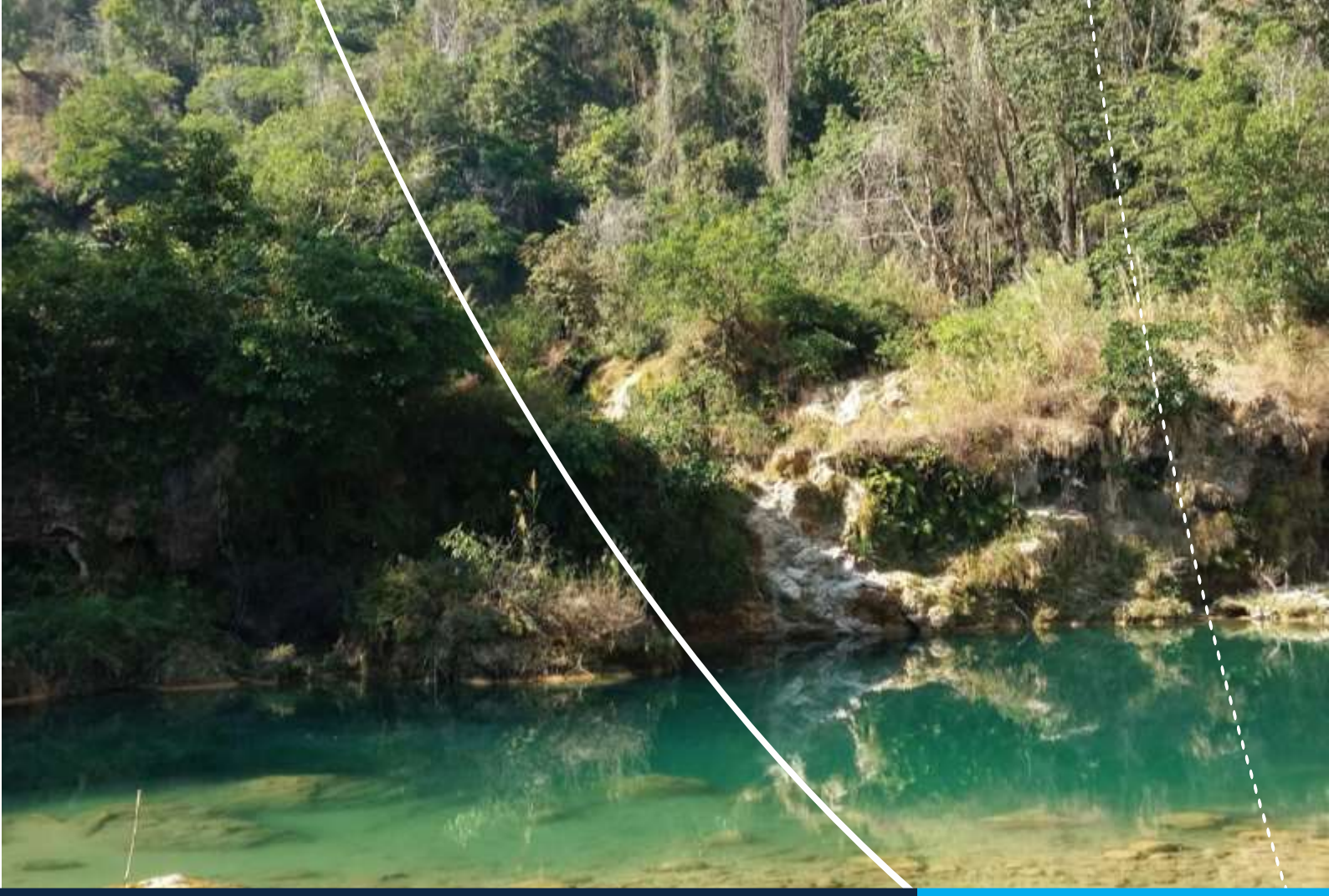

BASELINE ASSESSMENT REPORT
TERRESTRIAL BIODIVERSITY

Strategic Environmental Assessment of the
Hydropower Sector in Myanmar

IN PARTNERSHIP WITH:

Australian Aid

MOEE

MONREC

IFC International Finance Corporation
WORLD BANK GROUP
Creating Markets, Creating Opportunities

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ABBREVIATIONS

ADB	Asian Development Bank
AIT	Asian Institute of Technology
AMSL	above mean sea level
BANCA	Biodiversity and Nature Conservation Association
BEWG	Burma Environmental Working Group
BWS	Bumhpabum Wildlife Sanctuary
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMH	Clearing-House Mechanism
CR	Critical/endangered
DENR	Department of Environment and Natural Resources
EN	Endangered
FAO	Food and Agriculture Organization
FD	Forest Department
GDP	Gross Domestic Product
GMS	Greater Mekong Subregion
GoRUM	Government of the Republic of the Union of Myanmar
HPP	Hydropower Plant
HWS	Htamanthi Wildlife Sanctuary
ICEM	International Centre for Environmental Management
IFC	International Finance Corporation
ILWS	Inle Lake Wildlife Sanctuary
IORID	Investment Opportunities in Road Infrastructure Development
IUCN	International Union for Conservation of Nature
KBA	Keys Biodiversity Areas
KESAN	Karen Environmental and Social Action Network
LNDO	Lahu National Development Organization
MBCIV	Myanmar Biodiversity Conservation Investment Vision
MCCSAP	Myanmar Climate Change Strategy and Action Plan
MIMU	Myanmar Information Management Unit
MMSEA	mountainous regions of mainland Southeast Asia
MOECAF	Ministry of Environmental Conservation and Forestry
MoF	Ministry of Forestry
MWA	Moeyingyi (Moyingyi) Wetland Area
NAPA	National Adaptation Programme of Action
NASA	National Aeronautics and Space Administration
NBSAP	National Biodiversity Strategy and Action Plan
NBSAP	National Biodiversity Strategy and Action Plan
NDWC	National Disaster Warning Center
NFC	Northern Forest Complex
NTFP	Non-timber forest products
NWCD	Nature and Wildlife Conservation Division
PA	Protected Areas
PFE	Permanent Forest Estate

