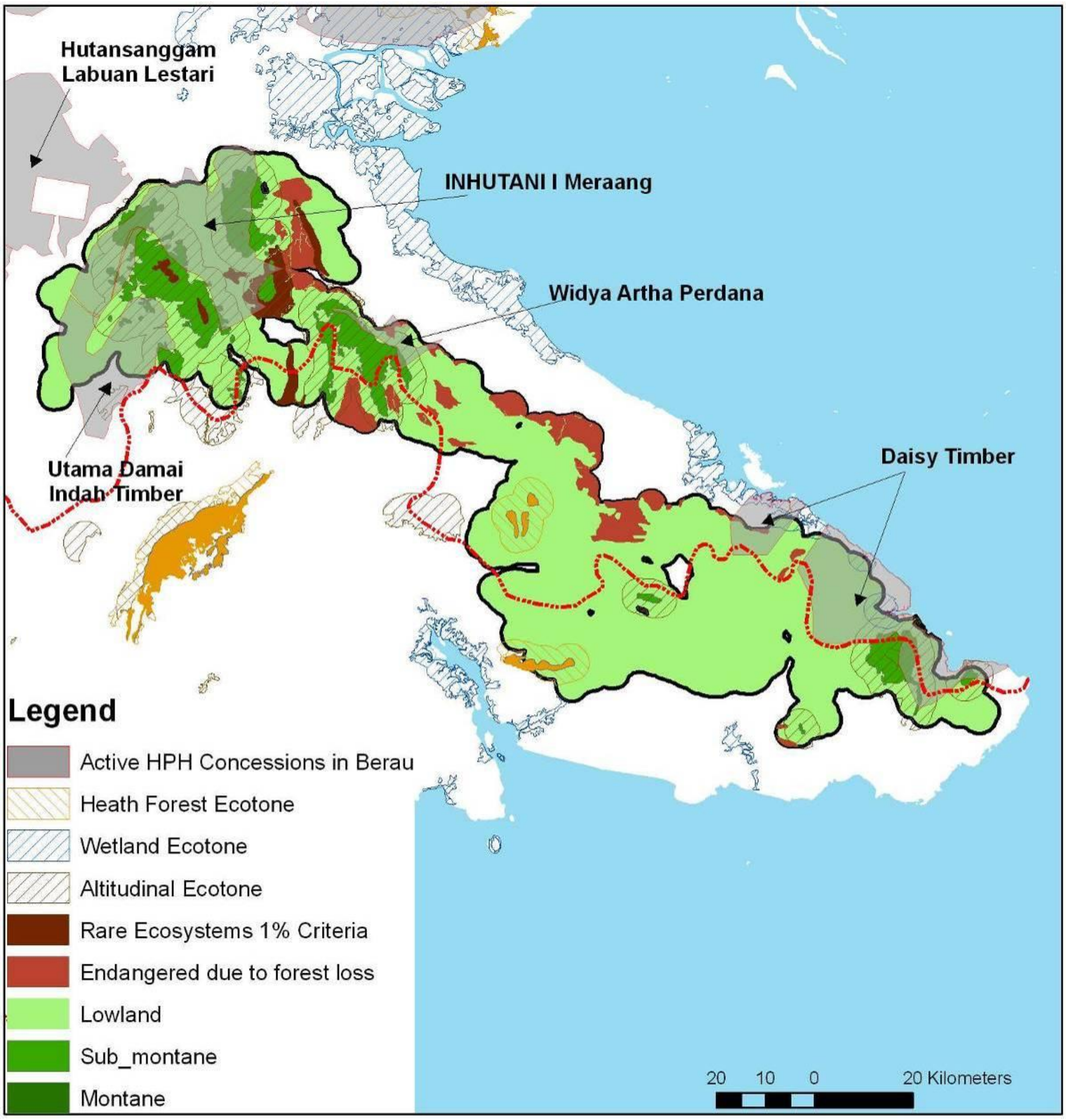


Figure 2.4.13 Known natural forest logging concessions (HPH) in Large Landscape 2 (Mangkalihat Peninsula) and its overlap with mapped HCV 2.2 and HCV 3 areas.

Logging has a number of effects on forested areas that can be generalised as:

- Associated damage from extraction, skid trails, logging roads. This alters the structure and composition of the forest, alters the microclimate, and exposes and compresses the soil. These effects can be noticeable for up to many decades.
- Increased access. The logging roads make the area more accessible potentially leading to increased hunting pressure, and agricultural expansion by small holders.

- Increased fire risk and susceptibility to drought. Degradation of forest due to over harvesting in poorly managed concessions can increase the risk of catastrophic fires c.f. causes of 1982/83 fire linked to ENSO droughts.
- Silvicultural practices impact biodiversity. Use of enrichment planting such as TPTJ or TPTII reduces the biodiversity value of logged forest. This technique creates large elongate and interconnected gaps in the canopy during strip clearing and could potentially greatly increase the risk of forest fires in years immediately after trees have been planted until the canopy closes as trees mature.

Agricultural Demand

Development of Berau will stimulate population growth, especially from economic migration, which combined with improved access due to plantation and HTI development is likely to increase demand for agricultural land and shift the agricultural frontier to regions previously considered inaccessible. The central region of Large Landscape 2 is relatively flat (<10% of slope; **Fig. 2.4.2**) and suitable for agriculture. Access is relatively good due to numerous existing logging roads, especially in the flatter areas (**Fig. 2.4.14**). Consequently, even areas classified as Forest Lands are likely to come under pressure. Government regulation and enforcement to prevent smallholder encroachment is generally weak and considered a severe political challenge. As such, threats from future unplanned deforestation along roads, especially in lowland areas, are considered high.

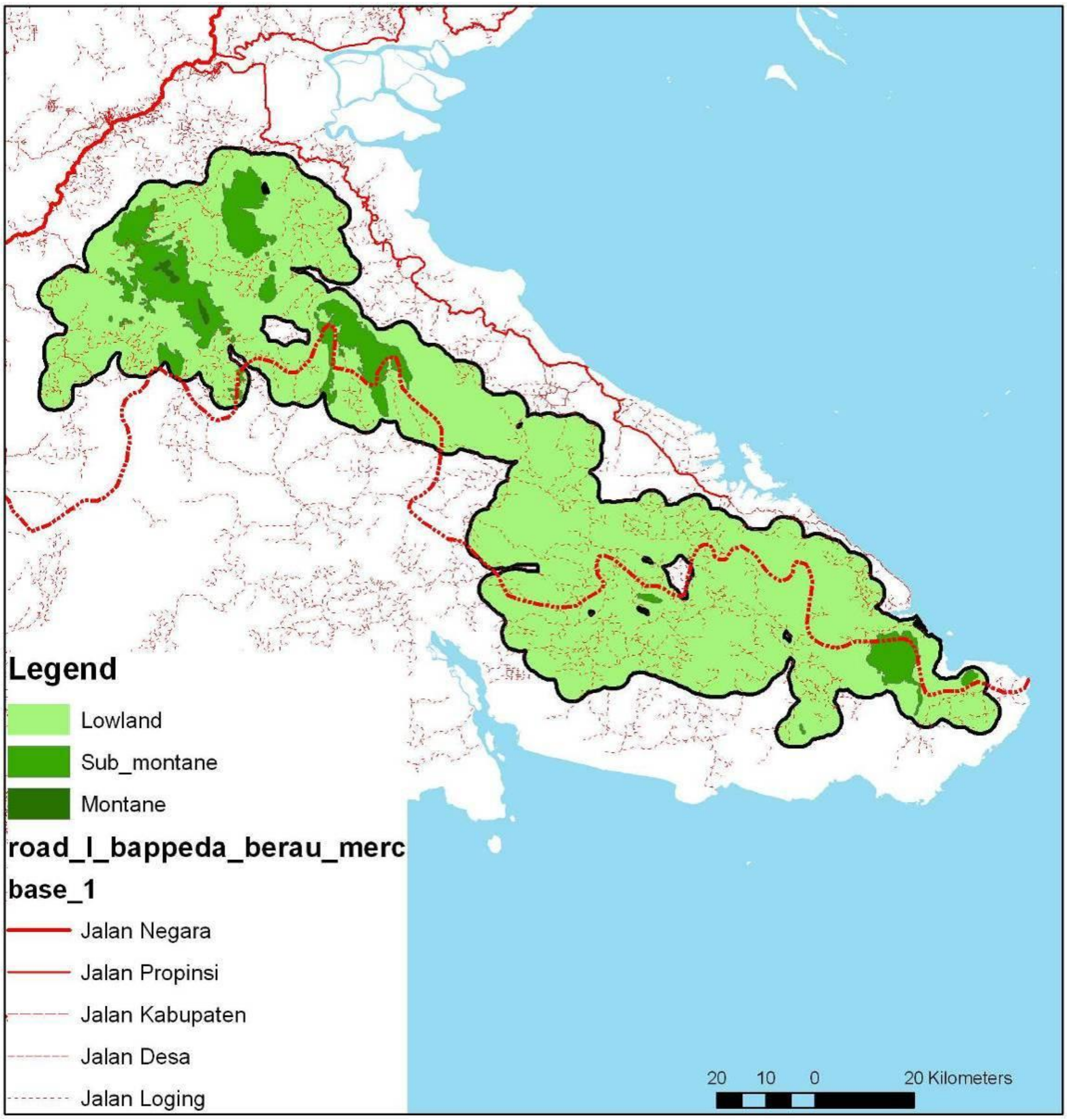


Figure 2.4.14 Existing road network and elevation vegetation zones indicating areas of higher risk for agricultural expansion in Large Landscape 2 (Mangkalihat Peninsula).

Degradation

Degradation of forest will occur to an extent in HPH. It is especially pronounced in poorly managed ones, and minimised in certified timber concessions. Uncontrolled illegal logging can also be a major source of degradation, where access is good via roads, trails, and rivers. In such areas, forest 'thinning' arising from low temperature ground fires caused by small scale shifting cultivation is also a degradation threat.

Degradation mapping of the Berau portion of Landscape 2 was performed by ICRAF (Dewi et *al*. 2010) (**Fig. 2.4.15**). Approximately 60% of the forested area is classified as logged (c 246,000 ha) which will have varying levels of degradation (Table 2.4.6). Nearly 150,000 ha are considered to be unlogged, some of this centred on hills or mountainous areas, though a noteworthy concentration also occurs in the central lowlands.

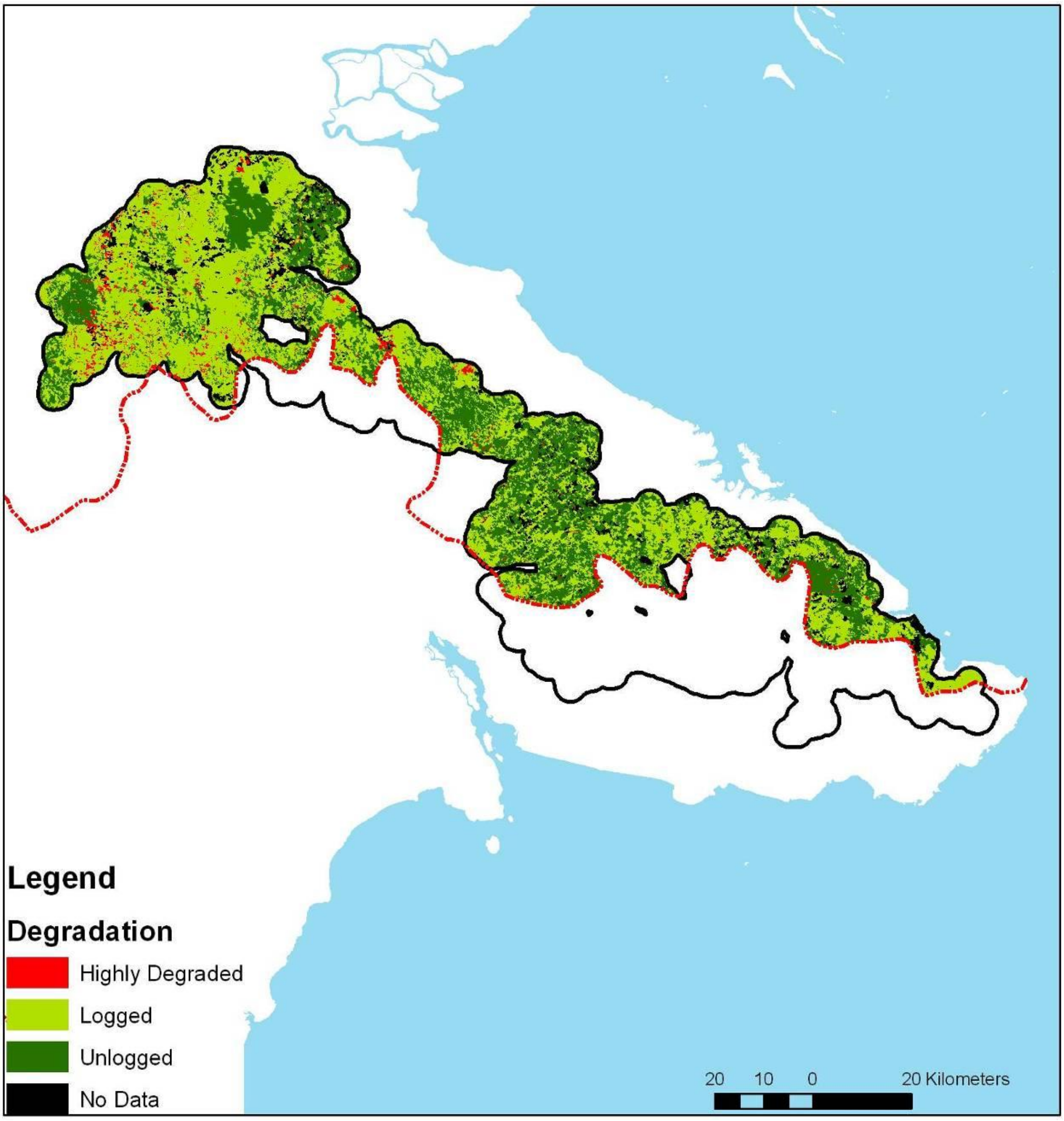


Figure 2.4.15 Forest degradation map (2005 & 2008 composite) in Large Landscape 2 (Mangkalihat Peninsula), using data from ICRAF (Dewi et *al* 2010).

Ecological impacts of degradation that affect HCVs include

- Altered forest structure and species composition
- Reduced population sizes for numerous Critically Endangered tree species in the Dipterocarpaceae, which are normally targeted for logging
- Reduced soil fertility causing slowing the growth and recovery of disturbed areas
- Increased severity of draught and surface ground temperatures, due to reduced shade and local humidity
- Increased risk of fires especially in comparison to non-degraded forest, which under natural conditions can be highly fire resistant.

Even medium to severely degraded forest can recover if targeted management interventions are applied, but the short-term economic value of such forest is low. This, in turn, provides a strong incentive to convert such forests to either HTI or non-forest agricultural uses. This is another indirect negative impact of degradation.

Table 4.6 Degradation class mapping for Berau Regency portions of Landscape 2, using data from ICRAF (Dewi et *al*. 2009).

Class	Area (ha)	% Classified
Highly degraded	12,779	3
Logged	246,234	60
Unlogged	149,507	37
No Data	30,150	N/A

Fire

There has been a long history of fire in the region with two catastrophic fire events in recent history, following the extended dry periods of the 1982/83 and 1997/98 ENSO events. These two events affected an estimated 2.7 million ha (Schindele *et al.* 1989) and 5.2 million ha (Hoffmann *et al.* 1999), respectively. The area worst affected was the southern part of the Nyapa-Mangkalihat Mountains and Hills immediately to the south of Landscape 2 and the Mahakam Lowlands further to the south (see Chapter 1). Three attributes of Landscape 2 make it potentially combustible during an extended dry season: (i) forest degradation combined with (ii) extensive areas of karst forest and (iii) surface coal seams, as indicated in geological maps (**Fig. 2.4.16** & **Fig. 2.4.17**). Fire is a commonly used method of land clearing by small holders (and by irresponsible plantation owners despite laws prohibiting it). When combined with the above factors, this could lead to further catastrophic fires. Large sections of Large Landscape 2 are considered to be at risk for fire given its current condition.

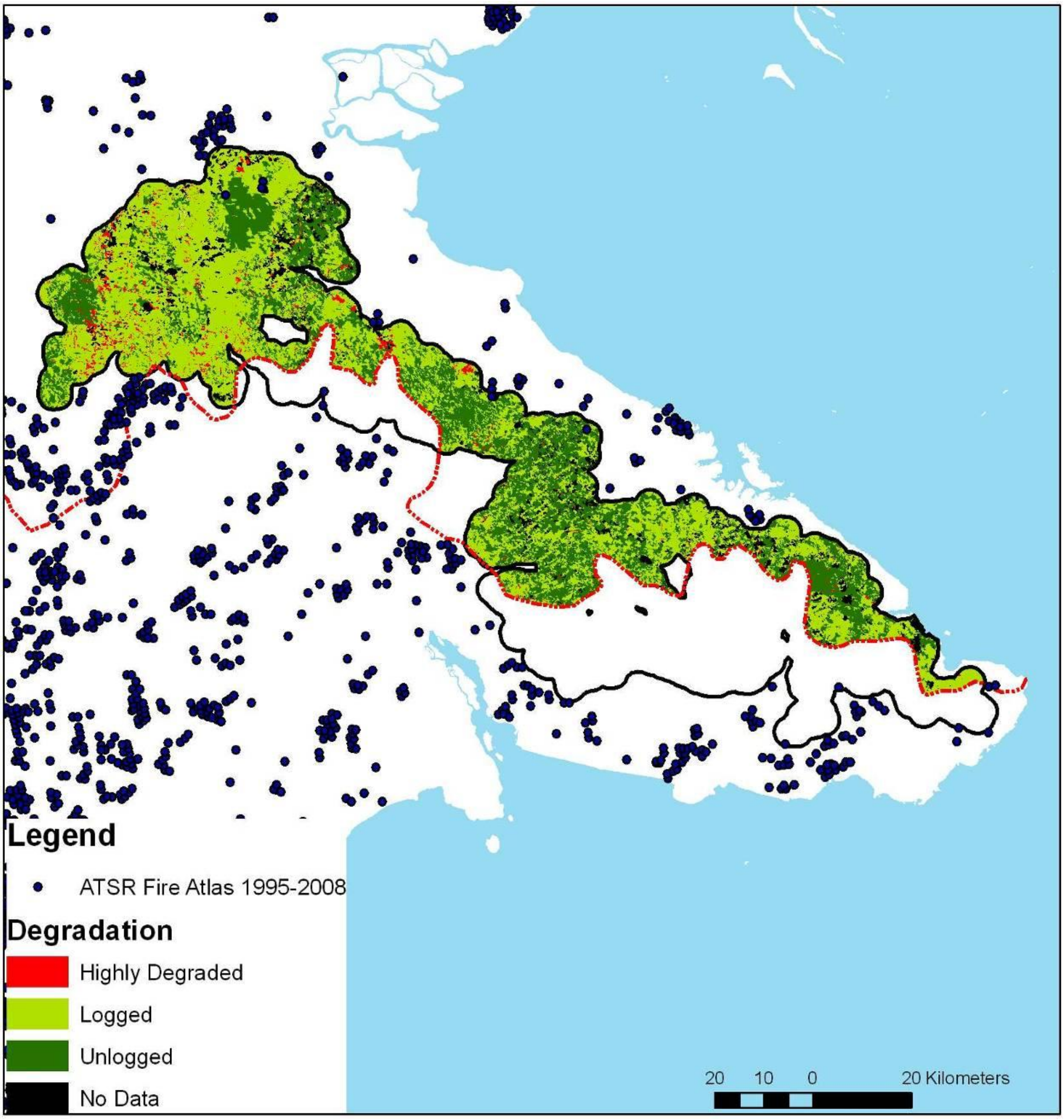


Figure 2.4.16 Fire history (1995-2008) in Large Landscape 2 (Mangkalihat Peninsula) using ATSR online database.