PSPA	Par Sar Protected Area
RCP	Representative Concentration Pathway
RECOFTC	The Center for People and Forests
RKIPN	Rays of Kamoethway Indigenous People and Nature
RLI	Red List Index
SE	Southern Extension
SE Asia	Southeast Asia
SEA	Strategic Environmental Assessment
TFC	Taninthayi Forest Corridor
TNR	Tanintharyi Nature Reserve
TRIP	Tenasserim River and Indigenous People Networks
UNEP	United Nations Environment Program
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
VU	Vulnerable
WCS	Wildlife Conservation Society
WWF	World Wildlife Fund

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1. INTRODUCTION

Biodiversity and linked natural resources and ecosystem services in Myanmar provide the foundation for human development and well-being. Ecosystem health equates to human health and productive economic sectors and livelihoods. Maintenance and enhancement of ecosystem health is a prerequisite for sustainable, resilience and acceptable hydropower development.

This chapter provides a national overview of the status and trends in biodiversity, identifying some of the main themes and issues, and the drivers of change which are shaping ecosystem health and their capacity to maintain ecosystem services. A summary of baseline biodiversity in the eight main river basins[1] in Myanmar is presented. Important spatial layers used to define and describe high priority biodiversity areas are ecoregions, Keys Biodiversity Areas (KBAs), Protected Areas (PAs) and biodiversity corridors. The chapter assesses the status of ecoregions that fall within each basin and the distribution of KBAs and PAs. Ecoregions, KBAs and PAs for each basin are analysed and mapped to describe the distribution of biodiversity areas by basin and for 58 sub-basins.

Also, maps and plots are presented to visualize key trends in forest degradation over the past 15 years as a foundation indicator for trends in biodiversity health overall - ie in species, habitats and genetic resources. For each basin, a line plot of cumulative forest loss was derived using data from Hansen et al., (2013)[2], where forest loss was determined for open forest (greater than 10% and less than or equal to 40% canopy cover), medium-closed canopy cover (more than 40% and less than or equal to 80% canopy cover), and intact forest (greater than 80% canopy cover). Maps and tables are supplemented with descriptions of the biodiversity status of each basin, along with drivers of change. Each basin biodiversity profile highlights key PAs that fall within basin boundaries, as a way drilling down so that overall trends are illustrated through location specific case examples.

While this chapter is intended as a baseline of terrestrial biodiversity for later assessment of planned hydropower projects, it provides a baseline to inform biodiversity conservation and development planning across all sectors. Hydropower development could play a very important role in supporting the Government of Myanmar implement the Aichi targets on biodiversity conservation. The tenth meeting of the Conference of the Parties to the Convention on Biodiversity Conservation, held in October 2010, in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011-2020 period. As Myanmar is a party to the Convention, this Plan provides an overarching framework on biodiversity management as a foundation for sustainable development and livelihoods and for community and ecosystem well-being.

At this outset of this baseline assessment chapter on biodiversity it is important to keep a number of the Aichi Biodiversity targets in mind as a framework for analysis and assessment throughout the SEA. Relevant targets include:

- **Target 5**: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
- **Target 6**: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

[1] See clarification in first para of section 3: Based on consultations during implementation of the SEA, eight major basins or combinations of basins are included in this baseline assessment: two relatively small basins, Surma-Meghna and Bilin basins, are treated in combination with Rakhine coastal and Sittaung basins respectively.

[2] Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

- **Target 11:** By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.
- **Target 12:** By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
- **Target 14:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
- **Target 15:** By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

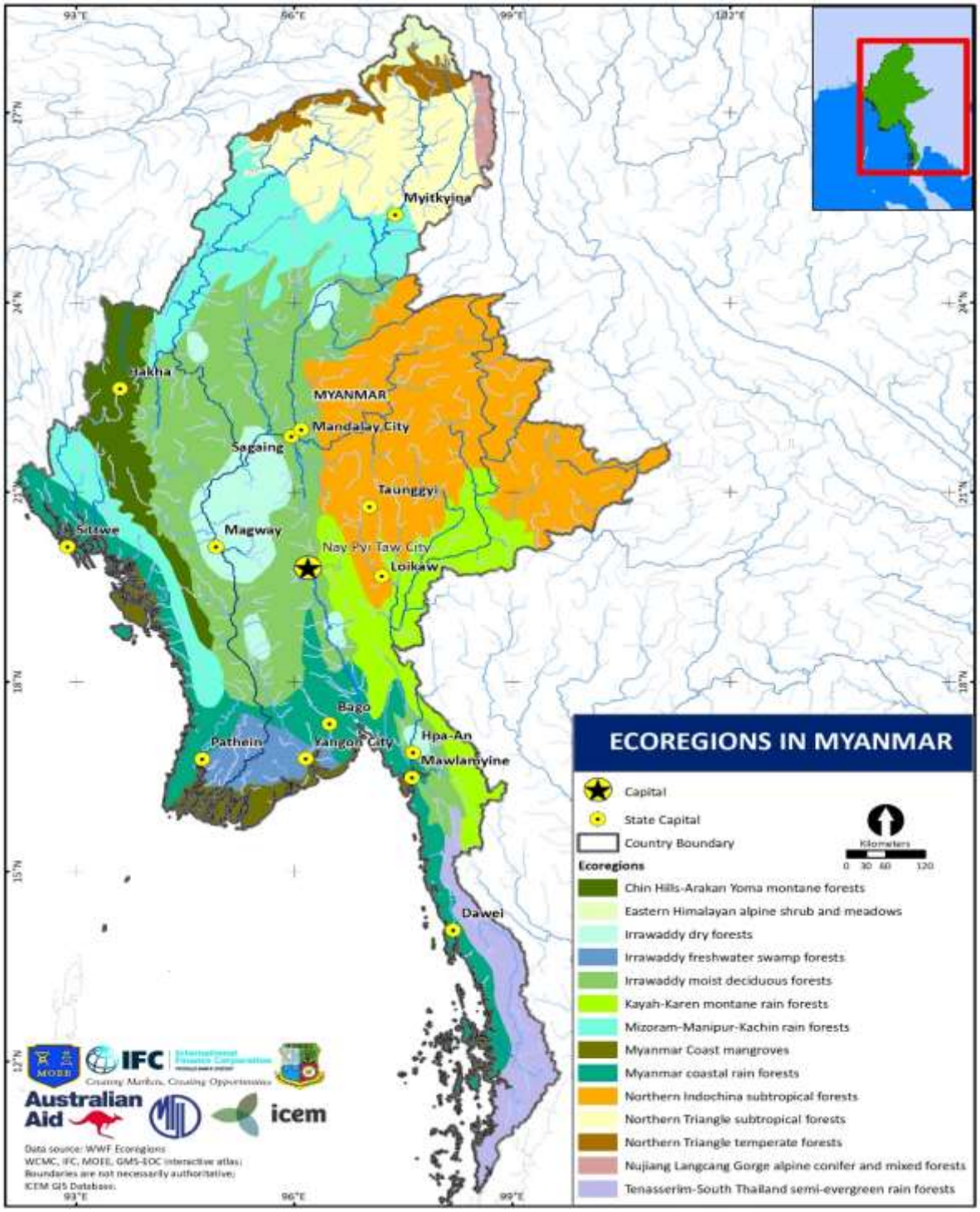
A critical goal for Myanmar is to expand the protected area system as envisaged in the Aichi Biodiversity Targets so it is representative and protective of the full diversity of ecosystems, species and services within the country. Equally important is the use of Key Biodiversity Areas, which extend well beyond the national PA system, as a framework for establishing connectivity in biodiversity assets across landscapes and river basins, and as a guide to all development in defining safeguards and in maintaining the ecosystem services on which they depend.

2. NATIONAL OVERVIEW

4.1 Ecoregion condition and trends

Myanmar is represented by 14 ecoregions which describe the original assemblage of plants, animals, climate and geomorphological characteristics in the country (Figure 2.1**Error! Reference source not found.**). Each ecoregion is a large area of land containing a geographically distinct mix of species, natural communities and environmental conditions.

Figure 2.1: Ecoregions of Myanmar



More than half of Myanmar is covered by just three of its 14 ecoregions - *Irrawaddy moist deciduous forest* (20.6%), *Northern Indochina subtropical forest* (20.4%) and *Mizoram-Manipur-Kachin rain forests* (10.5%) (Table 2.1). Overall, 71.8% of Myanmar's forest area and eight of its main forest categories, as represented by the ecoregions, are either vulnerable or critical/endangered. In this context "vulnerable" means likely to become endangered unless the circumstances threatening its survival improve. "Critical/endangered" means facing an extremely high risk of extinction - ie an assemblage is extremely fragmented and continuing to decline in area and quality. Given that 10 to 15 years have passed since those classifications were first defined by WWF and IUCN[3] - the vulnerable ecoregions have progressively degraded and reduced in area over that period as demonstrated in various trends identified in this assessment.

Table 2.1: Ecoregions of Myanmar, percentage national coverage, and status

Ecoregions[1]	Area (km^2)	National area coverage (%)[2]	Ecoregion status[3]	Trend
Chin Hills-Arakan Yoma montane forests	29,583	4.4	Relatively Stable/Intact	→
Eastern Himalayan alpine shrub and meadows	5,264	0.8	Relatively Stable/Intact	→
Irrawaddy dry forests	34,987	5.2	Critical/Endangered	↓
Irrawaddy freshwater swamp forests	15,085	2.3	Critical/Endangered	↓
Irrawaddy moist deciduous forests	137,909	20.6	Vulnerable	↘
Kayah-Karen montane rain forests	54,959	8.2	Relatively Stable/Intact	→
Mizoram-Manipur-Kachin rain forests	70,308	10.5	Vulnerable	↘
Myanmar coast mangroves	15,827	2.4	Critical/Endangered	↓
Myanmar coastal rain forests	65,368	9.8	Vulnerable	↘
Northern Indochina subtropical forests	136,723	20.4	Vulnerable	↘
Northern Triangle subtropical forests	53,709	8.0	Relatively Stable/Intact	→
Northern Triangle temperate forests	10,677	1.6	Relatively Stable/Intact	→
Nujiang Langcang Gorge alpine conifer and mixed forests	4,483	0.7	Critical/Endangered	↓
Tenasserim-South Thailand semi-evergreen rain forests	29,973	4.5	Relatively Stable/Intact	→
Total[3]	**664,854**	**99.3**	**71.8% of forest either vulnerable or critically endangered**	↘