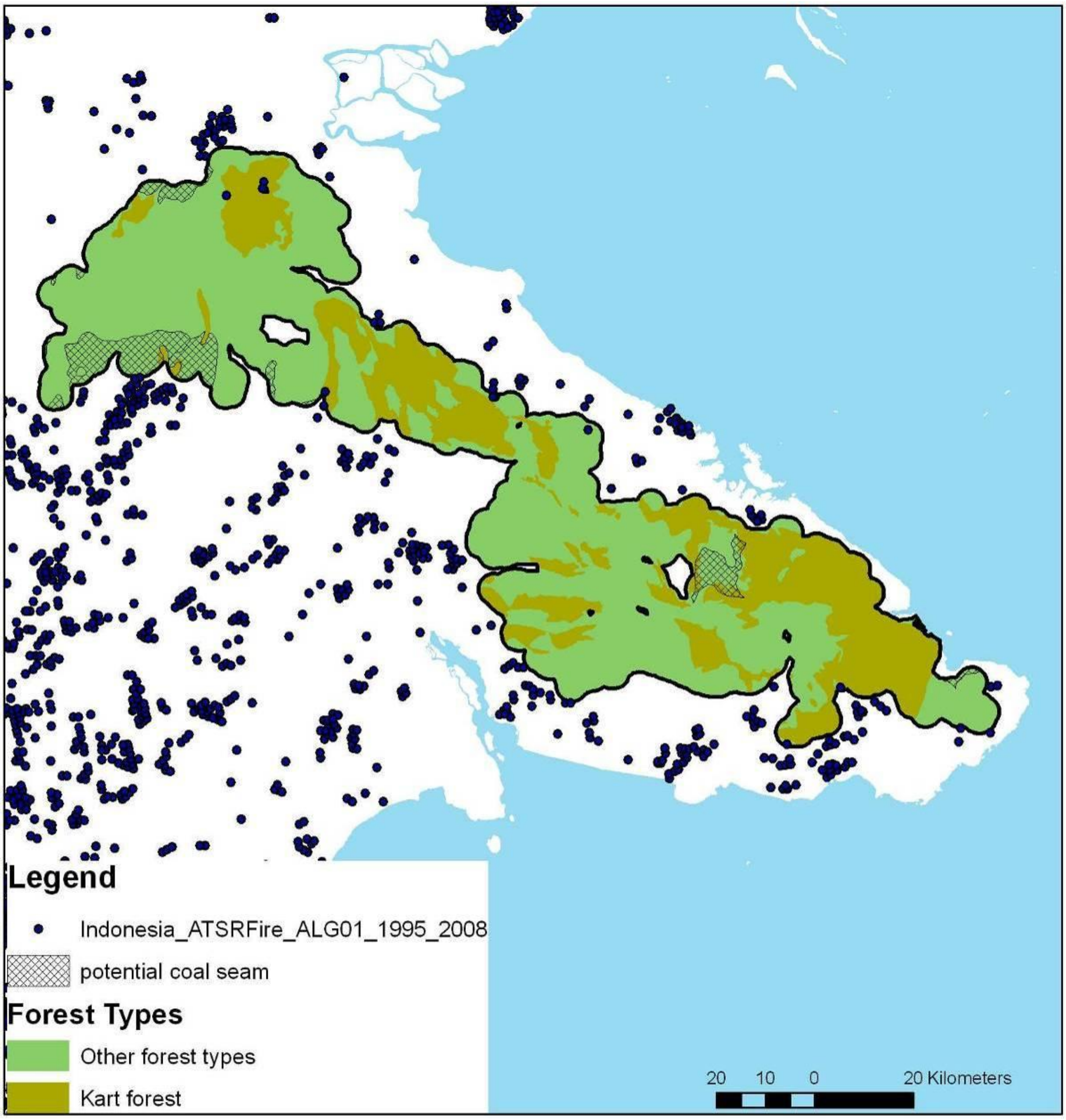


Figure 2.4.17 Map of potential coal seams and known karst areas that under conditions of drought and/or mismanagement may function as sources of ground fire in Landscape 2, Mangkalihat Peninsula.

2.4.5 Management Recommendations

General Recommendations

As with the other two Landscapes described in this report, the HCV management recommendations provided below all carry a potential cost of forgone conventional economic development for Berau and East Kutai Regencies. The Berau Forest Carbon Project (BFCP) currently under development by TNC and partners, however, provides an opportunity for carbon finance through REDD to offset these costs in part or in while, or even to provide net income streams in excess of conventional alternative land uses (e.g. REDD versus oil palm on high carbon, low productivity soils). Although carbon finance revenues under REDD are generated by avoided GHG emissions, considerable biodiversity co-benefits can be accrued through strategic planning of where those interventions are undertaken. Results of the landscape HCV mapping exercise described herein can be used to guide such strategic site selection.

Locations of possible site interventions recommended for consideration to maintain important HCVs in Landscape 2 are depicted in **Fig. 2.4.18**.

Rare Ecosystems. For rare HCV 3 ecosystems using the 1% criterion, it is recommended zero loss through conversion is permitted. This includes, most notably, the entire remaining area of **BTA** (Forest on dissected volcanic cones) and LPN (Forest on eroded mountainous stratovolcanoes) within the Nyapa-Mangkalihat Mountains and Plains, which currently fall within Large Landscape 2. Both of these ecosystems are threatened with partial conversion to HTI in the northern section of Landscape 2 (**Fig. 2.4.18**). The Toolkit provides general management guidelines that up to 20,000 ha of a rare or endangered HCV 3 ecosystem should be maintained within a core. Given that the **BTA** and LPN ecosystems are less than 20,000 ha in extent, much of the north-western section of the core of Landscape 2 (**Fig. 2.4.18**) will therefore be required to be maintained in its current state.

Endangered Ecosystems. Similar to rare ecosystems, the Toolkit specifies that the management goal should of HCV 3 endangered ecosystems present in a large landscape is to protect 20,000 ha within a Core Area. In the case of Landscape 2, neither the ecosystems of **BKN** or **LHI** reach this management objective. Endangered HCV 3 ecosystem **KPR** is represented by c. 43,600 ha within Landscape 2, but the vast majority of this falls within Buffer regions of the landscape, with only c. 18,200 ha within the Core Area. This implies that, for management of HCV 3, the extent of the Core Area and buffer should not be reduced further in the vicinity of all three of these HCV 3 ecosystems, as they are already under-represented in core habitat as prescribed by the Toolkit. These areas are concentrated in the north and northern central section of Landscape 2 (**Fig. 2.4.18**). Further, with reference to proposed general management recommendations outlined above in Table 1.1, all three ecosystems are further threatened by future planned conversion, placing them in Category 2 (**KPR** and **LHI**) and Category 3 (**BKN**) for management, making further losses unacceptable without demonstrable gains elsewhere of equal or greater magnitude to offset these losses.

Ecosystem Transitions. The Toolkit recommends that when HCV 2.2 ecosystem transition areas are present within a HCV 2.1 landscape, 10,000 ha of each ecosystem and the transitional area between them should be maintained (total c. 20,000 ha in size). Ideally, this would be located within the Core of the landscape, where possible. In Large Landscape 2, the three large areas of contiguous altitudinal transition zones to the northwest could be reduced in extent without violating Toolkits requirements (**Fig. 2.4.18**). However, for all other HCV 2.2 areas, the management objective should be to maintain them in their entirety, as they are less than or very close to 20,000 ha in extent.

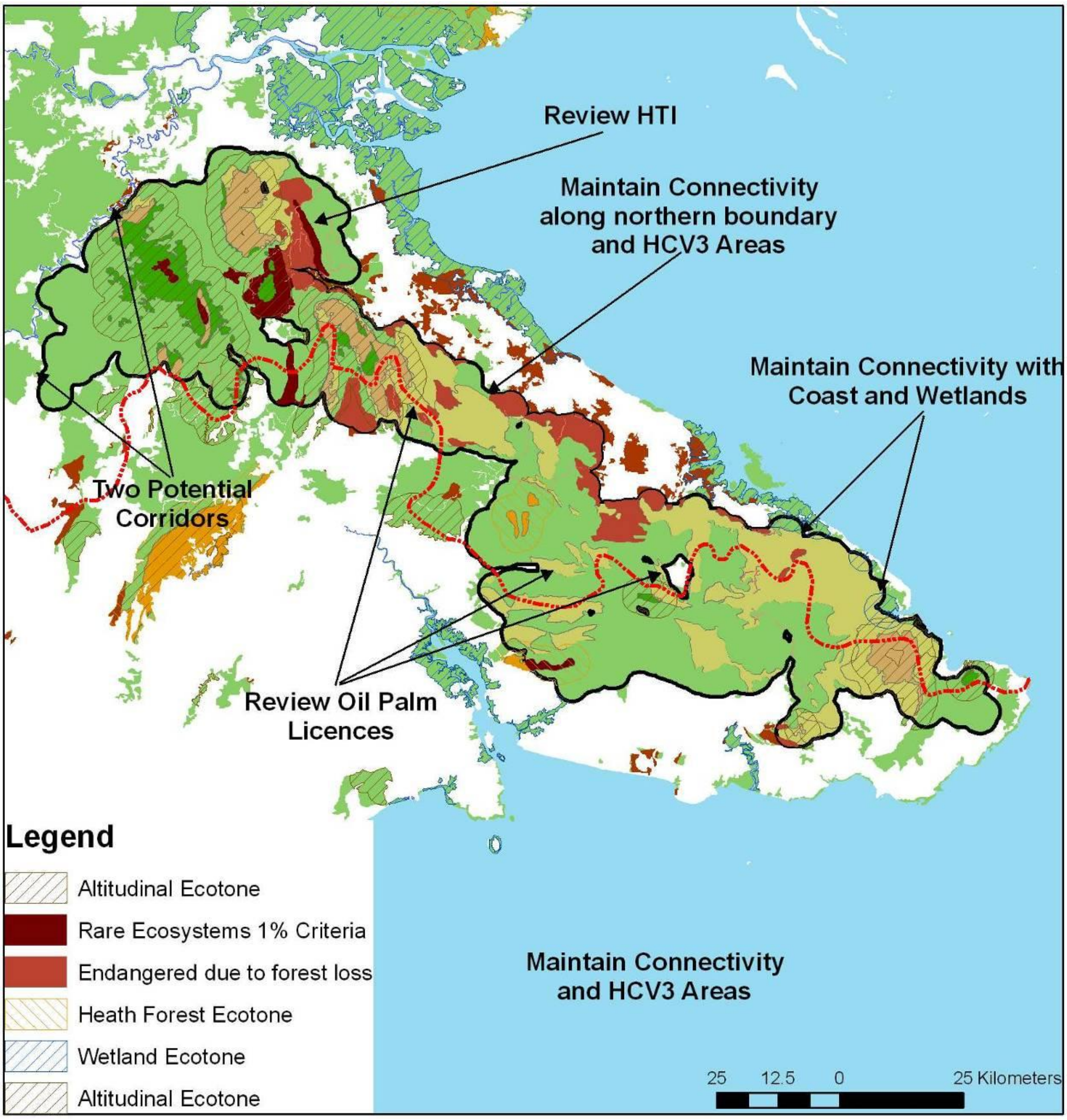


Figure 2.4.18. Possible site interventions recommended for consideration to maintain HCVs in Landscape 2, as discussed in Section 4.4 and below.

Land use planning

The current RTRWP and RTRWK would be greatly improved by differentiating between production forest areas that are eligible for conversion to HTI and those that are not. This would enable more strategic planning for HTI development to meet future expected needs or industry targets whilst maintaining HCVs. This would also carry the advantage that pulp and paper companies whose corporate policies require the maintenance of HCVs are not allocated (or do not seek) concessions where large HCV areas have already been identified, and their maintenance within plantation mosaic would be difficult to achieve.

Existing land use plans will fragment the Landscape 2 into 13 cores, two of which satisfy the HCV 2.1 criterion of <20,000 h ain size. By some interpretations, such fragmentation would be permitted by the Toolkit given the HCV 2.1 requirements alone, but when HCV 2.2 and HCV 3 are considered as well, current spatial plans would create losses of transitional HCV 2.2 areas that should be maintained, and erode the conservation status of some HCV 3 areas by redefining their position within the landscape from Core Area to Buffer. To prevent these losses, spatial plans will require modification. One such high priority is the region of Landscape 2 in the east, bordering the coast, wetlands and marine swamps, which also contains much of the endangered HCV 3 ecosystem **KPR** (**Fig. 2.4.18**). These areas are permitted for conversion but should be maintained as forest. This modification would also serve to improve contiguity within the region that would otherwise be lost.

At present, Large Landscapes 1 and 2 maintain a tenuous forest connectivity, which though insufficient to form a core, provides an important linkage between the Mangkalihat Peninsula and the vast interior forests of Borneo. This connectivity is threatened along the Kelai River due to a planned provincial road from Tanjung Redeb to Kelay. It is recommended that a corridor at least 5 km in width is maintained to connect Large Landscape 1 and 2. This could be achieved either by maintaining connections between the INHUTANI I Meraang and Hutan Sanggan Labuan Lestari HPHs or between the two divisions of Utama Damai Indah Timber HPH via the proposed protection forest (**Fig. 2.4.18**). The planned road will attract settlers even if the land either side of it is classified as Forest Land. Further consideration must be given to how forest along this road could be maintained.

HPH

The four known active logging concessions within Landscape 2 should be engaged with the following generic recommendations:

1. Those that are not certified through FSC or LEI should be mentored to assist them to improve management practices. This could be encouraged either by direct funding from a REDD program tied to IFM incentives, local tax relief for those that obtain certification or simply by making a persuasive case for cost control benefits through better management.
2. RIL should be practiced.
3. Pilot project silvicultural practices such as TPTJ and especially TPTII should be minimized, especially in hilly terrain and in areas close to the forest edge to avoid potential for increased susceptibility to fire from external sources.
4. Encroachment by small holders into the concession areas should be minimized by developing political support that provides alternative areas for small holder development, support for eviction if required, control of logging roads, and the

development of community based agro-forestry projects to stabilise the forest edge and provide direct benefits to local communities.
5. Concerted effort (including ground surveys) should be made to identify areas that are most severely degraded within these HPH for setting rehabilitation and replanting priorities, preferably with fast growing native species.
6. Site level HCV assessment should be conducted to identify areas of special importance for maintaining HCV 1 and other HCVs not covered in this study.
7. Seek intercompany support to maintain connectivity across HPH borders, control access, and coordinate fire fighting preparations and preventative measures.

HTI

The area of PT Tanjung Redeb Hutani fibre concession within Landscape 2 should be a very high priority for management interventions. The concession is a threat to an exceptional concentration of HCV 2.1, HCV 2.2 and HCV 3 areas. However, HTI could potentially be beneficial to long term conservation of Landscape 2 in the areas outside and immediately adjacent to these HCV areas, by acting as an additional buffer to stabilize the forest edge and provide fire control measures. This form of benefit could be optimised by engaging all HTI concessions neighbouring this landscape and encouraging them to undertake HCV assessments within their own concessions (or where applicable use the results provided here) to assist in the implementation of MoF required Macro and Mikro Delineation of conservation zones and management plans.

Oil Palm Estates

In conjunction with a revision of the proposed RTRWP as outlined above, the three planned oil palm estates within Landscape 2 are recommended for relocation outside the Core Area. As with HTI, oil palm plantations have the potential to stabilize forest edges if they provide meaningful benefits to local communities and restrict access to the forest, at least for commercial scale timber extraction and excessive hunting. Better managed estates tend to be run by companies working towards RSPO certification. Effort should be made to determine first if these three oil palm companies are RSPO members. Estates that border the current forest edge should also be engaged and encouraged to join the RSPO and work actively toward certification, first by respecting and protecting their borders with Landscape 2. When the new RTRWP is approved, the lands that become allocated for non-Forestry purposes are likely to be allocated to Oil Palm estates. At this time, a careful watch over new applications should be maintained, and TNC and partners should engage those companies that pose risk to Landscape 2.

2.5. Large Landscape 3 - Tanjung Batu Peninsula

Figure 2.5.1. Large Landscape 3 – Tanjung Batu Peninsula.

2.5.1 General Description

Large Landscape 3, Tanjung Batu Peninsula, covers c. 89,082 ha, with a Core Area (>3km from forest edge) of c. 40,000 ha in size. This relatively small Landscape is part of a larger block that is split between Berau Regency (the management area) and Bulungan Regency, outside the management area but potentially with an 'off site' impact on the HCVs within neighbouring Berau. The HCV 2.1 analysis included a buffer of up to 7 km from the borders of Berau, which in this case includes c. 10,000 ha of the 40,000 ha Core Area, as well as the corresponding buffers. As seen below the spatial plans for Bulungan Regency will have a major impact on this Landscape.

Physiographic Regions

Large Landscape 3 lies totally in the Northern Lowlands.

Past and Present Forest Cover

The area delineated as Large Landscape 3 was in c.1975 part of a 'Super Landscape' that covered much of East Kalimantan, as shown in**Fig.2.1**. The current landscape unit of c. 89,082 ha became separated (fragmented in terms of HCV 2.1 definitions) from Large Landscape 2 as a result of forest clearance in the vicinity of Tanjung Redeb and the flat low lying areas between Landscape 1 and the coast to the south (**Fig. 2.5.1**). Connectivity with Landscape 1 was lost entirely sometime after 2000 due to land clearance along the road built between Tanjung Redeb and Tanjung Selar and the Tanjung Redeb Hutani HTI concession.

Land Use Types

The provincial land use plan (RTRWP) for East Kalimantan distinguishes areas considered as Protection Forest, Production Forest (logging or HTI), and areas that may be used for non-forest uses such agriculture (e.g. oil palm) or other purposes. The sum of protected and production forest areas represents the total official extent of Forest Land, with forest areas outside this considered at risk for conversion to non-forest uses. According to RTRWP 1999, land use within Landscape 3 is 91% Forest Lands, all of which is production forest (c. 81,000 ha), and 9% (c. 7,000 ha) is classified as non-forest lands (Table 2.5.1). The proposed RTRWP v.2008 greatly reduces the proportion of Forest Land from 91% to 43%. Almost the entire forested area of Landscape 3 within Bulungan Regency is planned for non-forest purposes, as are portions in Berau Regency.

Slope and Altitudinal Distribution of Forest

Approximately 88% of Large Landscape 3 is flat to undulating (0-10% slope) terrain, 10% is rolling (10-15%) and the remaining 2% is hilly (Table 2.5.2 &**Fig. 2.5.2**). The elevation varies between sea level and 200m a.s.l., with a small range of hills that run along the border between the Berau and Balongan Regencies. All forest types are lowland.

Major Forest Types

The major forest types considered present within Landscape 3 are mangrove, peat swamp, riparian forest, heath forest, and other lowland forest on well-drained soils (**Fig. 2.5.3**). See Section 2.1.4 for more detailed description of major forest types.

Mangrove is present, covering only c. 800 ha of Landscape 3 as delineated, but is contiguous with a larger area of mangrove in the vicinity of the Berau delta (which was excluded from the buffer of Landscape 3 based on shape features).

Shallow peat swamp forest (<3m deep) are present inland behind the estuarine mangroves and cover an area of c. 4,500 ha in the Landscape as defined.

Riparian forest, which also includes backwater swamps (freshwater) and seasonally inundated areas, are found on all the larger rivers in Landscape 3, covering a total area of c. 2,600 ha.

Heath forest covers an estimated c. 15,000 ha, situated on the eastern half. This heath forest was not anticipated from the land systems present as mapped by RePPProT. However, the Berau Forest Management Program identified these areas and inspection of Landsat imagery appears to confirm this. It appears likely that the ecosystem proxy **PST** (Forest on marine terraces), supports heath when such terraces are forms by coarse textured sediments (sand), although RePPProT does not state this. Another possibility is that these heath forest areas have been misclassified by RePPProT and should be another land system type such as **PKU** (Forest on undulating sandy terraces), which is known to support heath forest. No attempt has been made to alter the land system maps and hence ecosystem proxies at present, as this could only be done with further inspection of Landsat imagery, geology, and soil maps.

Lowland forest on well-drained mineral soils is the largest major ecosystem type present, covering c. 65,000 ha on a variety of soil and geology types.

Table 2.5.1 Major forest types in Large Landscape 3 and their land use status under current (1999) and proposed future (version 2008) provincial land use plans (RTRWP) for East Kalimantan.

Major Ecosystem Types	Area (ha)	RTRWP 1999 Protected (ha)	RTRWP 1999 Production Forest (ha)	RTRWP 1999 Other (ha)	Proposed RTRWP v2008 Protected (ha)	Proposed RTRWP v2008 Production Forest (ha)	Proposed RTRWP v2008 Other (ha)	RePPProT Classes
Lowlands (<500m)								
Riperian Forest	2,631	0	2,360	271	0	790	1,841	KHY
Heath Forest	14,926	0	13,224	1,702	0	804	14,121	LWW, MPT, PST, TWH**
Peat Swamp Forest	4,456	0	2,236	2,221	0	1,267	3,189	MDW
Mangrove	837	0	312	525	0	212	625	KJP
Other Lowland Forest	64,970	0	62,331	2,638	0	35,245	29,724	LWW, MPT, PST, TWH
Non-Forest	729	0	674	55	0	90	639	
Total	**88,549**	**0**	**81,137**	**7,412**	**0**	**38,409**	**50,140**	
Water Bodies	533	**0**	**0**	**533**	**0**	**0**	**533**	
	89,082	**0**	**81,137**	**7,945**	**0**	**38,409**	**50,672**	

**These RePPProT Classes are not normally associated with heath forest

Table 2.5.2. Slope classes of Large Landscape 3, Tanjung Batu Peninsula.