[1]Other ecoregions of minor coverage nationwide excluded (ie representing a total of 240 km^2)

[2]As percentage of total area of eight basins (669,444 km^2)

[3]https://www.worldwildlife.org/biome-categories/terrestrial-ecoregions. Accessed on 16 May 2017

Four ecoregions are vulnerable (Figure 2.1**Error! Reference source not found.** and Table 2.1): (i) *Irrawaddy moist deciduous forests*, mostly within the Ayeyarwady River Basin and once covering one fifth of the country - now reduced to a small fraction of the original area by clearing and agricultural encroachment over hundreds of years; (ii) *the Myanmar coastal rain forests*, once stretching along the entire coastal zone and covering close to 10% of the country, now only relatively small pockets remain, the rest having been logged and cleared for agriculture and under continuing acute threat; (iii) *the Mizoram-Manipur-Kachin rain forests* also covered some 10% of Myanmar and, like all other rainforest categories in the country, continues to be the target for logging and clearing with around one third of this region retaining healthy forests; and (iv) *the Northern Indochina subtropical forests* covering more than one fifth of the country - confined to the northeast, but most of this globally important biodiversity area has been cleared by logging and shifting agriculture.

[3] WWF Terrestrial Ecoregions. URL: https://www.worldwildlife.org/biome-categories/terrestrial-ecoregions. Accessed on 16 May 2017

There is a similar picture of continuing decline for the four critical/endangered ecoregions - (i) *Irrawaddy dry forests* in the dry zone of the Ayeyarwady River Basin have been reduced to very small pockets despite the efforts of the Government's Dry Zone Greening Department; (ii) the *Irrawaddy freshwater swamp forests* and (iii) *Myanmar coast mangroves* together made up 4.7% of national land area, mainly in the Ayeyarwady Delta, but are greatly reduced and under continuing pressure from clearing and encroachment; and (iv), the *Nujiang Langcang Gorge alpine conifer and mixed forests* makes up only 0.7% of Myanmar in the far northeast but like its extension across the border in China, this has been the target of intensive logging, more so now a ban is in force in China.

4.2 Key biodiversity areas within ecoregions

A new tool for identifying areas of remaining important biodiversity is the Key Biodiversity Area (KBA) designation. Key Biodiversity Areas are sites of global significance with clearly defined boundaries. They are nationally identified using globally standardized criteria and thresholds and represent the most important sites for biodiversity conservation worldwide.[4] KBAs are an 'umbrella' designation, covering most protected areas, Important Bird Areas, Important Plant Areas and Important Sites for Freshwater Biodiversity. KBA identification is an evolving tool to assist countries in filling critical gaps in their national protected areas systems and to support development planning and environmental assessment so that negative impacts on biodiversity are avoided. Increasingly KBAs are used to inform safeguard frameworks[5], biodiversity offsets design and to target conservation investments.