Slope Class %	% of Area
0-10	88
10-15	10
15-20	2
20-40	1
>40	0
	100

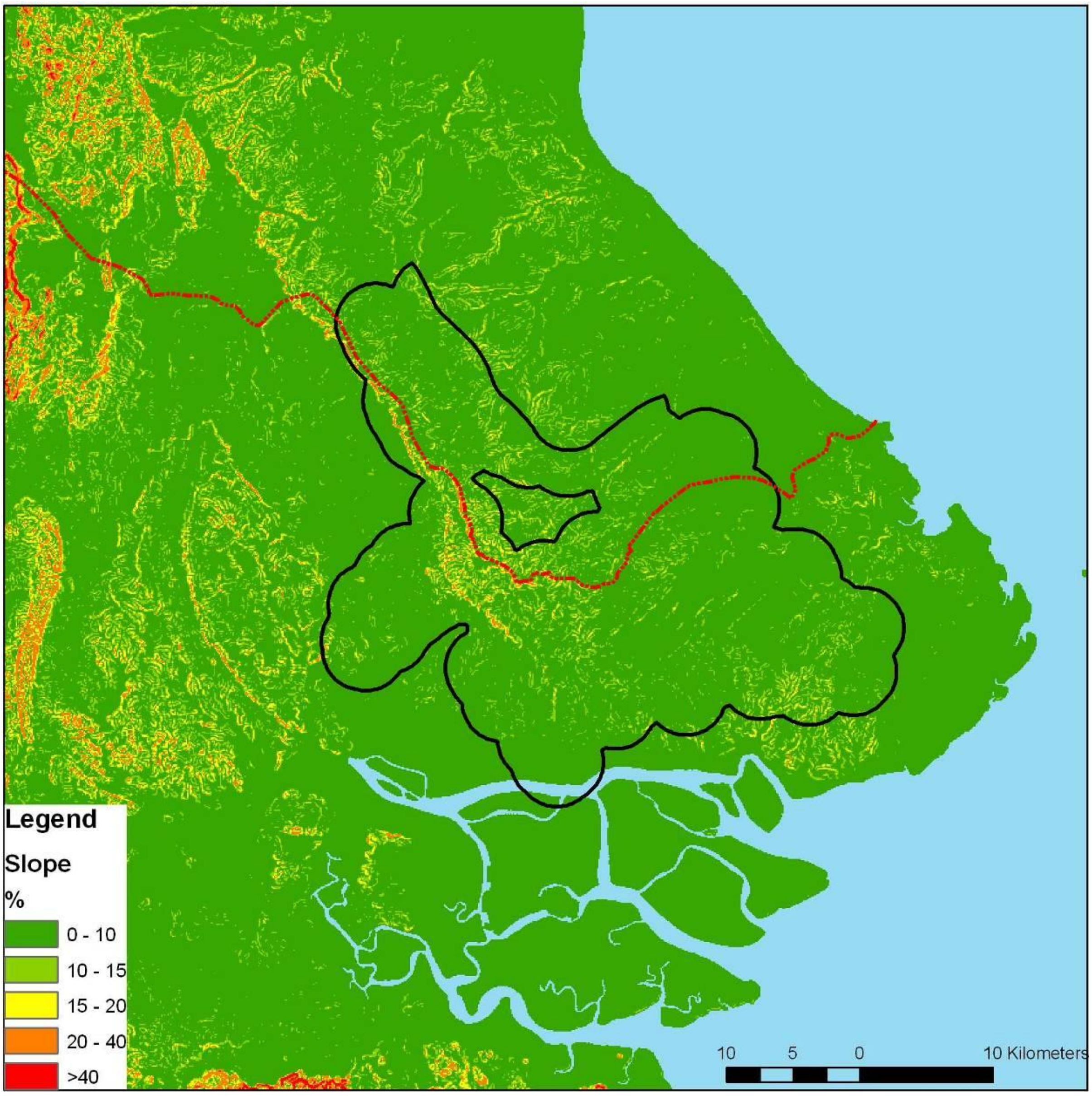


Figure 2.5.2 Map of slope classes within Large Landscape 3, Tanjung Batu Peninsula.

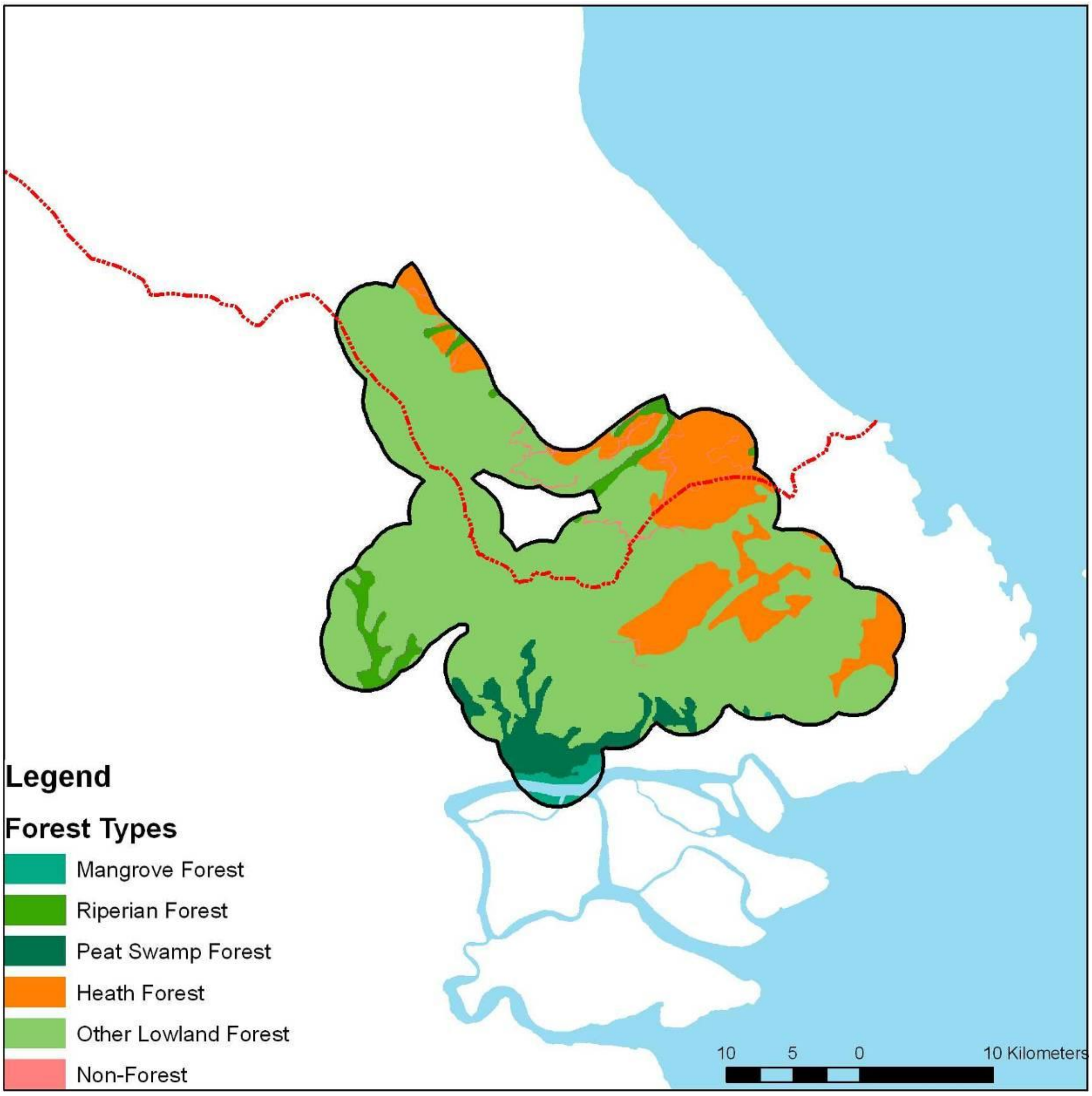


Figure 2.5.3 Map of major ecosystem types present in Large Landscape 3, Tanjung Batu Peninsula.

2.5.2 Description of HCV 2.2 - Areas that Contain Two or More Contiguous Ecosystems

Two different HCV 2.2 zones of transition among ecosystem types described in the Toolkit are present within Landscape 3:

1. Wetlands and non-wetlands
2. Kerangas and non-kerangas forest areas

The wetland and non-wetland transition zones occur on the interface of the mangrove, peat swamp and riparian forest with dry mineral soils. The transition area covers a total area of c. 43,000 ha, 48% of Large Landscape 3 (**Fig. 2.5.4**).

As noted, small areas of heath forest are also found in Landscape 1. Where present, heath forest is contiguous with non-heath lowland forest on mineral soils (**Fig. 2.5.4**), which the Toolkit also distinguishes as HCV 2.2. The total area of heath to non-heath transitions is c. 45,000 ha, 50% of Landscape 3, some of which overlap with the wetland transitions described above.

To map HCV 2.2 areas, a 3km buffer either side of the transition boundary was used, with borders between types as described by the modified RePPProT ecosystem proxy map (**Fig. 2.5.4**). This is considered a conservative estimate of distance required for most normal ecological processes to be maintained at that interface (e.g. vertebrate foraging patterns across habitat boundaries).

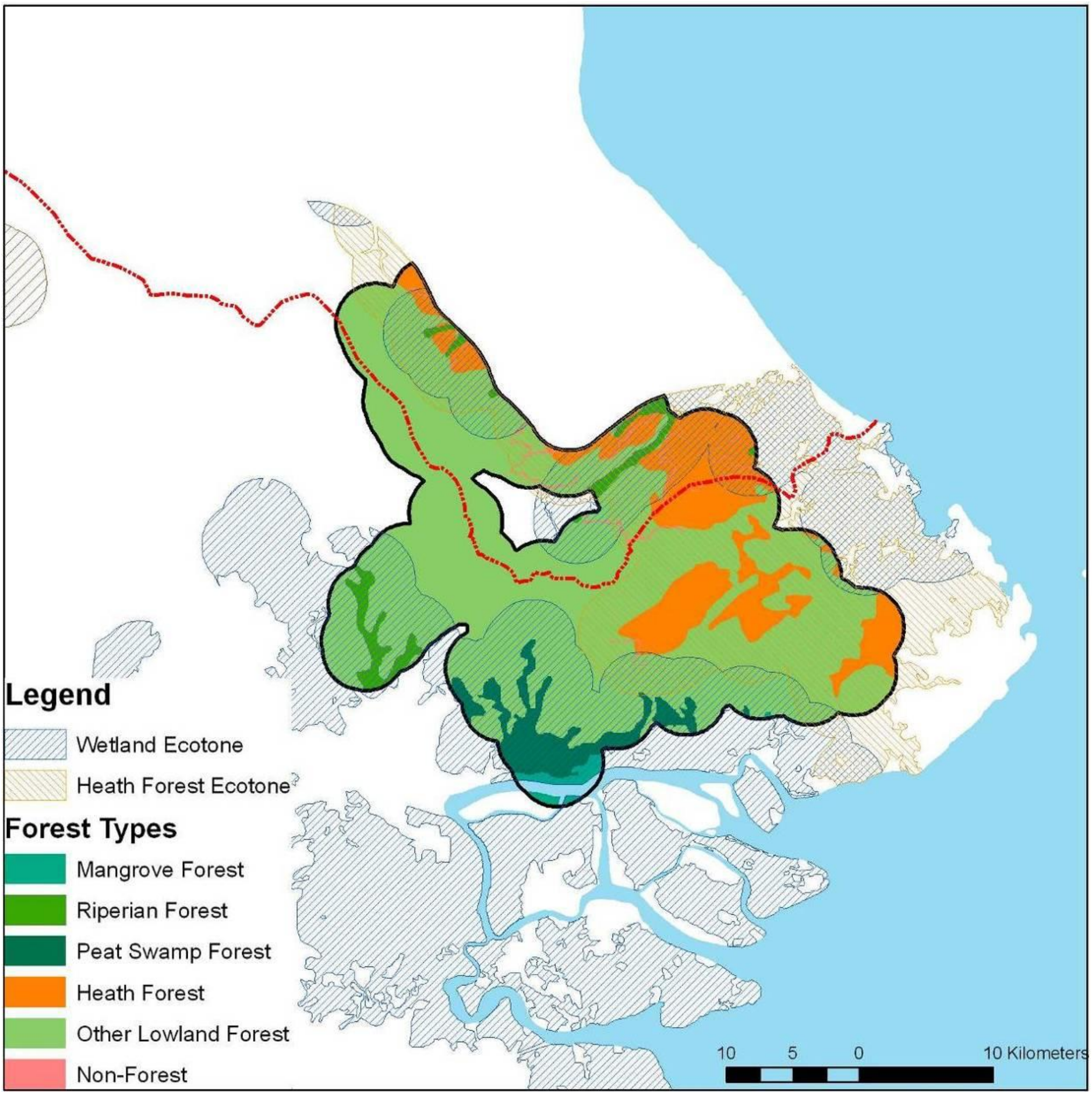


Figure 2.5.4 Zones of ecosystem transition (HCV 2.2) in Large Landscape 3, Tanjung Batu Peninsular.

2.5.3 Description of HCV 3 - Rare and Endangered Ecosystems

Rare Ecosystems

No ecosystem proxies are identified as Rare, i.e. represent currently less than 1% of the total area of natural ecosystems c. 1975 in the Northern Lowlands.

Endangered due to forest loss

No ecosystem proxies are identified as currently Endangered due to >50% loss of past extent since c. 1975.

Endangered due to planned deforestation from RTRWP

All ecosystems within Large Landscape 3 that meet the criterion for Endangered (HCV 3) as a result of future expected deforestation causing a decline of >75% of past extent (Table 2.5.3). These include **PST** (Forest on marine terraces), which under the proposed RTRWP is expected to lose 95% of its past extent c. 1975 (making it Critically Endangered). **KHY** (Forest coalescent estuarine/riverine plains) is expected to lose 81% of its past extent. Surprisingly the **KJP** ecosystem type (Inter-tidal mudflats under mangrove and nipa), is also endangered under future plans, with an expected loss of 78% of current extent, due to the planned and current conversion of mangroves to fish ponds (**Fig. 2.5.5**).

As noted above, this area contains a much greater extent of heath forest than predicted by the ecosystem proxies delineated, a likely result of incorrect land system classification by RePPProT. In this scenario, it is possible that the areas shown as heath forest are better classified as **PST** (Forest on marine terraces) or more likely **PKU** (Forest on undulating sandy terraces). Given the trend in proposed RTRWP of allocating lowland forest areas within the Northern Lowlands to non-forest purposes (i.e., not Forest Lands), it is highly likely that these heath forest areas should be treated as endangered based on future planned conversion.

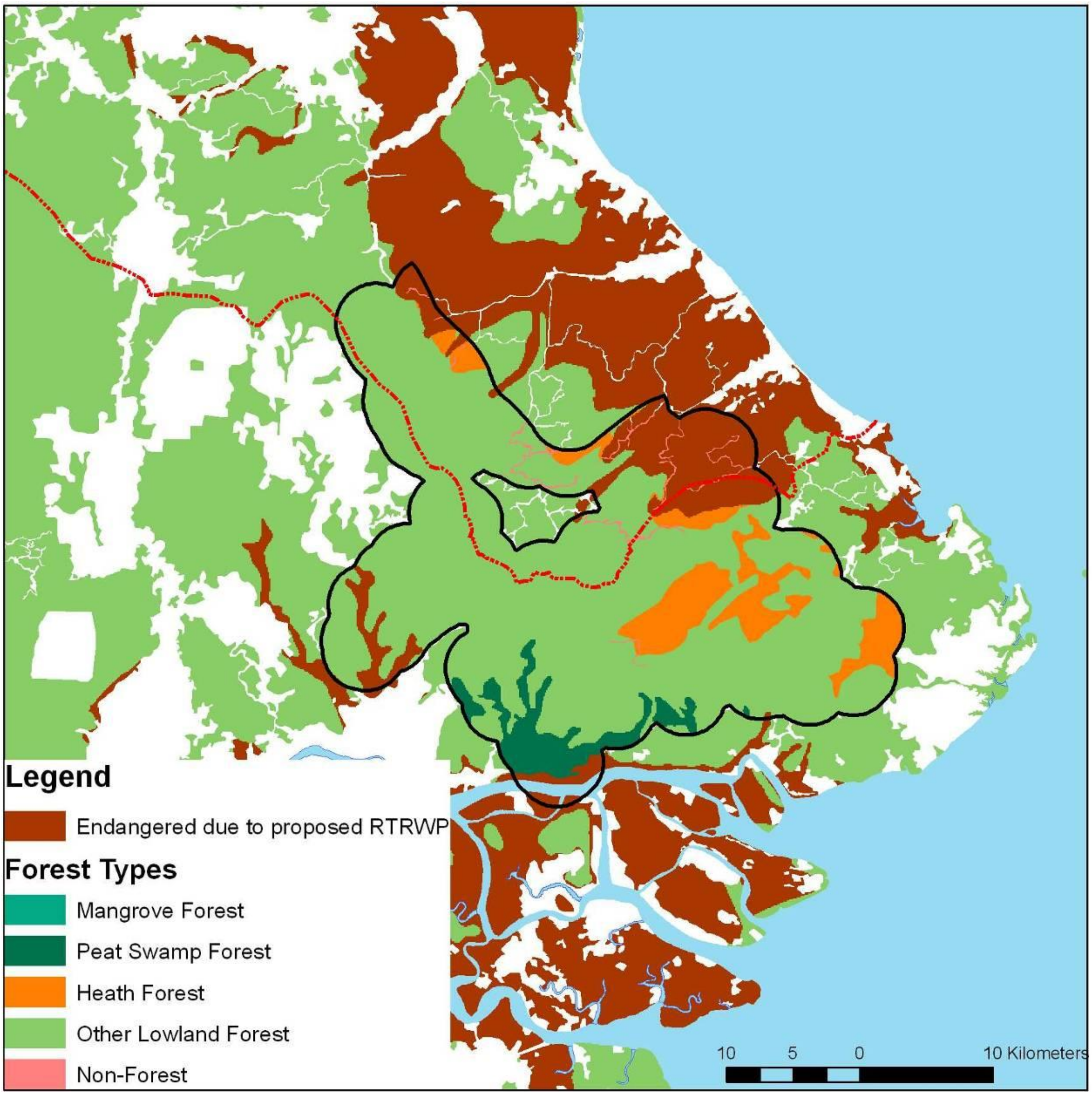


Figure 2.5.5 Map of Endangered ecosystems (HCV 3) in Large Landscape 3, Tanjung Batu Peninsula, based on the future expected loss criterion of HCV 3, i.e. <75% of the original extent is expected to remain given current land use plans. The heath forest areas are also likely to be endangered.

Table 2.5.3 Endangered ecosystems (HCV 3) in Large Landscape 3, Tanjung Batu Peninsular, based on the future expected loss criterion of HCV 3, i.e. <75% of the original extent is expected to remain given current land use plans.

Ecosystem Proxies	Description	Total Extant Remaining in Physiographic Region (ha)	Total in Landscape Region 2 (ha)	% of Total Extant	% Loss since C.1975	% Expected loss	Status Per Proposed RTRWP v2008			Management Level per Table 1.1
							Protected (ha)	Production (ha)	Other (ha)	
Northern Lowlands										
KHY	Coalescent estuarine/riverine plains	78,982	2,631		31	81	0	790	1,841	**1**
KJP	Inter-tidal mudflats under mangrove and nipah	197,291	837		48	78	0	212	625	**1**
PST	Marine terraces	51,110	6,878		43	95	0	212	6,667	**1**
			10,347							

2.5.4 Threats

This section provides a sketch of planned and/or unplanned deforestation or forest degradation that poses a threat to persistence of HCVs in Landscape 3.

Spatial Plans

The proposed RTRWP v2008 threatens to reduce Landscape 3 into one small core area of c. 4,300 ha and associated buffer of c. 18,700 ha. This would no longer meet the criterion for HCV 2.1 (**Fig. 2.5.6**).

In addition to fragmentation of the now contiguous Landscape 2, large parts of endangered ecosystems (HCV 3) contained within the current Core Area and Buffer of will either (i) be lost by planned deforestation, or (ii) no longer exist within a Core Area of the landscape (the management objective defined in the Toolkit to preserve ecological buffering for this value). A similar situation will result for a number of Ecosystem Transition zones currently mapped as HCV 2.2 (**Fig.2.5.7**). The spatial plans therefore will cause loss of most of the HCVs included in this assessment, including the loss of HCV 2.1 status. In addition to this the spatial plans will allow the conversion of the areas of forest including swamps that connect Large Landscape 3 to the coast that may have long-term ecological impact on Landscape 3.

As noted above in discussions of Landscape 2, Industrial Timber Estates (HTI) are often, though not exclusively, planned for Production Forest areas that have become exhausted of commercial timber resources. The entire remaining Forest Area could thus become targeted for HTI development by the MoF at some point in the future. As discussed in greater detail above, we recommend producing a variation of the currently proposed spatial plans for East Kalimantan Province and the Regencies to delineate those Forest Areas eligible for HTI, and those that are not. This would greatly assist in assessing threats and planning for maintaining HCVs and other conservation targets.

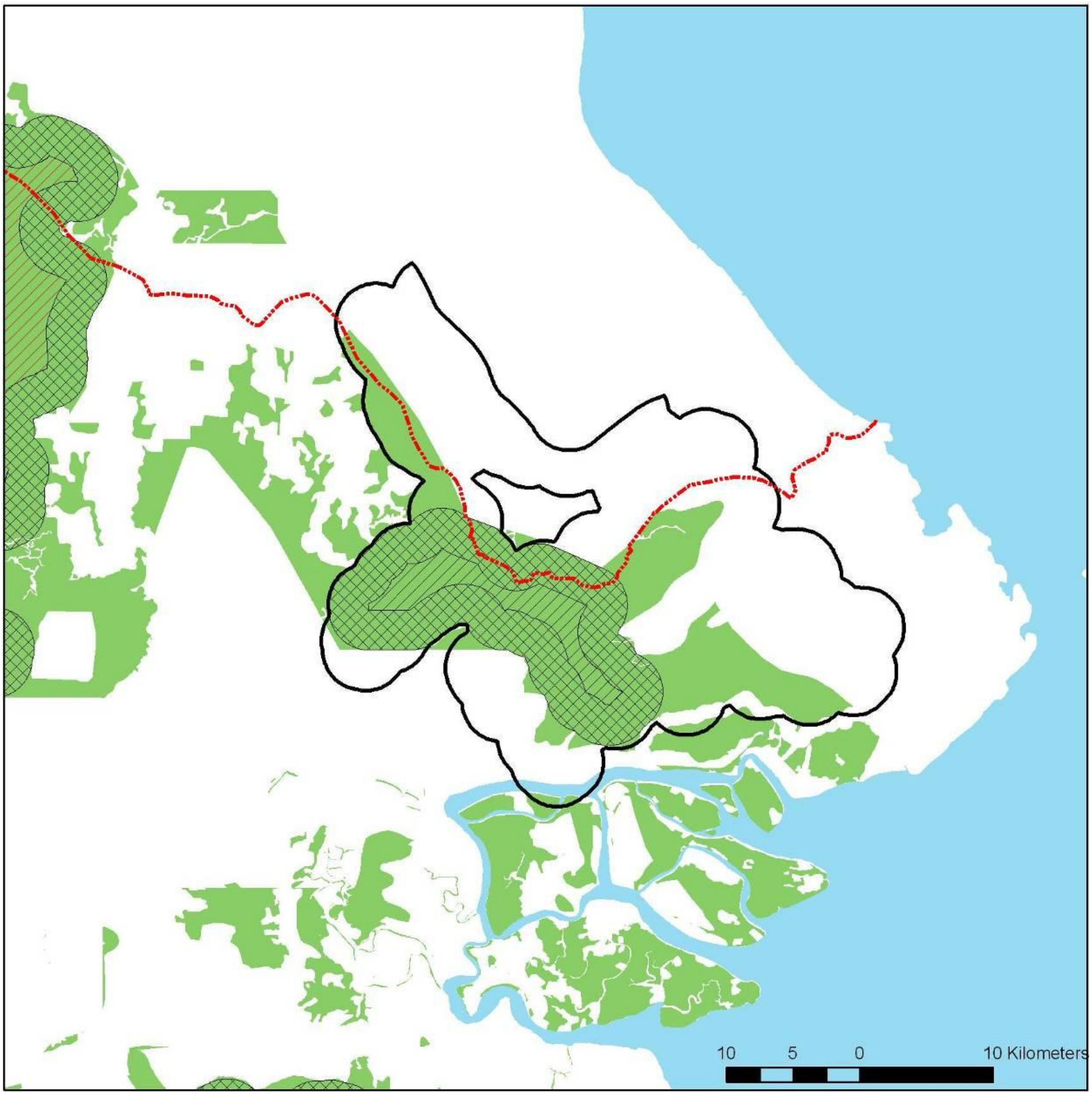


Figure 2.5.6 Future projected fragmentation of Large Landscape 3, resulting from planned deforestation under RTRWP ver 2008.

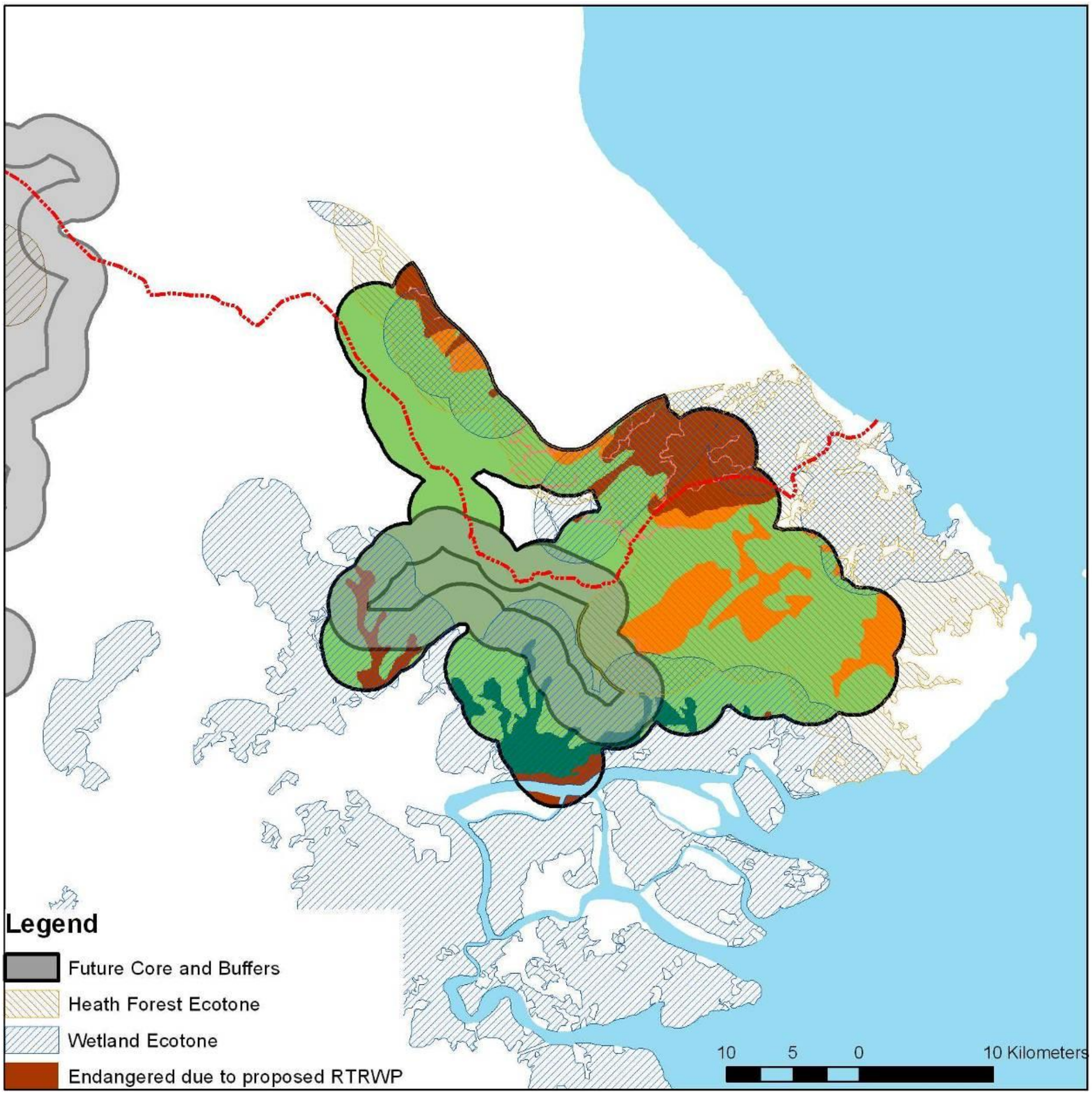


Figure 2.5.7 Future projected fragmentation of Large Landscape 3, and consequent elimination of the majority Ecosystem Transition Zones and the loss of most endangered ecosystems or elimination from a core, resulting from planned deforestation under RTRWP ver 2008.

Oil Palm

Oil palm development can occur in areas classified as Non-forest lands per the RTRWP and TGHK. It is one of the most likely drivers of forest cover change in areas of Landscape 3 that are legally permitted for conversion.

At present the number of licences issued in and around Large Landscape 3 is few. However, if the proposed RTRWP plans are accepted, it is expected that most of the areas reclassified as non-Forest Lands will be converted to Oil Palm. The Multigreen Sepurna Plantation (**Fig. 2.5.8**) is a direct threat to the Peat Swamp forest and hence the HCV 2.2 transition zone between peat and forest on mineral soils. Due to requirements for draining peat as preparation for palms, off site impacts to the remaining Peat Swamp within Landscape 3 are also very likely. Indo Alam Bumimakmur Tg Batu does not constitute a direct threat to Large Landscape 3, beyond a minor potential reduction of the Core Area if the licence area were to be fully converted; however, the estate includes an important stretch of forest that connects Large Landscape 3 to the coast to the east.

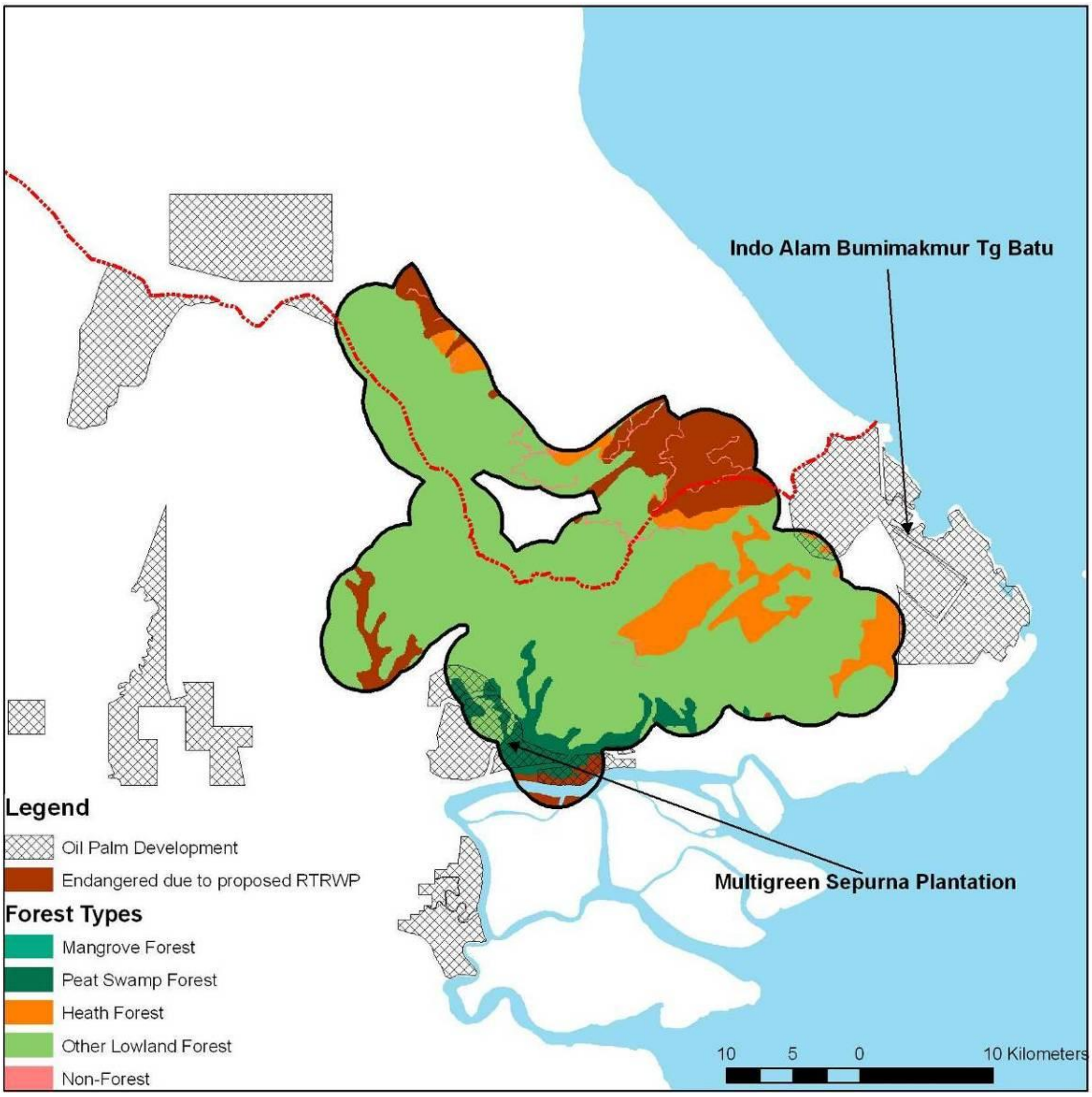


Figure 2.5.8 Planned oil palm development in Large Landscape 3 (Tanjung Batu Peninsula).

Industrial Timber Estates (HTI)

As noted above, it is possible for HTI to be developed on any Production Forest area provided a recommendation is obtained from the Bupati and the Ministry of Forestry approves. Conversion of remaining natural forest to monoculture fast growing tree crops would potentially further threaten endangered ecosystems (HCV 3), reduce or fragment Core Areas of the existing Landscape (HCV 2.1), and destroy or reduce the effectiveness of current ecotone transitions (HCV 2.2)(**Fig. 2.5.9**).

From the currently known distribution of HTI concessions, c. 8,000 ha is planned for development within the Core Area of Landscape 3 on the western side. If the entire area of this concession is converted to plantations, portions of the endangered (HCV 3) **KHY** ecosystem proxy (Forest on coalescent estuarine/riverine plains) overlapping with this concession will be lost, as will the wetland to non-wetland transition area associated with it (HCV 2.2). In addition, much of the future expected forest cover remaining in this Landscape will be lost (i.e. Forest Land that would have been expected to remain as forest once currently forested areas allocated in spatial plans to non-forest uses were converted).

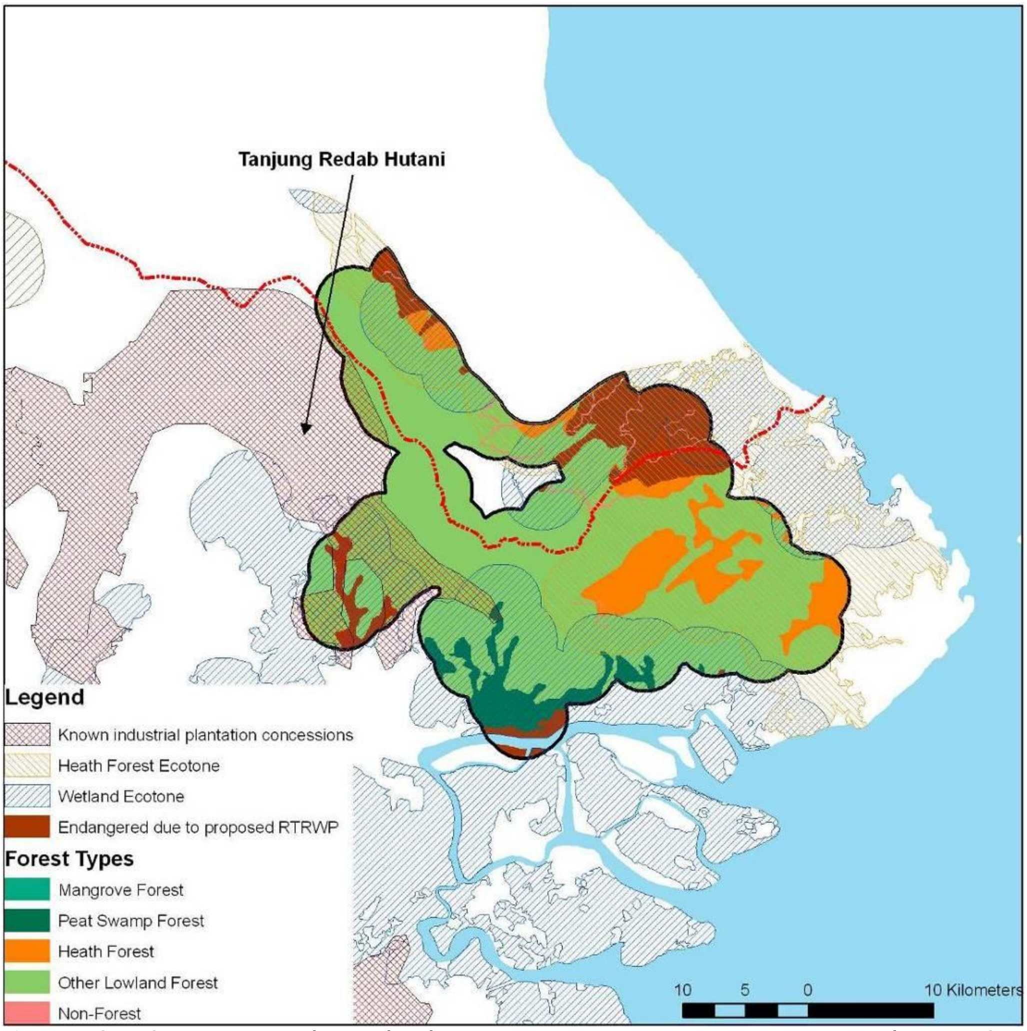


Figure 2.5.9 Known industrial plantation concessions in Large Landscape 3 (Tanjung Batu Peninsula) and its overlap with mapped HCV 2.2 and HCV 3 areas.

HPH (Natural Forest Logging Concessions)

As noted, approximately 80,000 ha of Landscape 3is Production Forest legally permitted for selective timber harvesting. Two active HPH are known to occur within Landscape 3 (**Fig. 2.5.10**). However, the future extent of Production Forest is expected to decline based on the proposed RTRWP, this potentially directly affects the two logging concessions as part of their concession areas are currently planned to become non-forest areas.
Logging has a number of effects on forested areas that can be generalised as:

- Associated damage from extraction, skid trails, logging roads. This alters the structure and composition of the forest, alters the microclimate, and exposes and compresses the soil. These effects can be noticeable for up to many decades.
- Increased access. The logging roads make the area more accessible potentially leading to increased hunting pressure, and agricultural expansion by small holders.
- Increased fire risk and susceptibility to drought. Degradation of forest due to over harvesting in poorly managed concessions can increase the risk of catastrophic fires c.f. causes of 1982/83 fire linked to ENSO droughts.
- Silvicultural practices impact biodiversity. Use of enrichment planting such as TPTJ or TPTII reduces the biodiversity value of logged forest. This technique creates large elongate and interconnected gaps in the canopy during strip clearing and could potentially greatly increase the risk of forest fires in years immediately after trees have been planted until the canopy closes as trees mature.

The occurrence of such large areas of HPH in Landscape 3 represents a serious threat to maintaining landscape HCVs, but also a genuine opportunity to protect them if proper forest management is implemented. This would also lower risk of conversion to plantations in the future, by retaining their long-term commercial timber value. The net effect of HPH on landscape HCVs clearly depends on management, but perhaps even more on the planned re-allocation of Forest Lands to non-Forest Lands.

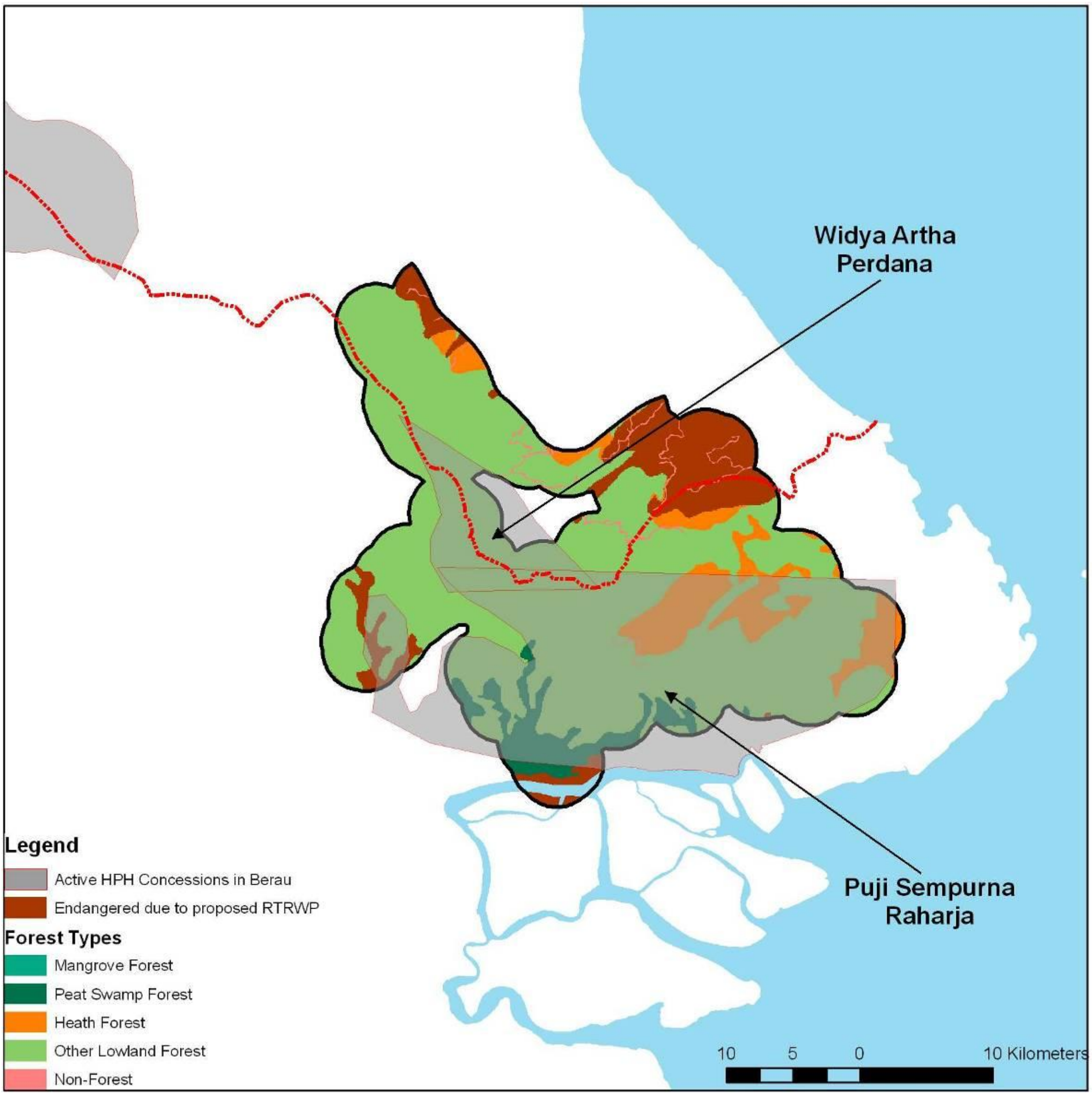


Figure 2.5.10 Known natural forest logging concessions (HPH) in Large Landscape 3 (Tanjung Batu Peninsula).

Agricultural Demand

Development of Berau will stimulate population growth, especially from economic migration. Combined with improved access due to plantation and HTI development, this will increase demand for agricultural land and push the agricultural frontier into regions previously considered inaccessible. Almost the entire area of Large Landscape 3 is relatively flat (<10% of slope, 88%; Table 2.5.2) and suitable for agriculture, although the Heath Forest areas may present a challenge for anything beyond tree crops such as rubber. Access is already relatively good due to numerous existing logging roads (**Fig. 2.5.11**), and will likely improve further. Consequently, even areas classified as Forest Lands in the future are likely to come under pressure. Government regulation and enforcement to prevent smallholder encroachment is generally weak and considered a severe political challenge. As such, threats from future unplanned deforestation along roads, especially in lowland areas, are considered very high.