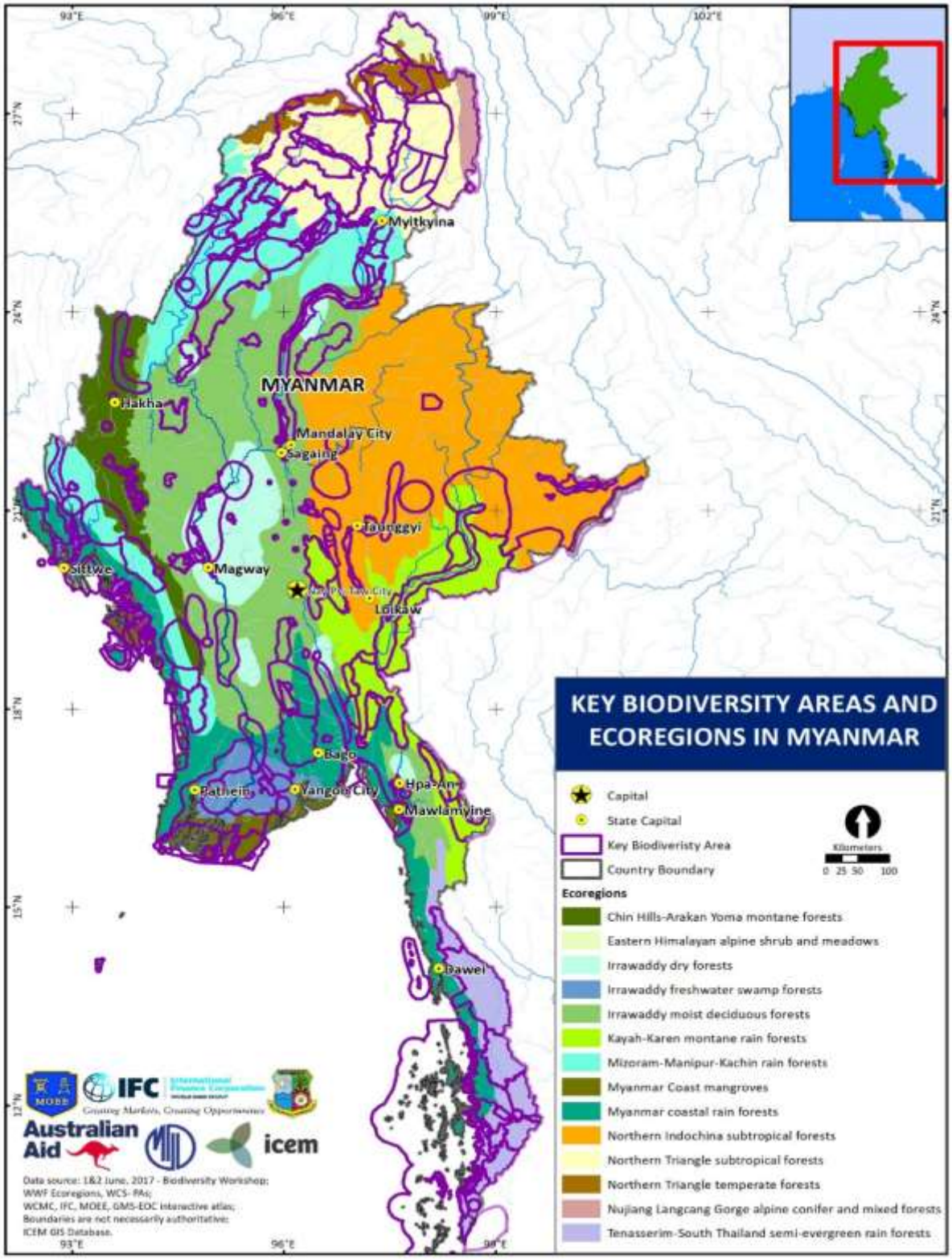
In Myanmar, KBAs have no legal standing as an official form of land tenure except where they overlap with formally established protected areas. KBAs now cover 41.2% of the country, comprising 194 sites (Annex 3 - Figure A3.1, Table A3.1). That area includes many different forms of land tenure, ownership and use, making their effective management to maintain and enhance biodiversity an all-of-government responsibility.

A striking feature of Myanmar's KBA network is the large complex in the northern mountainous region of the country stretching over most of the remaining forest area within four ecoregions - the *Northern Triangle Sub-tropical Forests*, the *Northern Triangle Temperate Forest, Eastern Himalayan alpine shrub and meadows* and the *Nujiang Langcang Gorge alpine conifer and mixed forests* with 80.8%, 86.2%, 100% and 99.3% coverage respectively (Figure 2.2 and Table 2.2). The other striking feature is the large KBA complex in the long narrow southern Tenasserim region running between the Myiek Archipelago in the west and the international border with Thailand to the east. That southern KBA complex takes in 75.8% of the *Tenasserim semi-evergreen rain forests*, and 36.8% of the *Myanmar coastal rain forests* which also extend across the Bago, Ayeyarwady Delta and Rakhine basins - both under significant pressure from palm oil and rubber plantation concessions, logging and agricultural encroachment.

[4] http://www.biodiversitya-z.org/content/key-biodiversity-areas-kba

[5] For example, IFC's Performance Standard 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources

Figure 2.2: Ecoregions and KBAs in Myanmar



Those two complexes alone, covering five ecoregions, together represent 31% of the total area of the current KBA network in Myanmar and the heartland of remaining biodiversity of global importance. Following the expert working sessions in 2017 conducted as part of the SEA process, the KBA network was expanded to reflect current biodiversity knowledge. Previously areas not well represented, especially to the east of the country within the linked Kayah-Karen montane rain forest and Northern Indochina subtropical forest, ecoregions which have been little studied, now have

increased KBA coverage: increasing from 7% to 65.2% for Kayah-Karen montane rain forest and 3.3% to 16.3% for Northern Indochina subtropical forest. Other previously poorly represented ecoregions such as the *Irrawaddy dry forests* (previously 5.4%) and *Irrawaddy freshwater swamp forests* (previously 3.3%) now have an increased KBA coverage of 27.8% and 81.7% respectively. These areas are so severely degraded that rehabilitation of barren areas is an important conservation strategy.

Table 2.2: KBAs and PAs by ecoregion

Ecoregions	Total Area Ecoregions (km^2)[1]	% Ecoregion	Area KBA inside Ecoregion (km^2)	% KBA/Ecoregion	Area PAs inside Ecoregion (km^2)	% PAs/Ecoregion
Chin Hills-Arakan Yoma montane forests	29,583	4.4	6,519	22.0	1,093	3.7
Eastern Himalayan alpine shrub and meadows	5,264	0.8	5,264	100.0	4,794	91.1
Irrawaddy dry forests	34,987	5.3	9,723	27.8	163	0.5
Irrawaddy freshwater swamp forests	15,085	2.3	12,324	81.7	6	0.0
Irrawaddy moist deciduous forests	137,909	20.7	27,321	19.8	2,488	1.8
Kayah-Karen montane rain forests	54,959	8.3	35,810	65.2	348	0.6
Mizoram-Manipur-Kachin rain forests	70,308	10.6	36,662	52.1	4,798	6.8
Myanmar coastal rain forests	65,368	9.8	24,085	36.8	225	0.3
Myanmar Coast mangroves	15,827	2.4	12,684	80.1	118	0.7
Northern Indochina subtropical forests	136,723	20.6	22,331	16.3	1,242	0.9
Northern Triangle subtropical forests	53,709	8.1	43,418	80.8	18,540	34.5
Northern Triangle temperate forests	10,677	1.6	9,206	86.2	4,361	40.8
Nujiang Langcang Gorge alpine conifer and mixed forests	4,483	0.7	4,451	99.3	21	0.5
Tenasserim-South Thailand semi-evergreen rain forests	29,973	4.5	22,734	75.8	1,617	5.4
TOTAL	**664,854**	**100**	**272,531**	**41.0**	**39,812.92**	**6.0**