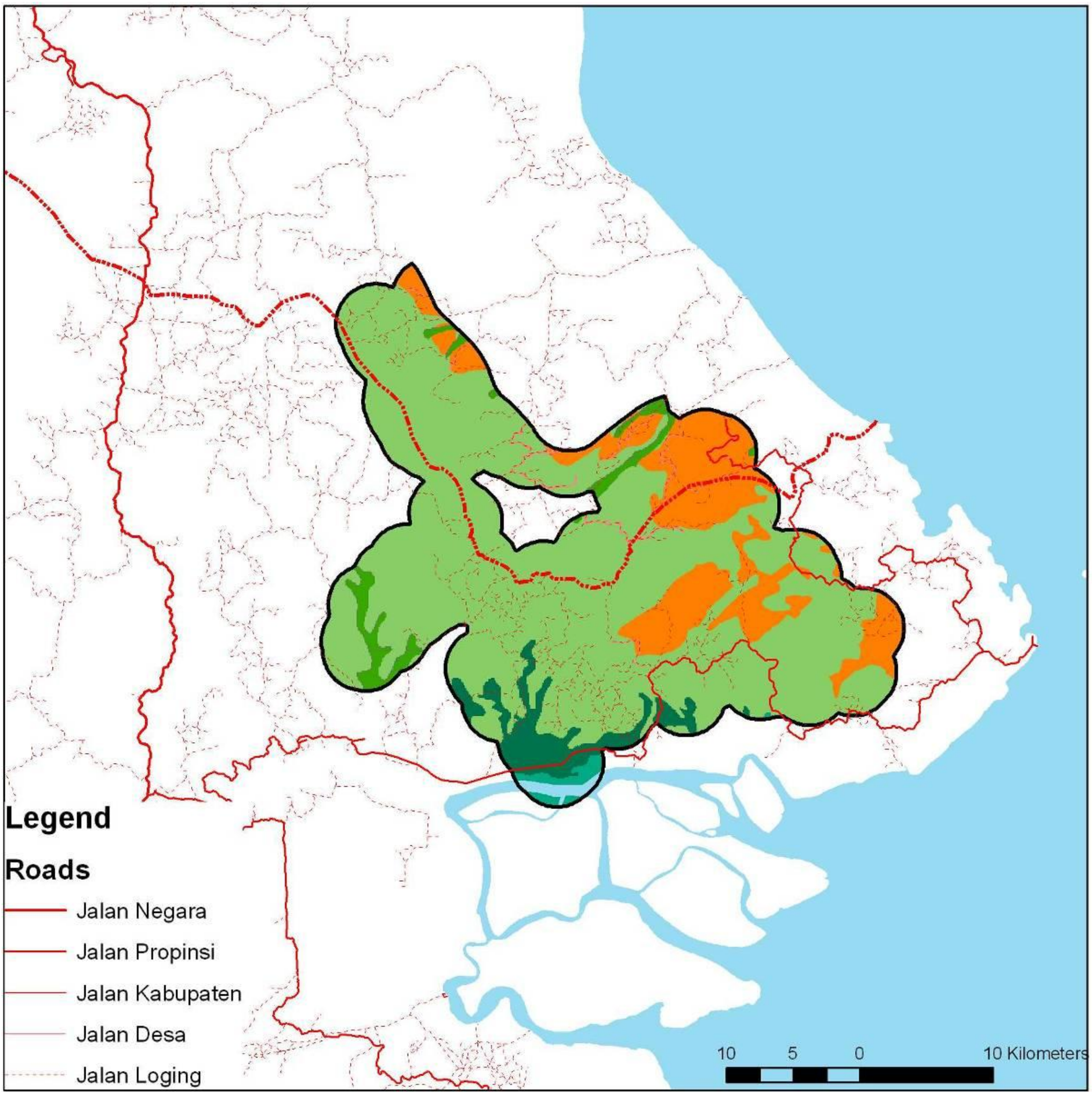


Figure 2.5.11 Existing road network indicates areas of higher risk for agricultural expansion in Landscape 3 (Tanjung Batu Peninsular).

Degradation

Degradation of forest will occur to an extent in HPH. It is especially pronounced in poorly managed ones, and lower in certified timber concessions. Uncontrolled illegal logging can also be a major source of degradation, where access is good via roads, trails, and rivers. In such areas, forest 'thinning' arising from low temperature ground fires caused by small scale shifting cultivation is also a degradation threat.

Degradation mapping of the Berau portion of Landscape 3 was performed by ICRAF (Dewi et *al*. 2010). Approximately 7% of the forested area (c 5,000 ha) is considered to have experienced high levels of degradation or is non-forest. The majority of the area (78%) has been logged over (c. 50,000 ha) with varying degrees of degradation, and only 14% is considered unlogged (c. 9,000 ha) (Table 2.5.4). The areas that are unlogged appear patchy with no clear pattern although the highly degraded areas appear concentrated on the
western side of the Landscape (**Fig. 2.5.12**). It is likely that a similar distribution of degradation exists within the Balongan portions of Landscape 3.

Ecological impacts of medium to severe degradation that affect HCVs include

- Altered forest structure and species composition
- Reduced population sizes for numerous Critically Endangered tree species in the Dipterocarpaceae, which are normally targeted for logging
- Reduced soil fertility causing slowing the growth and recovery of disturbed areas
- Increased severity of drought and surface ground temperatures, due to reduced shade and local humidity
- Increased risk of fires especially in comparison to non-degraded forest, which under natural conditions can be highly fire resistant.

Even highly degraded forest can recover if targeted management interventions are applied and sufficient time is provided. The short-term economic value of such forest is low, however, providing a strong incentive to convert such forests to either HTI or non-forest agricultural uses. This is another indirect negative impact of degradation.

Table 2.5.4 Degradation class mapping for Berau Regency portions of Landscape 3, using data from ICRAF (Dewi et *al*. 2010).

Class	Area (ha)	% Classified
Highly Degraded/Non-Forest	4,797	7
Logged	50,294	78
Unlogged	9,073	14
No Data	1,060	N/A

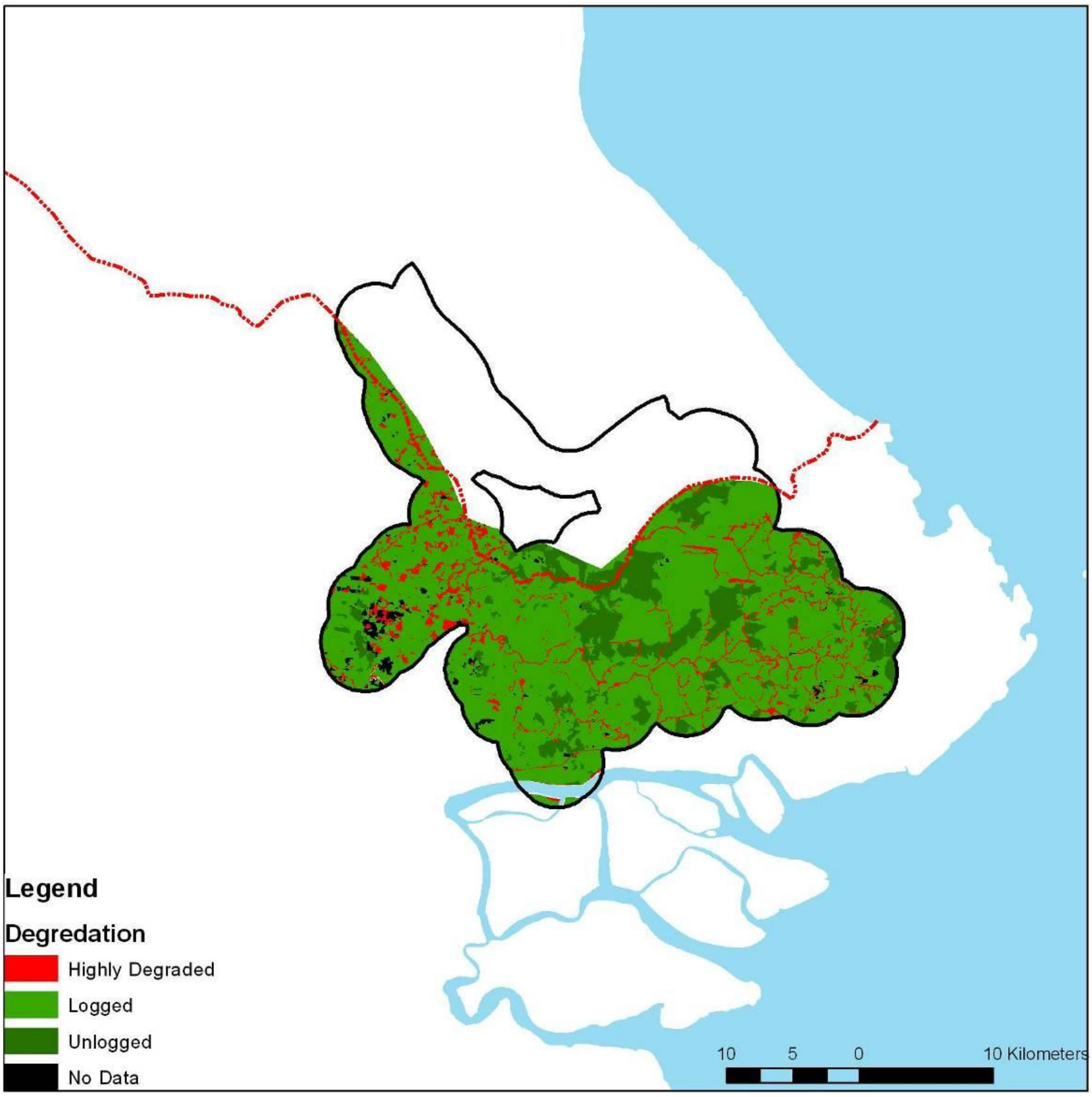


Figure 2.5.12 Forest degradation map (2005 & 2008 composite) in Landscape 3 (Tanjung Batu Peninsular), using data from ICRAF (Dewi et *al* 2010).

Fire

There has been a long history of fire in East Kalimantan with two recent catastrophic events during extended dry periods of the 1982/83 and 1997/98 ENSO events. These events affected an estimated 2.7 million ha (Schindele et *al*. 1989) and 5.2 million ha (Hoffmann *et al*. 1999), respectively.

However, northern Berau has been relatively unaffected by fires. It is likely that a number of factors explain lesser fire impacts in this part of Berau. These include lower (and less extensive) forest degradation levels and the smaller extent of fire prone ecosystem types such as Karst forest and drained peat lands. Historically, Landscape 3 has been resistant to large fires, but three attributes of Landscape 3 make it potentially combustible during an extended dry season: (i) forest degradation combined with (ii) presence of peat swamp forest that may be drained as part of oil palm development and (iii) potential surface coal seams over most of the area (inferred from geological maps; **Fig. 2.5.13**&**Fig. 2.5.14**). The south-eastern corner looks at risk from fire as the adjacent area appears to have some fire prone alang-alang grasslands, but overall the western region of the Landscape is at this point the most degraded. In the future, if the peat swamps are drained this is another severe potential fire risk. Further, fire is a commonly used method of land clearing by small holders (and by irresponsible plantation owners despite laws prohibiting it). All risk factors combined, this could lead to a catastrophic fires.

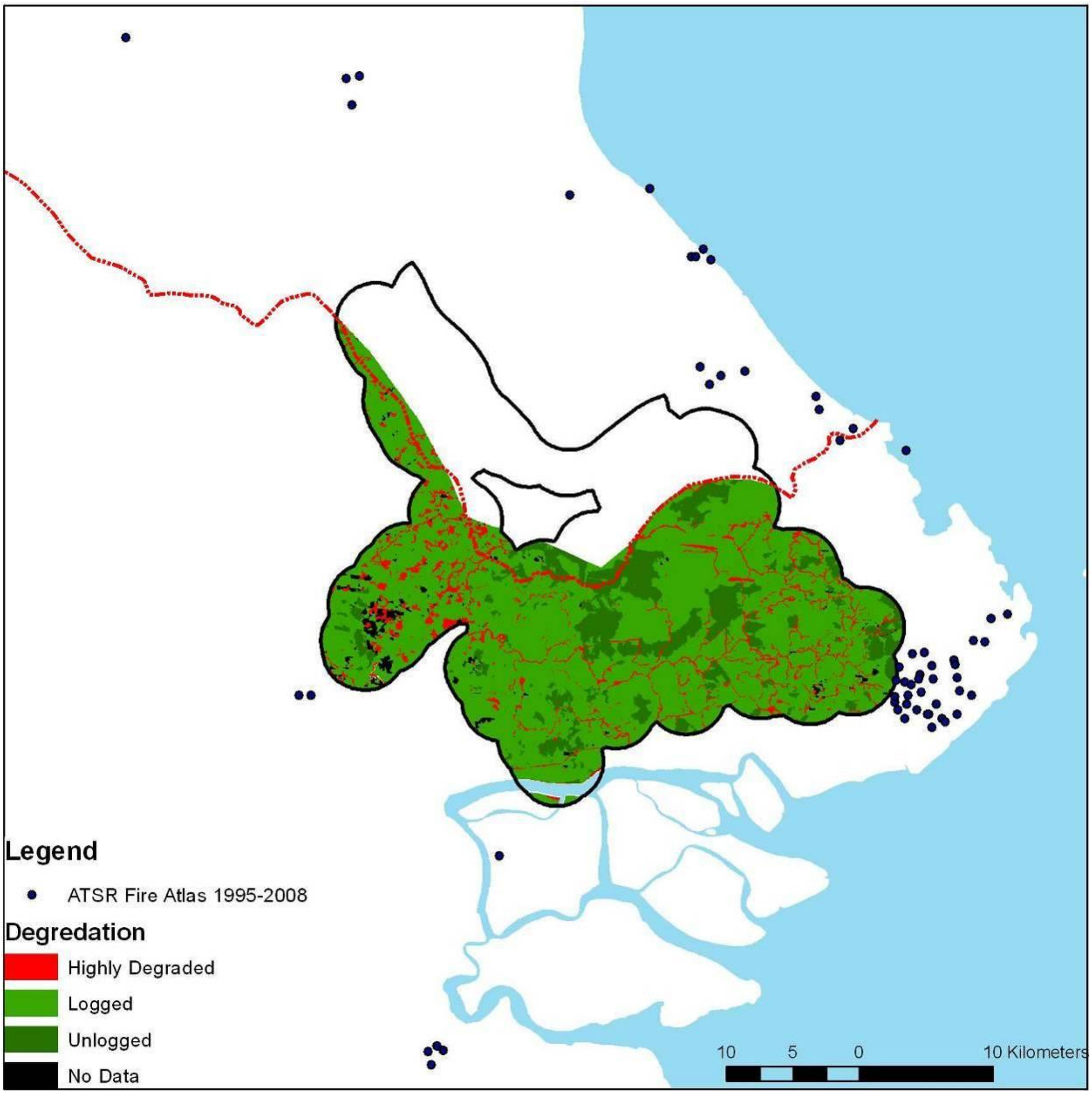


Figure 2.5.13 Fire history (1995-2008) in Landscape 3 (Tanjung Batu Peninsular) using ATSR online database.

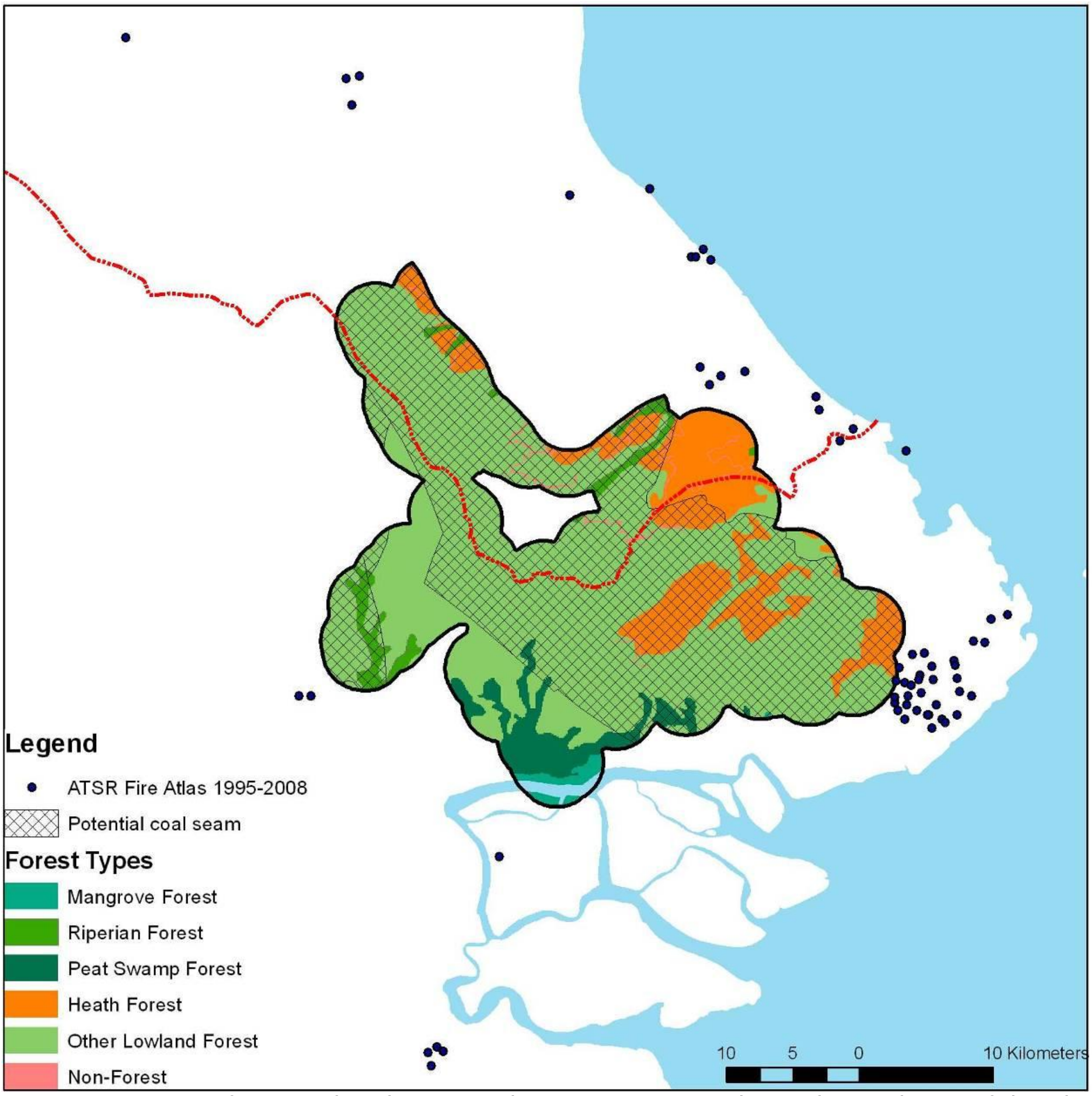


Figure 2.5.14 Map of potential coal seams and peat swamp areas that under conditions of drought and/or mismanagement may function as sources of ground fire in Landscape 3 (Tanjung Batu Peninsular).

2.5.5 Management Recommendations

General Recommendations

As with the other two HCV 2.1 Large Landscapes described in this report, the HCV management recommendations provided below all carry a potential cost of forgone conventional economic development for Berau and East Kutai Regencies. The Berau Forest Carbon Project (BFCP) currently under development by TNC and partners, however, provides an opportunity for carbon finance through REDD to offset these costs in part or in whole, or even to provide net income streams in excess of conventional alternative land uses under certain conditions (e.g. REDD versus oil palm on high carbon, low productivity soils). Although carbon finance revenues under REDD are generated by avoided GHG emissions, considerable biodiversity co-benefits can be accrued through systematic evaluation of alternative sites where those interventions are undertaken. Results of the landscape HCV mapping exercise described herein can be used to guide such strategic site comparison and selection.

Locations of candidate site interventions that would carry co-benefits of promoting HCV maintenance in Landscape 3 are depicted in **Fig. 2.5.15**.

Rare Ecosystems. None known to be present

Endangered Ecosystems. None of the ecosystems present are classified as endangered due to current forest loss. However, three ecosystems are considered endangered due to expected forest loss (**KHY**, **KJP**, &**PST**). As noted earlier all the heath forest areas (c. 15,000 ha) in the Landscape should also be considered endangered as a precautionary measure. The Toolkit specifies that the management goal of HCV 3 endangered ecosystems in a large landscape is to protect 20,000 ha within a Core Area. In the case of Landscape 3, none of the endangered ecosystems are sufficient in extent to reach this minimum target for management as stated above. Furthermore, in the future predicted Core Area none of the endangered ecosystems are represented in the small remaining core, or likely to remain extant due to expected conversion of forest and development of fast growing wood fibre plantations.

For management of HCV 3 areas, the extent of the Core Area and buffer should not be reduced further in the vicinity of all of these HCV 3 ecosystems, as they are already under-represented in core habitat as prescribed by the Toolkit. Further, with reference to proposed general management recommendations outlined above in Table 2.1.1, all the endangered ecosystems are threatened by future planned conversion, placing them in Category 1 for management, making further losses unacceptable without demonstrable gains elsewhere of equal or greater magnitude to offset these losses. It must be emphasized; the minimum pre-condition for such conversion should be modifications to the RTRWP that ensure future expected losses do not exceed 75%.

Ecosystem Transitions. The Toolkit recommends that when HCV 2.2 ecosystem transition areas are present within a HCV 2.1 landscape, 10,000 ha of each ecosystem and the transitional area between them should be maintained (total c. 20,000 ha in size). Ideally, this would be located within a Core Area of a large HCV 2.1 landscape, where possible. In Large Landscape 3, with the broad distribution and often overlapping wetland and heath forest transition zones (c. 43,000 ha and 45,000 ha respectively), these transition zones could be reduced to some extent without violating Toolkits prescriptions (**Fig. 2.5.15**). However, given the relatively small size of the current Core Area (c. 40,000 ha) and its spatial arrangement, any further reductions in the ecosystem transition areas are likely to lead to a large reduction in the Core Area. We conclude and therefore recommend that all transition areas should be maintained for Landscape 3.

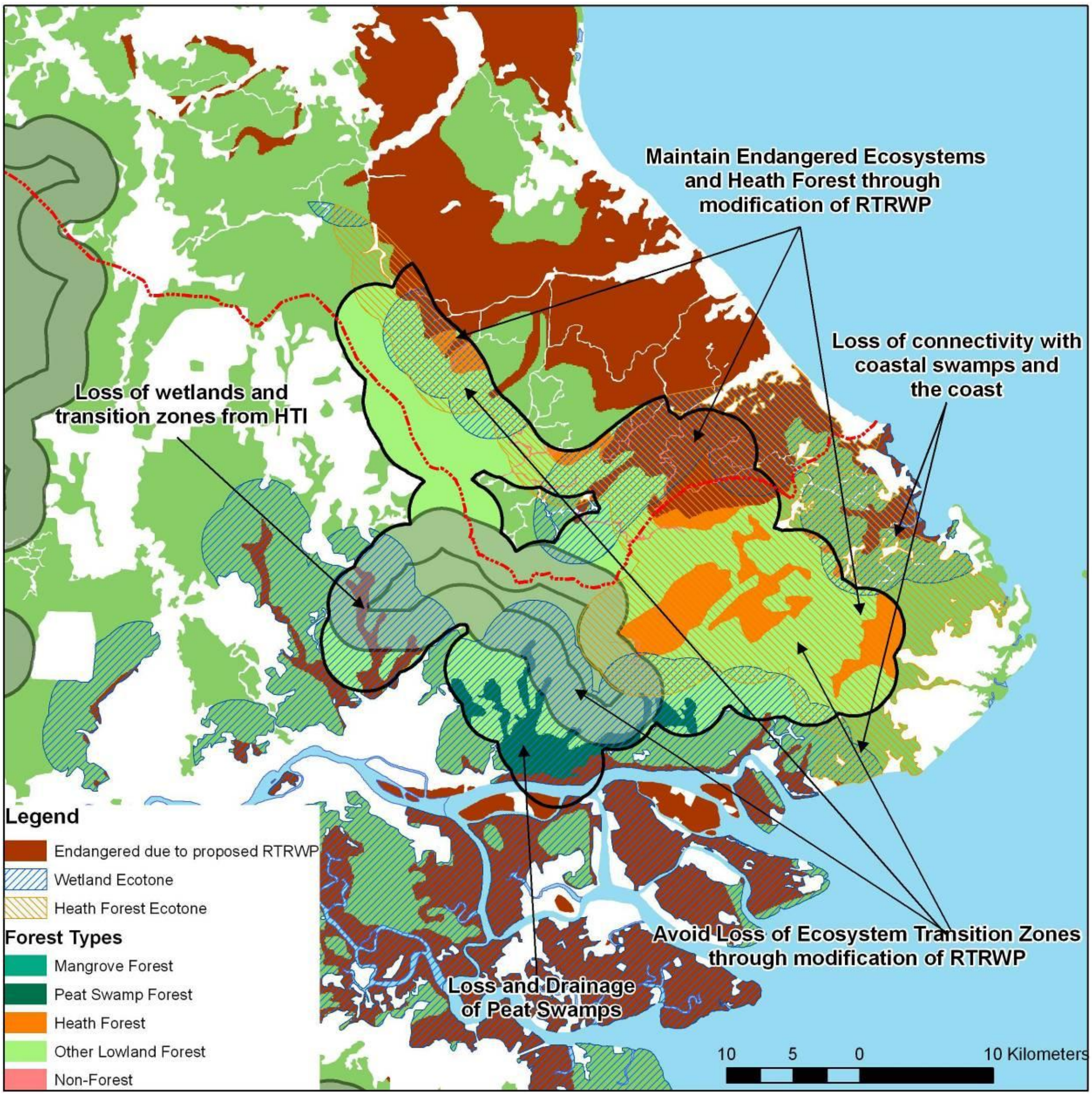


Figure 2.5.15 Possible site interventions recommended for consideration to maintain HCVs in Landscape 3, as discussed in Section 5.4 and below.

Land use planning

As noted above in discussions of Landscape 2, Industrial Timber Estates (HTI) are often but not exclusively planned for Production Forest that has become exhausted of its commercial timber. As discussed in greater detail above, we recommend producing a variation of the currently proposed spatial plans for East Kalimantan Province (RTRWP) and the Regencies (RTRWK) to delineate those Forest Areas eligible for HTI, and those that are not. This would greatly assist in assessing threats and planning for maintaining HCVs and other conservation targets.

The currently proposed RTRWP for East Kalimantan and the corresponding RTRWK for Berau at present threaten: existence of Landscape 3 as an HCV 2.1 area, the almost total loss of the HCV 2.2 and HCV 3 areas. If this Landscape is to persist and maintain its HCV attributes, an amendment of the current RTRWP plans must be considered a matter of urgency prior to the plans being formally accepted. A change in the RTRWP would also mitigate many of the threats to Landscape 3 and its HCVs that are within Balongan Regency and outside the management area of Berau.

HPH

The two known active logging concessions within Landscape 3 should be engaged with the following generic recommendations:

1. Those that are not certified through FSC or LEI should be mentored to assist them to improve management practices. This could be encouraged either by direct funding from a REDD program tied to IFM incentives, local tax relief for those that obtain certification or simply by making a persuasive case for cost control benefits through better management.
2. RIL should be practiced.
3. Pilot project silvicultural practices such as TPTJ and especially TPTII should be minimized, especially in hilly terrain and in areas close to the forest edge to avoid potential for increased susceptibility to fire from external sources.
4. Encroachment by small holders into the concession areas should be minimized by developing political support that provides alternative areas for small holder development, support for eviction if required, control of logging roads, and the development of community based agro-forestry projects to stabilise the forest edge and provide direct benefits to local communities.
5. Concerted effort (including ground surveys) should be made to identify areas that are most severely degraded within these HPH for setting rehabilitation and replanting priorities, preferably with fast growing native species.
6. Site level HCV assessment should be conducted to identify areas of special importance for maintaining HCV 1 and other HCVs not covered in this study.
7. Seek intercompany support to maintain connectivity across HPH borders, control access, and coordinate fire fighting preparations and preventative measures.

HTI

The area of PT Tanjung Redeb Hutani (TRH) fibre concession that lies partly within Landscape 3 should be a priority for management interventions. The concession poses a direct threat to HCV 2.1, HCV 2.2 and HCV 3 areas. However, with appropriate delineation of conservation areas, TRH could potentially serve a beneficial long-term management purpose for Landscape 3 by acting as an additional buffer to stabilize the forest edge and control fire risks. This form of benefit could be optimised by encouraging them to undertake HCV assessments within their own concessions (or where applicable use the results provided here) to assist in the implementation of MoF required Makro and Mikro Delineation of conservation zones and management plans for the plantation.

Oil Palm Estates

In conjunction with a revision of the proposed RTRWP as outlined above, the planned oil palm estates in the vicinity of Landscape 3 should be engaged. As with HTI, oil palm plantations have the potential to stabilize forest edges if they provide meaningful benefits to local communities and restrict access to the forest, at least for commercial scale timber extraction and excessive hunting. Better-managed estates tend to be run by companies working towards RSPO certification. Effort should be made to determine first the two companies near Landscape 3 are RSPO member and if not then encourage them to join the RSPO and work actively toward certification, first by respecting and protecting their borders with Landscape 3. When the new RTRWP is approved, the lands that become allocated for non-Forestry purposes are likely to be allocated to Oil Palm estates. At this time, a careful watch over new applications should be maintained, and TNC and partners should engage those companies that pose risk to Landscape 3.

In the short term, PT Multigreen Sepurna Plantation should be engaged as a matter of urgency, given that areas of its licence area contain endangered **KJP**, intertidal swamps, as well as some peat swamp forest. In addition to the loss of part of an endangered ecosystem the conversion and draining of these areas is likely to have an offsite impact on the remaining peat swamps and will greatly reduce the amount of HCV 2.2 wetland transition zones. In addition to this PT Indo Alam Bumimakmur Tg Batu should be engaged to ensure connectivity between the Large Landscape 3 and the coastal swamps and the coast is maintained including the associated HCV 2.2 wetland and heath forest transition zones.

2.6. HCVs Occurring Outside of Large Landscapes

Outside of the large HCV 2.1 landscapes described in Section 3-5 exists a number of HCV 2.2 areas and HCV 3 ecosystems that will also require management. This chapter first identifies and provides management recommendations for these HCV 2.2 areas, then subsequently provides the same for HCV 3 ecosystems.

2.6.1 HCV 2.2 Areas

Overview

Three types of ecosystem transition zone are present in Berau and East Kutai: Elevational clines (Elevation), Heath to Non-Heath Forest (Heath), and Wetland to non-Wetland areas (Wetland). The Elevation transition zones and heath (**Fig. 2.6.1**) occur almost exclusively within the current Large Landscape HCV 2.1 areas described above. The Wetland transition zones, however, occur almost exclusively outside the HCV 2.1 Core Areas, and are associated primarily with coastal swamps and peat swamp forest. Heath transition zones are found equally within and outside the HCV2.1 Core Areas.

The revised HCV Toolkit provides little guidance on how HCV 2.2 transition areas outside HCV 2.1 landscapes should be managed, although the objective is clear: Management should aim to guarantee the movement of species and flow of energy and materials across ecosystem types. In this report, we have proposed conservatively that the management zone for an HCV 2.2 area should be a 3 km wide buffer either side of the transition boundary. Such a buffer is very likely to be sufficient when transitions zones are part of a large relatively intact block, but may not be sufficient, if, for example, the transition zone has become fragmented or the remaining extent of the two contiguous ecosystem types are small. A total of 72 distinct Wetland transition zones identified in the Berau and Kutai Timur Regencies occur outside of HCV 2.1 cores, and thus likely fall into the latter of these two categories. Specific recommendations for each of these transition areas are beyond the scope of this study, so we have limited ourselves to general recommendations.

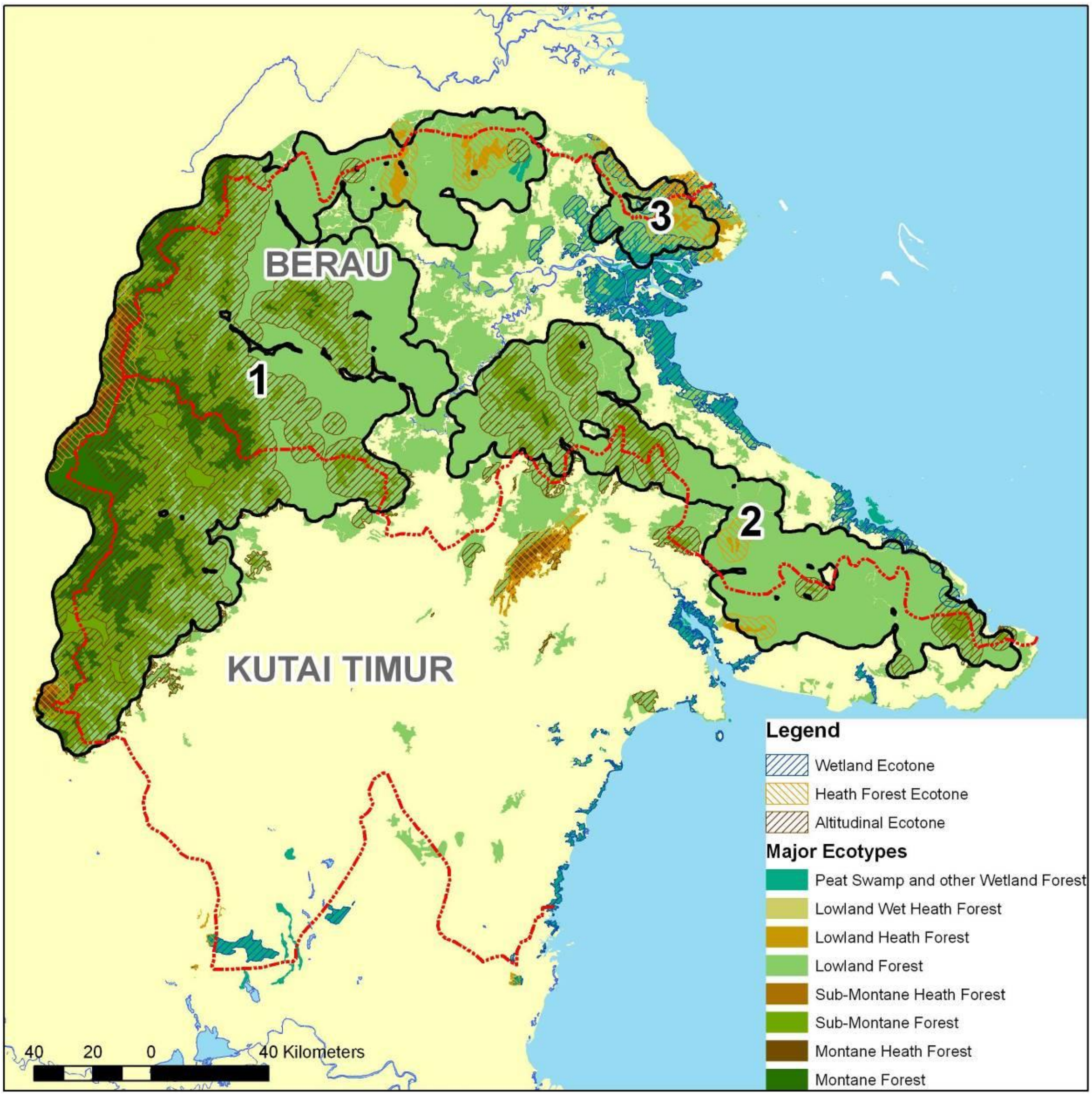


Figure 2.6.1 Distribution of three ecosystem transition zones (HCV 2.2) within Berau and Kutai Timur Regencies. A majority of the heath and altitudinal transition zones are within HCV 2.1 areas described separately, but the majority of the wetland transition zones exist outside the Core Areas of the HCV 2.1 zones.

Threats

Elevational Transitions

The elevational transitions facing most serious threats are the transitions from lowland to Sub-montane areas, especially those which contain areas that are relatively flat and therefore suitable for agricultural or plantation development.

Heath Forest Transitions

There are two large areas of heath forest outside the three HCV 2.1 Landscape Areas. The first heath forest transition area is nearby and to the east of Large Landscape 3. It is directly threatened with agricultural development, as described in Section 2.5.5 above. The second heath transition is to the south of Large Landscape 2, and appears not to face severe threats due to its mountainous terrain.

Wetland Transitions

The threats to Wetland transition zones can be divided into two categories. The first represents factors that threaten integrity of the wetland itself. Wetlands have increasingly been targeted for drainage and conversion to agricultural lands, plantations, and fish ponds in the case of mangroves. Drainage in one part of a wetland can have considerable off-site impacts elsewhere depending on local hydrology and resulting patterns of drainage. In the case of peat swamps, drainage also markedly increases risk of fire during extended dry periods, as illustrated by the destruction of vast areas of inland peat swamp forest surrounding the Mahakam Lakes during the 1986-87 ENSO events. The second threat to Wetland transitions is factors that promote conversion of adjacent non-wetland forest, which often represent flat lowland areas suitable for agriculture.

Management Recommendations

Elevational Transitions

There are three locations with elevational transitional zones that are not part of a larger HCV 2.1 Landscape. Given their relatively small size (<25,000 ha each), all three of these should be maintained in their entirety to maintain the HCV 2.2 function. The lowland portions (<500m a.s.l.) of these transition areas should be targeted for protection, as they are at higher risk than upslope areas (**Fig. 2.6.2**).

Heath Forest Transitions

The extensive heath forest transition zone to the south of Large Landscape 2 should be maintained in its entirety, along with the adjacent elevational transition noted above (**Fig. 2.6.2**). To maintain the heath forest transition zone occurring to the east of Large

Landscape 3, this area should be maintained at least to the full extent of the overlap with the nearby wetland transition, described further below.

Wetland Transitions

Within Berau the wetland transition zones associated with the coastal swamps are probably the highest priority for targeted interventions of HCV 2.2 areas described in this section, because they lie entirely outside the Large HCV 2.1 Landscapes, are highly threatened, and frequently also support endangered ecosystems as part of the wetland habitat mosaic (see Section 2.6.2 below).

To the east of Large Landscape 3, there is potential for maintaining connectivity of the upland portions of Landscape 3 with the endangered mangrove forest areas on the coastline. This would also maintain the wetland transition zone, at least in part (**Fig. 2.6.2**). This area, however, is currently threatened by an existing oil palm license (see Section 2.5.4 above).

On the coast, between Landscape 2 and 3, is an extensive area of primarily mangrove swamps, portions of which that fall in the Northern Lowlands region are considered endangered (**Fig. 2.6.2**). Immediately behind (inland) of these mangroves are forest areas of somewhat limited extent on mineral soils. Much of these mangroves are planned for conversion to fish ponds. Noting that mangroves generate considerable economic benefits for local fisheries and coastal protection, a review of development plans for this coastal area should be conducted with the aim of striking a more rational balance between maintenance of mangroves and development of fish ponds, especially in areas where connectivity can be maintained with inland forests on mineral soils contiguous with it.

Further south, and along the Mangkalihat Peninsula, all of the remaining wetland and coastal vegetation areas along the northern border of Landscape 2 and in the vicinity of the PT Daisy logging concession should be maintained (**Fig. 2.6.2**; see Section 2.4.5 for fuller discussion of this area).

Along the coast of Kutai Timur, all the remaining coastal swamps should be maintained, in addition to any contiguous inland forests on mineral soils (**Fig. 2.6.2**).

North of the Mahakam Lakes, the few remaining wetlands that include peat swamp should be maintained in their entirety (**Fig. 2.6.2**).

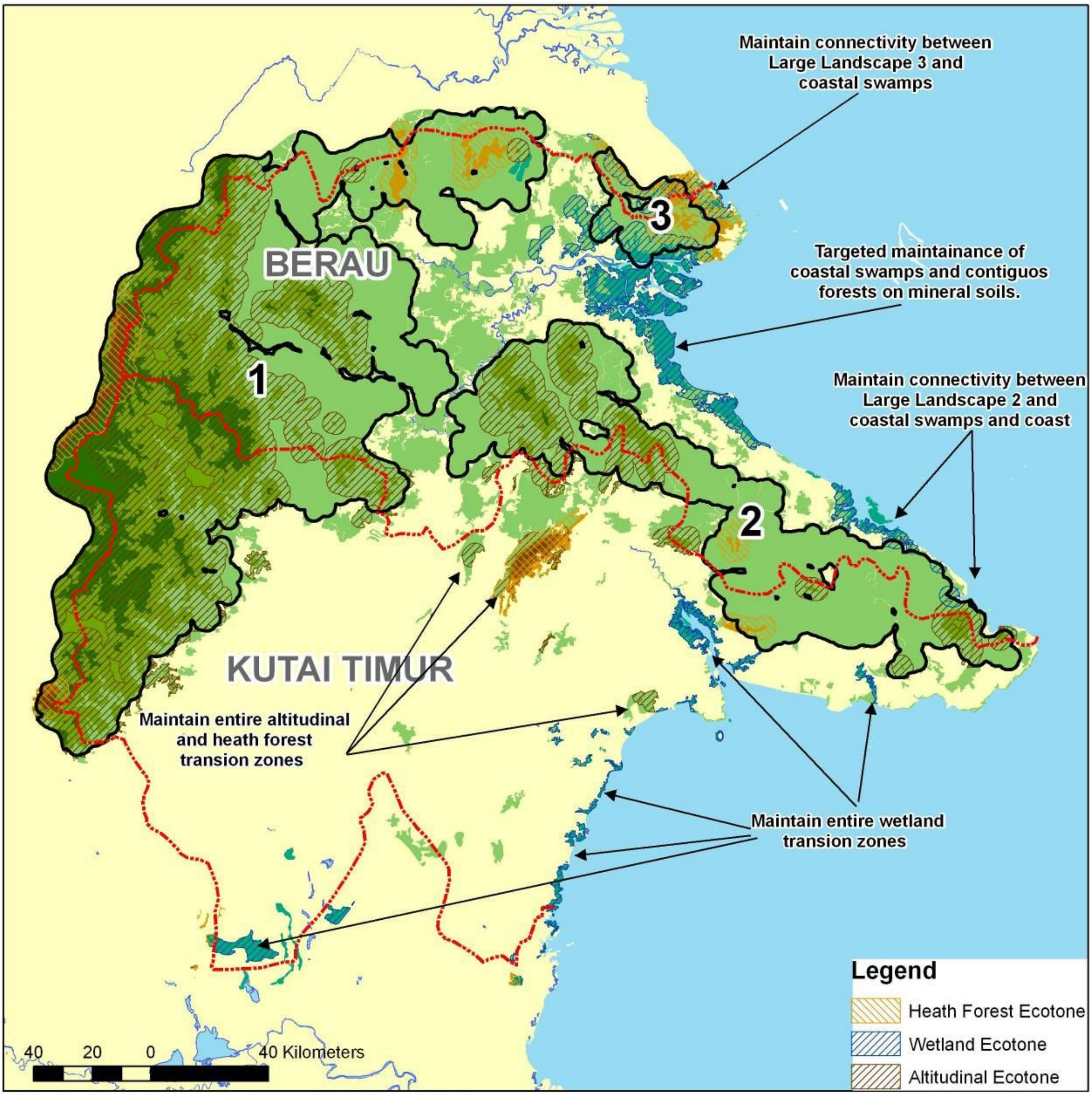


Figure 2.6.2 Candidate site interventions recommended for consideration to maintain HCV 2.2 areas that occur outside the Large Landscape blocks identified under HCV 2.1.