[1]ecoregions with minor coverage nationwide excluded (ie. with an area of less than 150km^2 per ecoregion, which amounts to 240km^2 in total excluded)

4.3 Ecoregion coverage by river basins

Table 2.3 sets out the original ecoregion areas in each of Myanmar's eight river basins. It provides a valuable foundation of information for the later analysis of basin by basin biodiversity values. The first point as a link to the earlier section is that the two main KBA complexes stand out sharply with 92% of the Headwater Ayeyarwady and 51.1% of the Chindwin covered by the northern complex and 64.7% of the Tanintharyi River Basin covered by the southern complex. Figure 2.3 shows the main river basin boundaries overlaid on the ecoregions.

The Ayeyarwady River Basin, the dominant feature in Myanmar, embraces a cascade of 12 ecoregions from Hkakabo Razi Mountain with an elevation at 5,881 m and the alpine shrub and meadow system dropping down to the Delta mangroves. The Chindwin Basin feeding the Ayeyarwady also has a diversity of ecosystems shaped largely by elevation and geology. Similarly, the Thalwin Basin embraces seven ecoregions but two outside the country from its source in Tibet from where it flows through eastern Tibet and Yunnan Province before entering Myanmar. Other basins such as the Mekong, Bago and Rakine have relatively simpler ecoregion diversity and tend to be dominated by one, for example the 97.5% of *Northern Indochina subtropical forest* in Myanmar's portion of the Mekong Basin.

The condition of each ecoregion within a basin - and the extent of protection it has through PAs, as well as recognition of its biodiversity values through the KBA network, all contribute to determining its relative importance for conservation management in integrated basin wide development planning.

Table 2.3: Coverage of ecoregion by river basin in Myanmar

Areas of biodiversity	Bago	Chindwin	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady 2	Ayeyarwady[b]	Mekong	Rakhine Coastal	Surma-Meghna	Rakhine Coastal/Surma-Meghna[c]	Sittaung	Bilin	Sittaung/Bilin[d]	Tanintharyi	Thanlwin	National coverage
Key Biodiversity Areas (KBAs)	42.1	51.1	92.0	38.7	35.8	13.1	37.2	28.0	46.1	0.3	45.5	40.1	42.1	40.3	64.7	35.0	41.3
Protected Areas (PAs)	0	20.4	23.2	1.5	8.4	1.0	5.5	0.7	3.6	0	3.6	0.6	1.8	0.7	4.2	0.8	6.0
Ecoregions:																	
Chin Hills-Arakan Yoma montane forests		9.4		7.4			2.7		22.0	98.1	23.1						
Eastern Himalayan alpine shrub and meadows			12.2				1.9										
Irrawaddy dry forests		1.9		21.3	3.3	7.7	11.0					4.3		3.9		1.1	
Irrawaddy freshwater swamp forests	11.7			13.8			5.0										
Irrawaddy moist deciduous forests	5.8	28.8		36.0	18.7	44.1	31.5					40.9		37.6	0.1	6.6	
Kayah-Karen montane rain forests						0.3	0.1	2.5				28.0	48.0	29.6		33.9	
Mizoram-Manipur-Kachin rain forests		32.6		1.7	53.6	2.8	7.5		32.7	0.9	32.3						
Myanmar coastal rain forests	68.9			10.7			3.9		34.2		33.7	25.3	51.4	27.4	29.9	3.9	
Myanmar coast mangroves	11.6			8.8			3.2		7.5		7.4				2.9	0.3	
Northern Indochina subtropical forests			0.2		7.8	45.2	17.6	97.5				0.4				52.9	
Northern Triangle subtropical forests		22.3	63.0		16.7		11.6										
Northern Triangle temperate forests		4.7	14.1				2.2										
Nujiang Langcang Gorge alpine conifer and mixed forests			10.4				1.6										
Tenasserim-South Thailand semi-evergreen rain forests															64.3	1.1	

[a] ecoregions with minor coverage nationwide excluded (i.e., with total area of less than 150 km^2 per ecoregion)

basins with more than 25% and less than 50% KBA cover

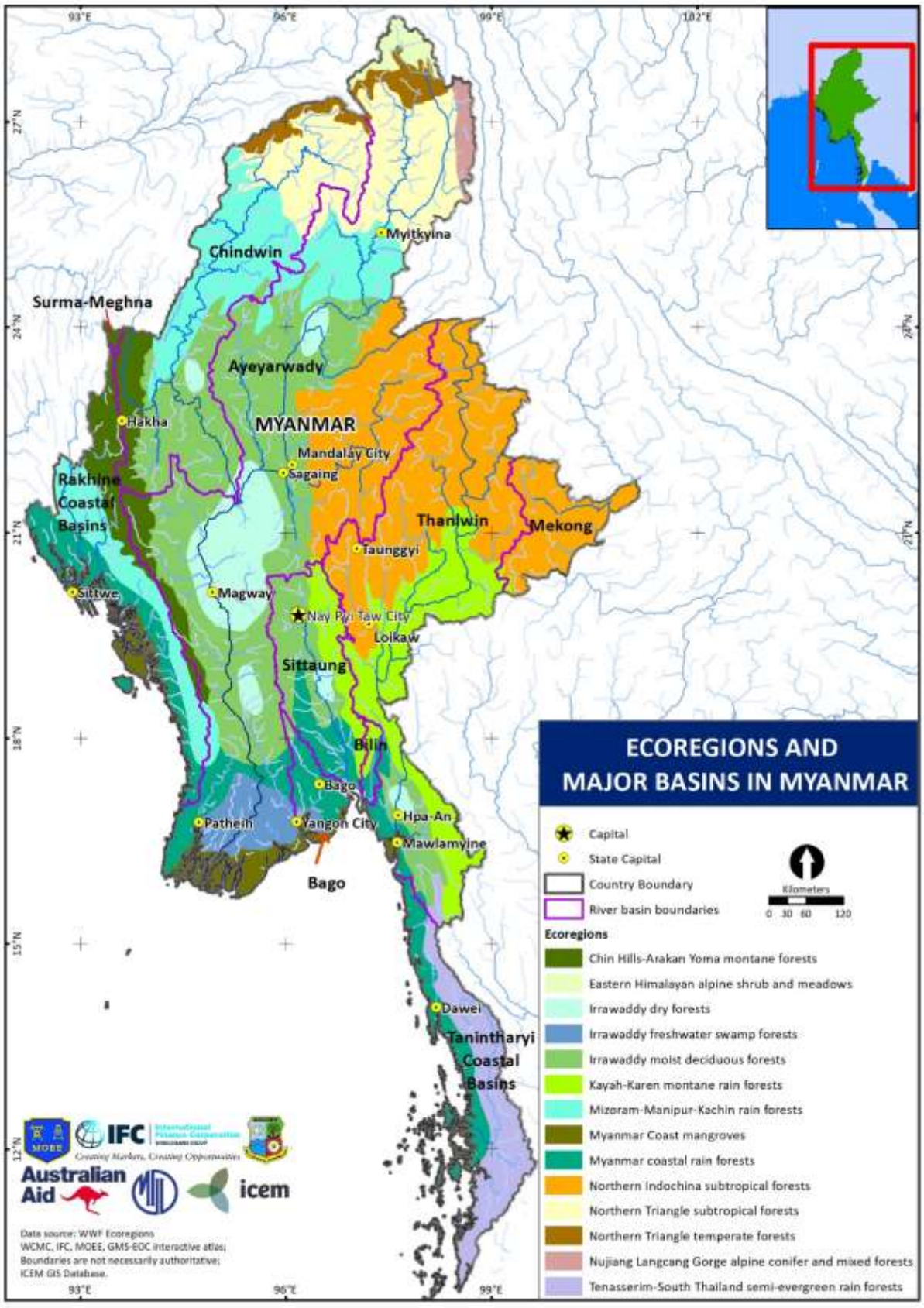
basins with more than 50% KBA cover

Ayeyarwady[b]: combined Headwater Ayeyarwady, Lower Ayeyarwady to Delta, Middle Ayeyarwady 1, and Middle Ayeyarwady 2

Rakhine Coastal/Surma-Meghna[c]: combined Rakhine Coastal and Surma-Meghna basins