2.6.2 HCV 3 Ecosystems outside of HCV 2.1 Landscapes

Overview

Rare and Endangered ecosystems (HCV 3) are evaluated throughout Sub-units of the major island, referred to as physiographic regions, not along administrative borders. The two Regencies Berau and Kutai Timur fall within four separate physiographic regions (**Fig. 2.6.3**). This can mean that a particular ecosystem type present in two regions may be rare or endangered in one physiographic region but not in the other. However, for management of the endangered ecosystems (HCV 3 areas) that fall outside the three Large Landscapes (HCV 2.1) defined here, it is convenient to consider each Regency separately. This also makes practical sense, as the separate Regencies will have management authority over the areas.

A given ecosystem can be considered rare and/or endangered (**Fig. 2.6.3**), and management recommendations can differ depending on this status. The distribution of rare ecosystems can be seen in **Fig. 2.6.4**. Further, to assist in the identification of priority interventions for endangered HCV 3 ecosystems, in this report we define and use a new term -- Critically Endangered – in reference to ecosystems where more than 90% of the ecosystem type has been lost or is expected to be lost based on current land use planning (**Fig. 2.6.5**).

A large number of rare or endangered ecosystems exist throughout the two Regencies, which, in turn can be found in multiple locations, each with its own potential threats and therefore its own specific management prescriptions. We have limited ourselves to generic recommendations for rare and endangered ecosystems (see Section 2.1.3). However, in the case of where the endangered ecosystems are found either within a non-HCV 2.1 core area and/or in a HCV 2.2 ecosystem transition area we provide specific recommendations for that block of forest.

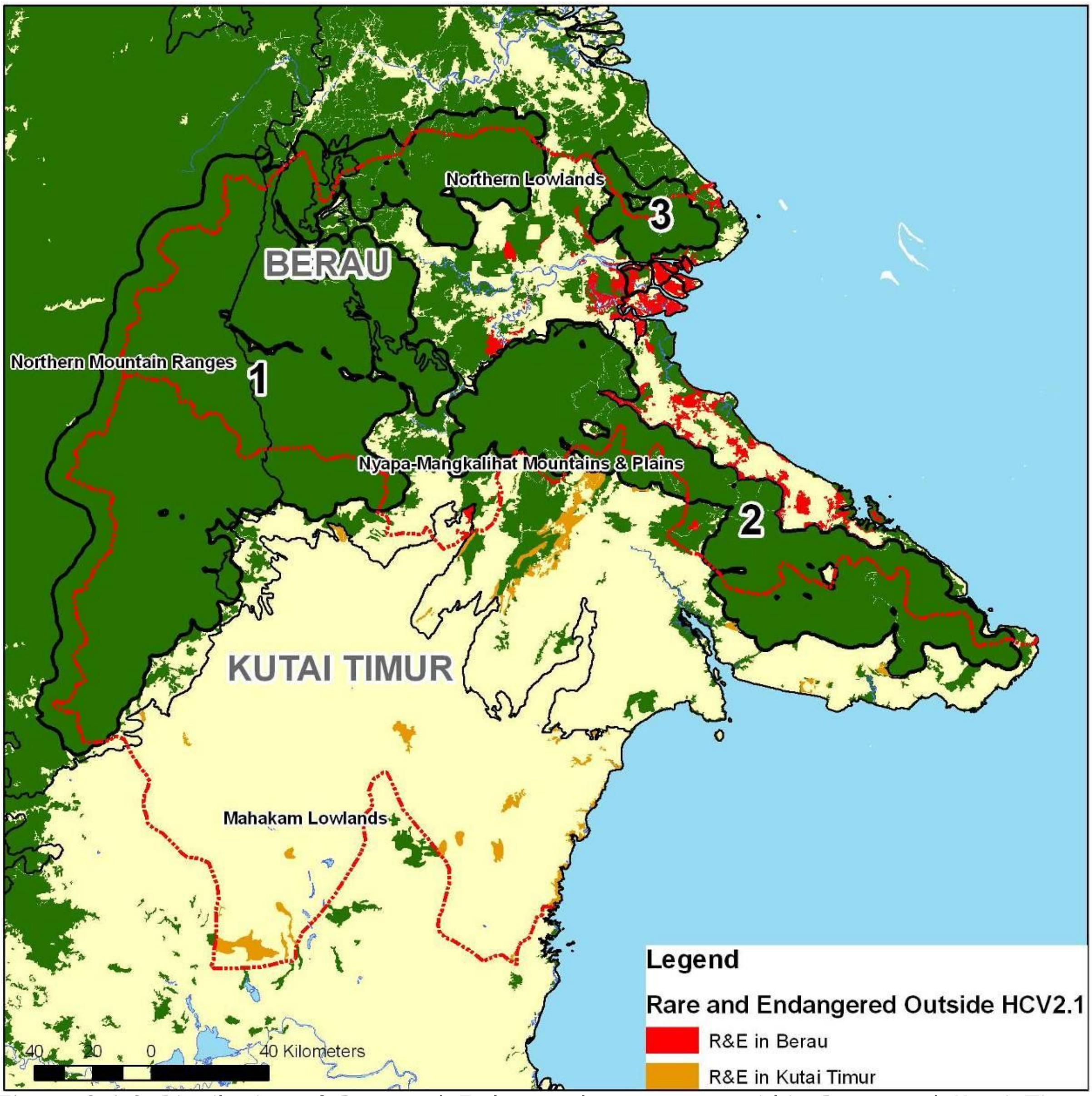


Figure 2.6.3 Distribution of Rare and Endangered ecosystems within Berau and Kutai Timur Regencies outside HCV 2.1 Areas. The two Regencies overlap with the four physiographic regions shown.

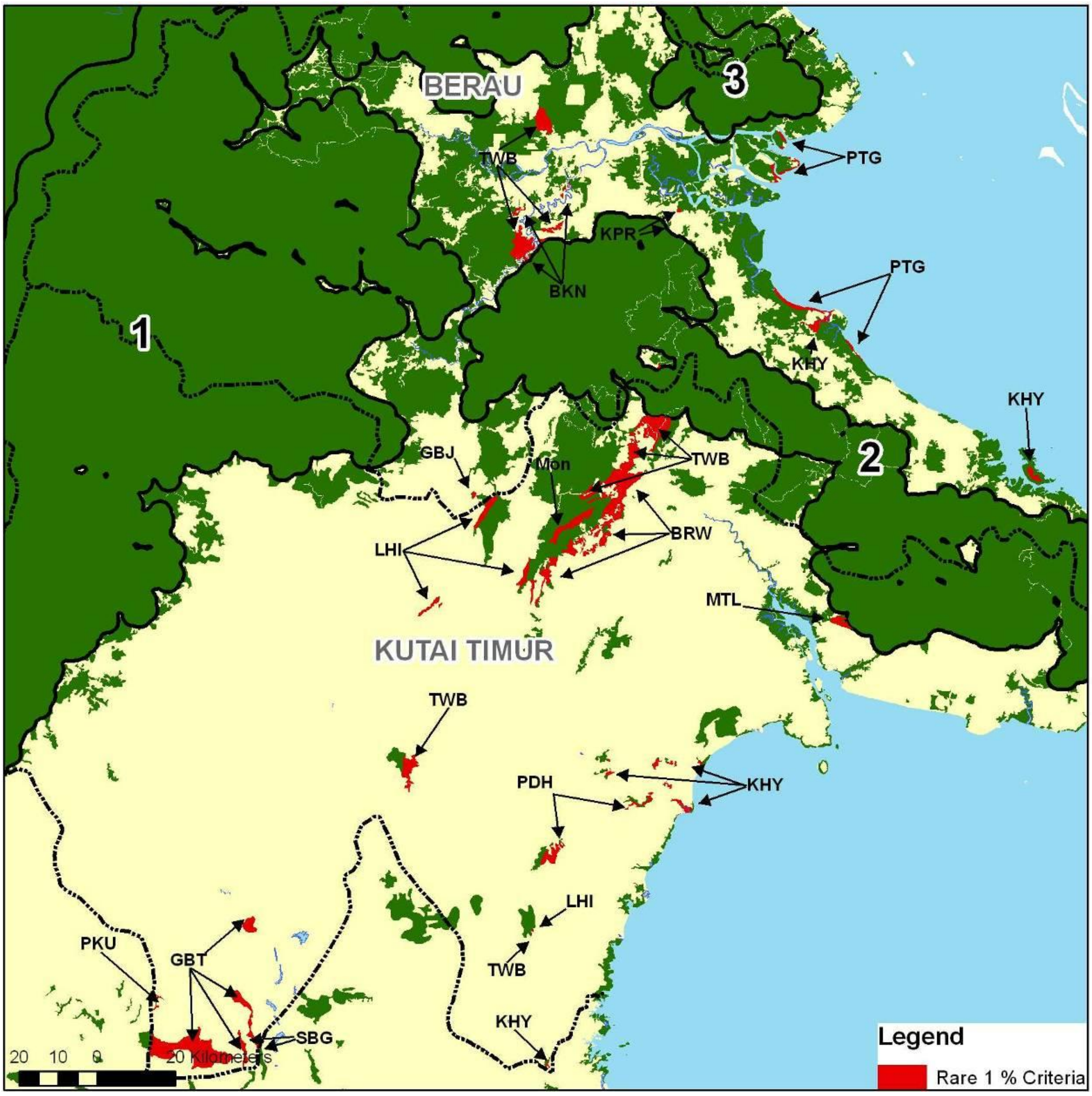


Figure 2.6.4 Distribution of Rare ecosystems (using 1% criterion) within Berau and Kutai Timur Regencies.

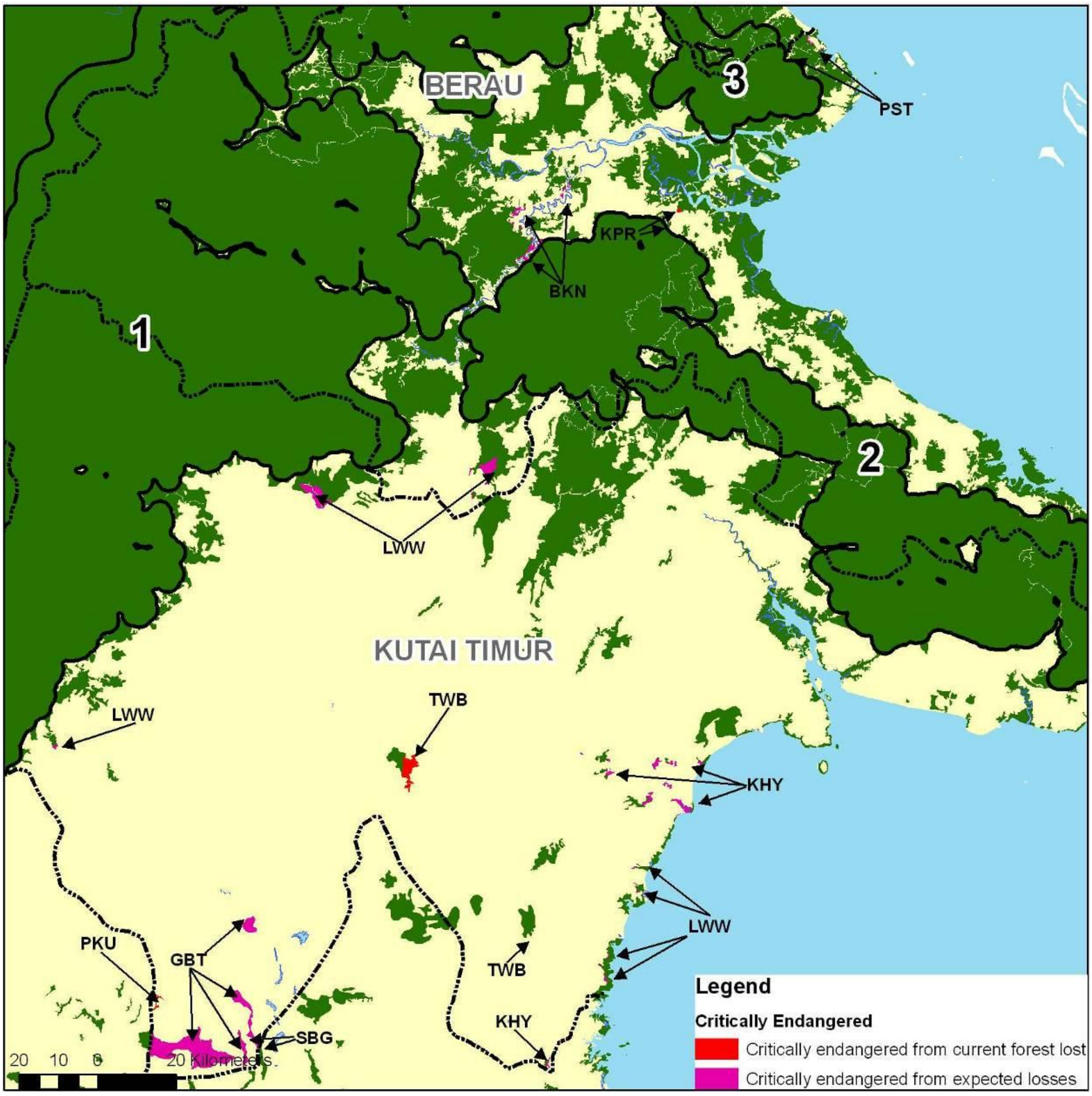


Figure 2.6.5 The distribution of critically endangered HCV 3 ecosystems in Berau and Kutai Timur Regencies. Critically Endangered ecosystems have currently lost, or in the future are expected to lose, >90% of their historical extent (c. 1975).

Generic Recommendations for Rare or Endangered Ecosystems

Rare Ecosystems

In line with recommendations outlined in Section 2.1.3 above, we propose that any further loss of rare HCV 3 ecosystems is unacceptable, unless it can be demonstrated that (i) without management intervention (that entails partial conversion) the entire patch would be eliminated due to planned or unplanned conversion, and (ii) proposed operations will guarantee that overall losses do not exceed a stakeholder agreed upon maximum amount (which under no circumstances may be greater than 90% of the historical extent within the physiographic region).

Other recommendations include:

- Ensure offsite impacts from development outside the HCV 3 areas do not affect the rare ecosystems, especially the drainage patterns and quality of water.
- A buffer of at least 1 km is maintained were operational activities are kept to a minimum, such that they are unlikely to affect the rare ecosystem.

Endangered Ecosystems

In line with recommendations outlined in Section 2.1.3, endangered ecosystems fall into three separate categories depending on the extent of current and future expected loss, with recommended management dependent on category (see discussion under Section 2.1.3). In general, however, further losses should be avoided.

Other recommendations include:

- Ensure offsite impacts from development outside the HCV 3 areas do not affect the endangered ecosystems, especially the drainage patterns and quality of water.
- A buffer of at least 1 km is maintained were operational activities are kept to a minimum such that they are unlikely to affect the rare ecosystem.

Rare and Endangered Ecosystems that fall within a Core Area but outside a HCV 2.1 landscape

In addition to the above recommendations for rare and endangered ecosystems, where a rare or endangered ecosystem exists within a Core Area of a forest block that does not meet HCV 2.1 criteria (i.e., <20,000 in size), then as much as possible of the ecosystem should be kept within the Core. By extension, this will require the Core and its associated buffers to be maintained.

Rare and Endangered Ecosystems that represent HCV 2.2 Transition Zones

In addition to the above recommendations, for rare and endangered ecosystems that form part of a HCV 2.2 Transition Zone, sufficient area of each ecosystem and the transition between them must be maintained.

Berau - Rare and Endangered Ecosystems Outside of Large Landscapes

Berau Regency contains a total of 17 ecosystems that meet one or more criteria as rare and/or endangered, distributed across three Physiographic Regions in which the Regencies overlap (**Fig. 2.6.6** and Table 2.6.1). Overall, a total of c. 85,400 ha of HCV 3 ecosystems outside of Large Landscapes are found within Berau, approximately 1% of these are within protected forest, 47% within production forest, and 52% within non-forest areas according to the proposed RTRWP for East Kalimantan (Table 2.6.1).

Four of the endangered ecosystems are considered Critically Endangered. These include: **KPR**, forest on undulating karstic planes with hums, which in the Northern Lowlands has lost greater than 90% of its natural vegetative cover since c.1975, with only 107 ha remaining, all of which is expected to be lost in the future; **BKN**, forest on minor valley floors within hills, which in the Northern Lowlands has lost at present 73% of its historical extent and is expected to lose 95% based on future land use plans (1,244 ha of this ecosystem occurs within Berau, representing 92% of its remaining extent in the physiographic region; **PST**, forest on marine terraces, also within the Northern Lowlands, which currently has lost only 43% of its current extent but is expected to lose 95% (portions of **PST** that remain inside Berau but outside HCV 2.1 areas are small, representing less than one percent of its total remaining extent); and **LWW**, forest on undulating to rolling sedimentary plains, with c. 1,300 ha in Berau outside of HCV2.1 areas, overall within the Mahakam Lowlands c. 102,000 ha remain but 86% has already been lost and an expected total of 91% of historical extent will be lost in the future.

For all the rare and endangered ecosystems outside of HCV 2.1 Core Areas within Berau, the previously stated generic recommendations apply (see Table 2.6.1).

Berau - Rare and Endangered Ecosystems that occur outside of HCV 2.1 Large Landscapes that form part of HCV 2.2 Ecosystem Transition Zones

In number of locations outside the three Large Landscape HCV 2.1 areas in Berau, rare endangered ecosystems occur within forest blocks that have Core Areas but of insufficient size to represent HCV 2.1 areas, and/or form part of HCV 2.2 Ecosystem Transitions (**Fig. 2.6.7**). In general terms, all of the Core Areas and all or parts of the HCV 2.2 Transition Zones should be maintained to ensure the future survival and integrity of these endangered ecosystems (see **Fig. 2.6.7**).

Table 2.6.1 Rare and Endangered Ecosystems in Berau Regency. Those highlighted in red are considered Critically Endangered with over 90% loss of historical extent since c. 1975. Those highlighted in yellow are expected to become Critically Endangered based on the proposed RTRWP for East Kalimantan (version 2008).

Ecosystem Proxy	Symbol	Description	Total Extent in Physiographic Region (ha)	% Loss since c. 1976	% Expected Loss	Total Extent in Berau outside HCV2.1 (ha)	% of Total Extent in Berau outside HCV2.1	Rare 1% Criteria	Endangered from current loss	Endangered from expected loss	Protected Forest (ha)	Production Forest (ha)	Other (ha)	Management Level HCV3 per Table 1.1
Northern Lowlands														
BAKUNAN	BKN	Minor valley floors within hills	1,356	73	95	1,244	92	Y	Y	Y		237	1,007	**3**
KAHAYAN	KHY	Coalescent estuarine/riverine plains	78,982	31	81	3,716	5			Y		280	3,436	**1**
KAJAPAH	KJP	Inter-tidal mudflats under mangrove and nipah	197,291	48	78	36,042	18			Y		20,226	15,816	**1**
KAPOR	KPR	Undulating karstic plains with hums	107	93	98	107	100	Y	Y	Y		29	77	**3**
PULAU SEBATIK	PST	Marine terraces	51,110	43	95	155	0			Y			155	**1**
PUTING	PTG	Coastal beach ridges and swales	4,014	40	69	1,037	26	Y				941	97	**2**
TEWAI BARU	TWB	Hillocky sedimentary plains with steep parallel ridges	13,320	20	53	5,082	38	Y				2,925	2,157	**2**
Nyapa-Mangkalihat Mountains & Plains														
BAKUNAN	BKN	Minor valley floors within hills	79	10	37	58	73	Y				34	24	**2**
BATU AJAN	BTA	Dissected volcanic cones	7,700	2	2	32	0	Y			32			**2**
KAHAYAN	KHY	Coalescent estuarine/riverine plains	1,516	14	30	1,516	100	Y				1,238	277	**2**
KAPOR	KPR	Undulating karstic plains with hums	79,425	52	70	32,659	41		Y		689	12,124	19,846	**1**
LOHAI	LHI	Steep long-sided narrow ridges	4,971	80	80	1	0	Y	Y	Y		1		**2**
PUTING	PTG	Coastal beach ridges and swales	1,605	11	31	1,605	100	Y				1,237	367	**2**
TEWAI BARU	TWB	Hillocky sedimentary plains with steep parallel ridges	12,608	38	38	58	0	Y				58		**2**
Mahakam Lowlands														
GUNUNG BAJU	GBJ	Hillocky karstic plains	135	85	87	135	100	Y	Y	Y		116	18	**2**
LAWANGUWANG	LWW	Undulating to rolling sedimentary plains	102,229	86	91	1,341	1		Y	Y		35	1,306	**3**
TEWEH	TWH	Hillocky sedimentary plains	435,619	74	80	685	0		Y	Y		401	284	**2**
						85,471					**721**	**39,883**	**44,868**	

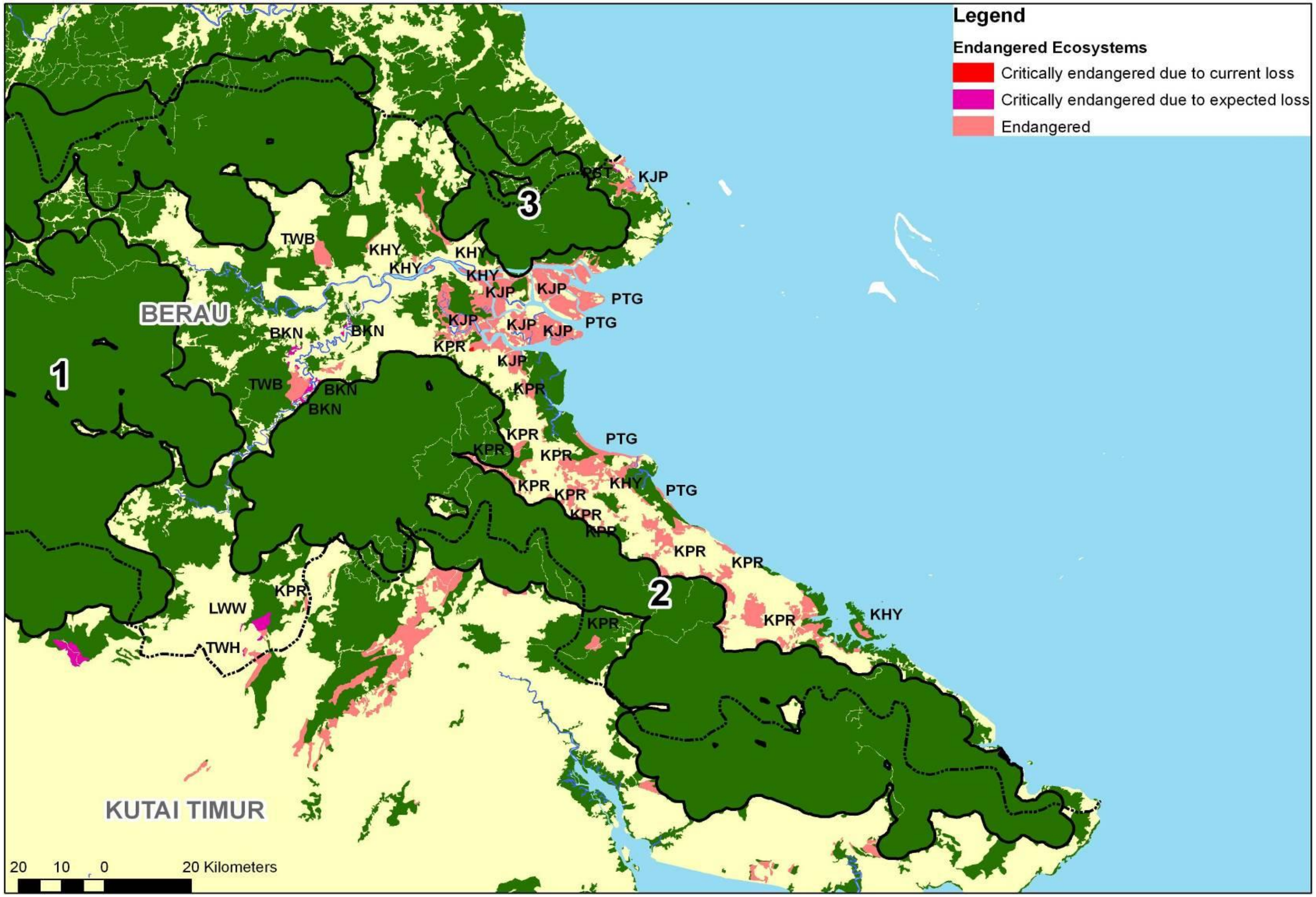


Figure 2.6.6 Distribution of endangered ecosystems in Berau Regency. Critically Endangered Ecosystems are shown in red (based on current loss) or purple (based on future expected loss).

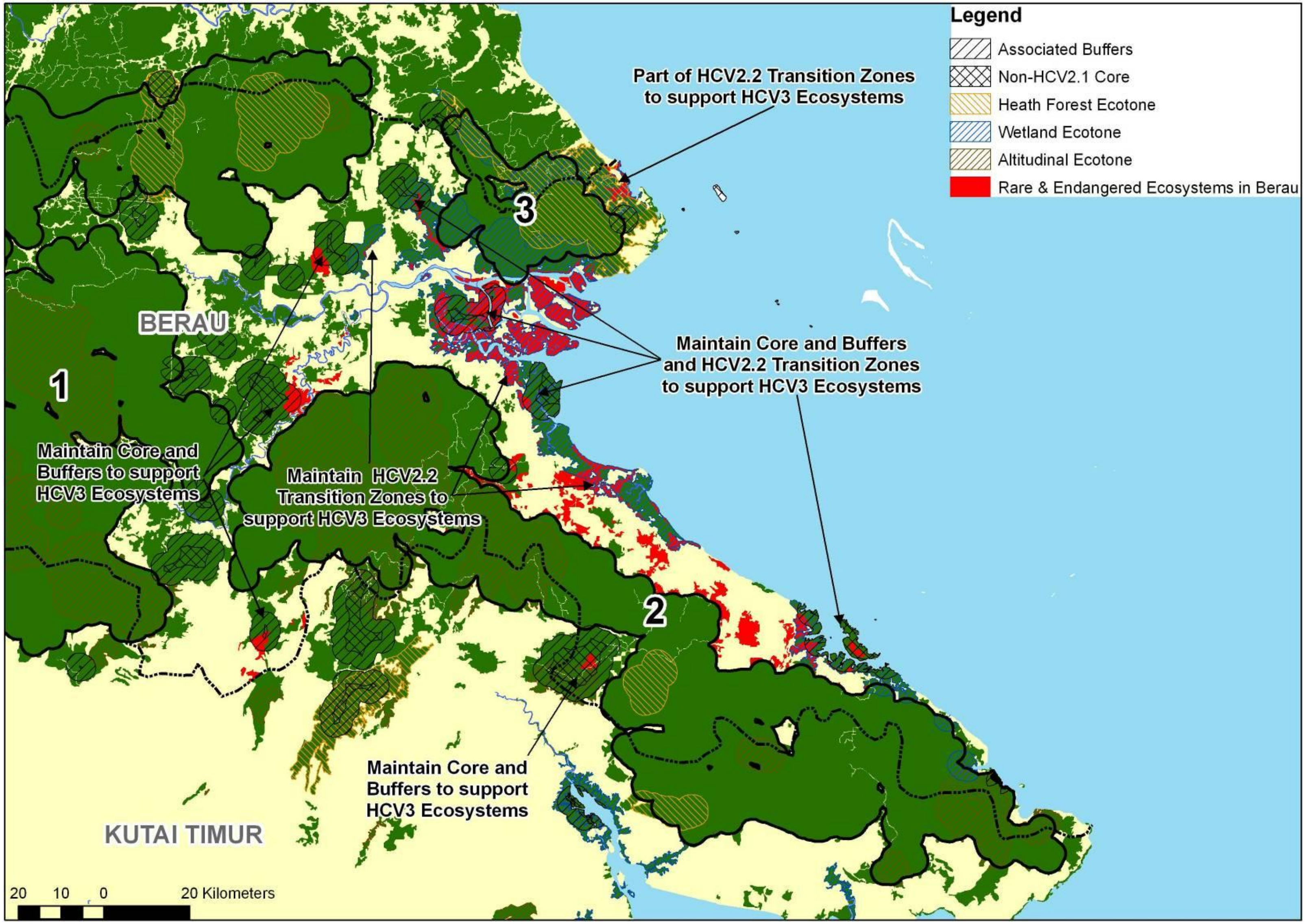


Figure 2.6.7 Distribution of endangered ecosystems in Berau District with specific recommendations where they interact with non-HCV2 Core Areas and HCV 2.2 Transition Zones.

Kutai Timur - Rare and Endangered Ecosystems Outside of Large Landscapes

Kutai Timur District contains a total of 17 ecosystem types that meet one or more of the criteria for rare or endangered distributed throughout two Physiographic Regions (**Fig. 2.6.8** and Table 2.6.2). Overall, a total of c. 65,000 ha of such rare or endangered ecosystems are found within Kutai Timur, approximately 41% of which fall within protected forest, 40% within production forest, and 20% within non-forest areas according to the proposed RTRWP for East Kalimantan (Table 2.6.2).

Six of the Endangered Ecosystems are considered Critically Endangered (>90% current of future expected losses since c. 1975), both of which occur in the Mahakam Lowlands. Two of these are critically endangered due to >90% loss of natural extent since c. 1975. The first of these (**PKU**, forest on undulating sand terraces) has lost 98% of its extent, with the remaining 222 ha in protected forest. The second of these (**TWB**, forest on hillocky sedimentary plains with steep parallel ridges) has lost 97% of its historic extent c. 1975, with the remaining 1,829 ha falling almost entirely within production forest. The remaining four deemed Critically Endangered are at risk of losing >90% of their past extent based on the proposed RTRWP. This includes the remaining peat swamp forest (**GBT** and **MDW**); **LWW**, forest on undulating to rolling sedimentary plains; and **SBG**, forest on meander belts of large rivers with broad levees.

For all the rare and endangered ecosystems outside of HCV 2.1 Core Areas of Large Landscapes within Kutai Timur, the previously stated generic recommendations apply (see Table 2.6.2).

Kutai Timur - Rare and Endangered Ecosystems with non-HCV 2.1 Cores and HCV 2.2 Ecosystem Transition Zones

In one location within Kutai Timur District, outside the three HCV2.1 Large Landscapes, the Critically Endangered **LWW** intersects with the buffer of a small Core Area. Although it only overlaps with a buffer of a Core Area, due to it being Critically Endangered we recommend maintaining the Core Area and its associated buffer (**Fig. 2.6.9**). In the second location Rare and/or Endangered **BRW**, **LHI**, **Mon**, and **TWB** overlap with a small core, a heath forest transition zone and an altitudinal transition. We recommend maintaining the entire complex defined by the endangered ecosystems, the Core Area and its buffer and the HCV 2.2 Transition Zones (**Fig. 2.6.9**).

Table 2.6.2 Rare and Endangered Ecosystems in Kutai Timur District. Those highlighted in red are considered Critically Endangered with over 90% loss of historical extent since c. 1975. Those highlighted in yellow are expected to become Critically Endangered based on the proposed RTRWP for East Kalimantan (version 2008).

Ecosystem Proxy	Symbol	Description	Total Extent in Physiographic Region (ha)	% Loss since c. 1976	% Expected Loss	Total Extent in Kutai Tim outside HCV2.1 (ha)	% of Total Extent in Kutai Tim outside HCV2.1	Rare 1% Criteria	Endangered from current loss	Endangered from expected loss	Protected Forest (ha)	Production Forest (ha)	Other (ha)	Management Level HCV3 per Table 1.1
Nyapa-Mangkalihat Mountains & Plains														
BERIWIT	BRW	Mountainous sandstone cuestas with dissected dipslopes	8,473	59	60	8,473	100	Y	Y		828	7,536	108	1
KAPOR	KPR	Undulating karstic plains with hums	79,425	52	63	3,202	4		Y		172	1,335	1,695	1
LOHAI	LHI	Steep long-sided narrow ridges	4,971	80	80	2,727	55	Y	Y	Y	1,639	1,088	0	2
MANTALAT	MTL	Linear sedimentary ridge systems with steep dipslopes	2,315	10	44	898	39	Y			0	236	661	2
Montane	Mon	Mountainous sandstone cuestas with dissected dipslopes	6,379	0	0	2,111	33	Y			443	1,668	0	2
TEWAI BARU	TWB	Hillocky sedimentary plains with steep parallel ridges	12,608	38	38	9,908	79	Y			2,769	7,139	0	2
Mahakam Lowlands														
GAMBUT	GBT	Deeper peat swamps, commonly domed	37,319	88	95	13,485	36	Y	Y	Y	10,935	2,148	401	3
KAHAYAN	KHY	Coalescent estuarine/riverine plains	7,075	85	94	1,931	27	Y	Y	Y	102	87	1,742	3
KAJAPAH	KJP	Inter-tidal mudflats under mangrove and nipah	66,735	54	71	5,580	8		Y	Y	1,908	47	3,626	1
LOHAI	LHI	Steep long-sided narrow ridges	15,831	74	76	46	0	Y	Y	Y	46	0	0	2
LAWANGUWANG	LWW	Undulating to rolling sedimentary plains	102,229	86	89	2,448	2		Y	Y	54	1,992	402	2
MAPUT	MPT	Sedimentary hills, non-orientated	242,314	62	66	5,036	2		Y		1,096	350	3,590	1
PENDREH	PDH	Sedimentary mountains, non-orientated	11,224	80	80	1,594	14	Y	Y	Y	1,380	0	214	2
PAKAU	PKU	Undulating sandy terraces	1,774	98	100	222	13	Y	Y	Y	222	0	0	3
SEBANGAU	SBG	Meander belt of large rivers with broad levees	11,117	81	97	57	1	Y	Y	Y	25	11	21	3
TEWAI BARU	TWB	Hillocky sedimentary plains with steep parallel ridges	4,032	97	98	1,829	45	Y	Y	Y	3	1,805	21	3
TEWEH	TWH	Hillocky sedimentary plains	435,619	74	78	5,493	1		Y	Y	4,880	342	270	2
						65,040					**26,504**	**25,786**	**12,750**	

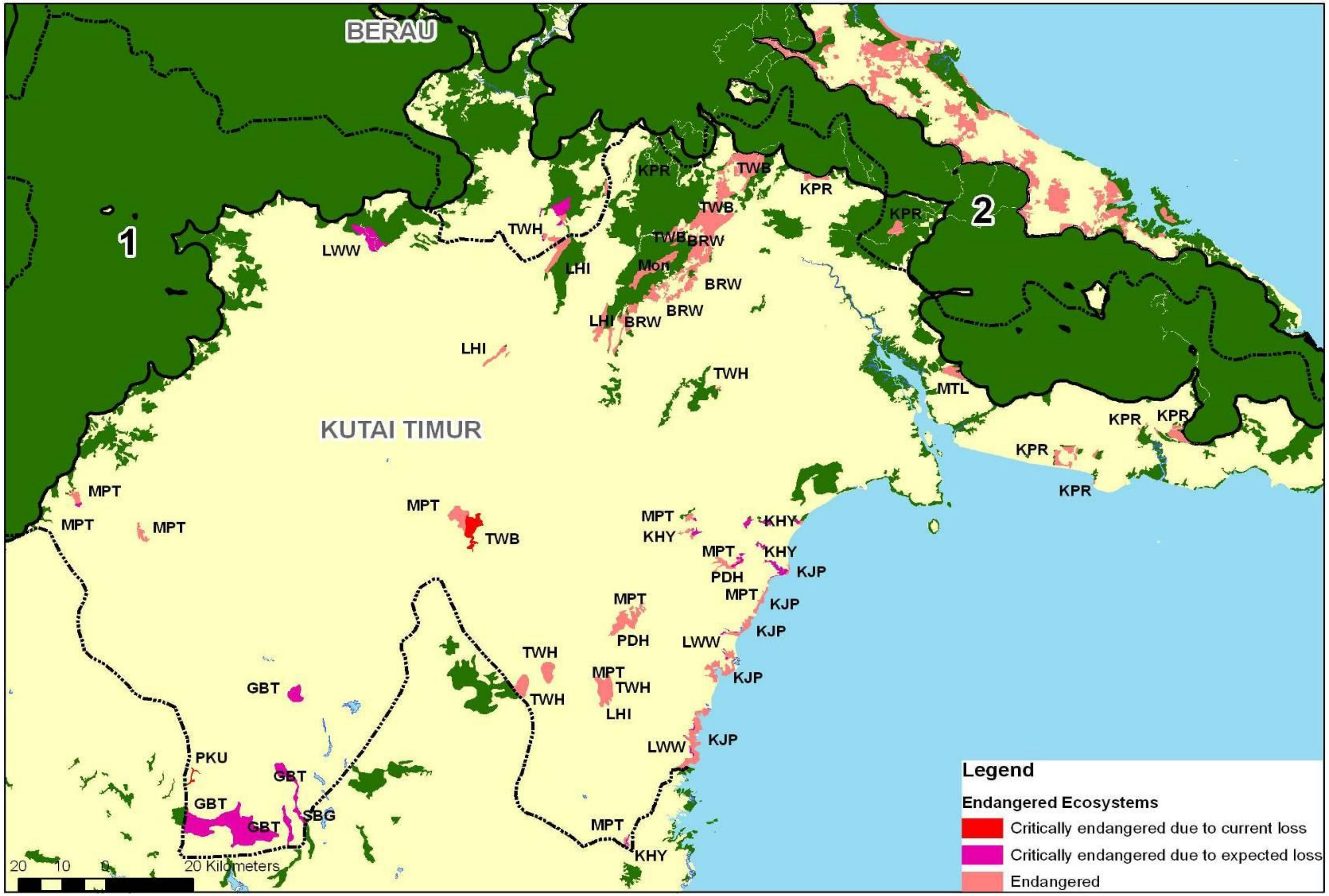


Figure 2.6.8 Distribution of endangered ecosystems in Kutai Timur District. Critically Endangered Ecosystems are shown in red (based on current loss) or purple (based on future expected loss).

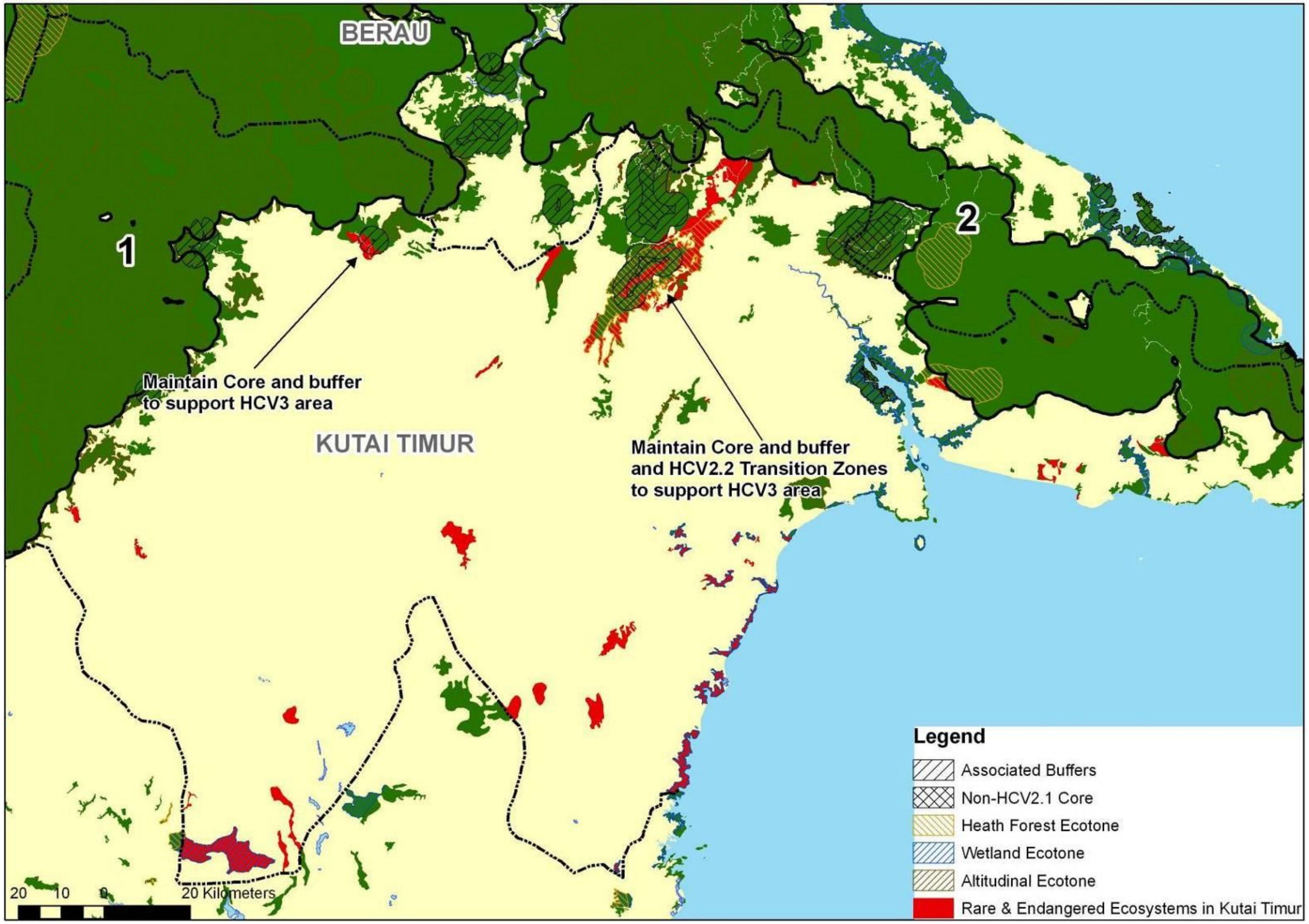


Figure 2.6.9 Distribution of endangered ecosystems in Kutai Timur District with specific recommendations where they form part of non-HCV2 Core Areas and HCV 2.2 Transition Zones.

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