Sittaung/Bilin[d]: combined Sittaung and Bilin basins

Figure 2.3: Main river basins and ecoregions in Myanmar

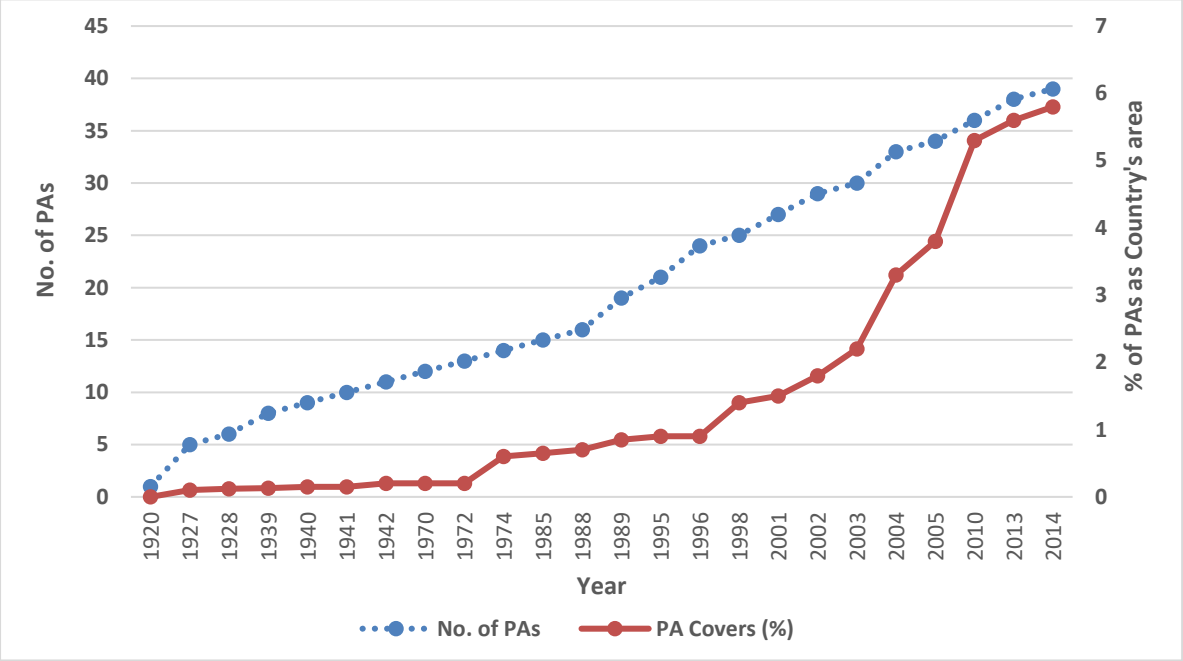


4.4 Protected area coverage and trends

Past trends and current situation	
Theme:	Protected area coverage and management
Issues:	• Size of PA system • Coverage of habitats and species • Uncontrolled exploitation • Institutional capacity and resources

The main vehicle for protecting biodiversity within Myanmar is the protected area system. Figure 2.5 shows the national PA network relative to KBAs and ecoregions. Table 2.2 provides a breakdown of the area and percentage of PAs within each ecoregion, and Table 2.3 and Table 2.4 and Figure 2.7 show PAs and KBAs by river basin. Figure 2.4 shows the growth in the national PA system from its origin in 1920 to 2015. The most significant feature of that history is the 74% expansion of area under protection from the year 2000 onwards. That leap is due mainly to the large PAs set up in the Upper Ayeyarwady and Chindwin. Overall the 37 PAs cover 6% of Myanmar (Table 2.3).

Figure 2.4: Establishment of protected areas - 1920 to 2015



Source: Adapted from the NBSAP 2015

2.4.1 Protected areas in ecoregions

Looking more closely at the PA system's representativeness of ecoregions, three are well represented - the *Eastern Himalayan alpine shrub and meadows* with 91.1% coverage, the *Northern Triangle temperate forests* with 40.8% protected and the *Northern Triangle subtropical forests* with 34.5% under formal PA designation - all in the thinly populated far north of the country (Table 2.2 and Figure 2.5). A few large PAs, particularly in Kachin State and Sagaing Region, contribute disproportionately to national PA coverage. Seven ecoregions covering 50% of Myanmar, including biodiversity of global importance, have less than 1% or no protection.

The situation with *Dry Mixed Deciduous Forest* illustrates well the trend confronting most other ecoregions. Relatively large areas of *Dry Mixed Deciduous Forest* remain in Sagaing Region, Shan and Rakhine States but those areas are degrading rapidly while overall only 2% is protected (compared to about 40% in Thailand and Cambodia). Due to a large human population in this

ecoregion, there are few opportunities for establishing large PAs. In such densely populated areas, community-based conservation, including community forestry, community conservation agreements, and other forms of sustainable management become more appropriate for remaining forest patches (NBSAP 2015).

2.4.2 Protected areas in rivers basins

A similar lack of balance and representativeness is found when looking through the lens of river basins (Table 2.3 and Figure 2.6). There are three stand-out characteristics of Myanmar's PA system: First - it is very small compared to the national systems of its Mekong regional neighbours (Figure 2.6). Only 25% of KBAs are formally protected, much less comprehensive than in the other countries of the GMS, where, on average, 71% are formally protected (Tordoff, 2012). Of the 132 terrestrial and coastal KBAs identified in 2012 (covering 10% (65,304 km^2) of land area), only 35 are partly included within PAs (NBSAP 2015).

Second, the PA network is concentrated in the Headwater Ayeyarwady and Chindwin Basins, where PAs cover 23.2% and 20.4% of these basins respectively. Other basins are poorly protected, ranging from 0.7% to 4.2% coverage. Four of the eight basins have under 1% protected (Table 2.4). The third outstanding feature of the system is that most of the PAs are small in area, thus limiting their value as biodiversity havens, with 16 (43%) having no staff to manage them (Annex 2), and only around US$2 million annually allocated for PA management in the national budget.

The estimated total Government budget contribution for biodiversity conservation in Myanmar during 2006-2010 was US$5 million (Tordoff et al., 2012). Myanmar's PAs depend wholly on central government funds for their core budget. Over the last five years, an average of US$1.9 million a year (US$43/km^2) has gone to PAs. The 20 PAs under NWCD management have an average annual budget of around US$55,000 each, with seven receiving less than US$30,000 each per year (NBSAP 2015).

Over the last five years, both government and international funding for PAs has increased significantly, with government funding rising by around 50% in real terms and externally-funded grants and projects committing almost US$20 million in 2014 (NBSAP 2015). However, there remains a critical shortage of consistent funding, staffing and capacity. The experience has not been good in terms of sustainability of conservation effort once externally funded projects end. For example, a support program for Chatthin Wildlife Sanctuary, the main site in Myanmar for the conservation of Eld's deer, had an encouraging start, however, deer numbers dropped when external funding stopped (IUCN 2011).

To date there has been no significant funding of biodiversity conservation by the private sector, either as direct public interest grants or as part of large scale infrastructure projects. An exception is the funding from Total and Petronas for the Tanintharyi Nature Reserve since 2004.

Figure 2.5: National PA and KBA networks by ecoregion in Myanmar

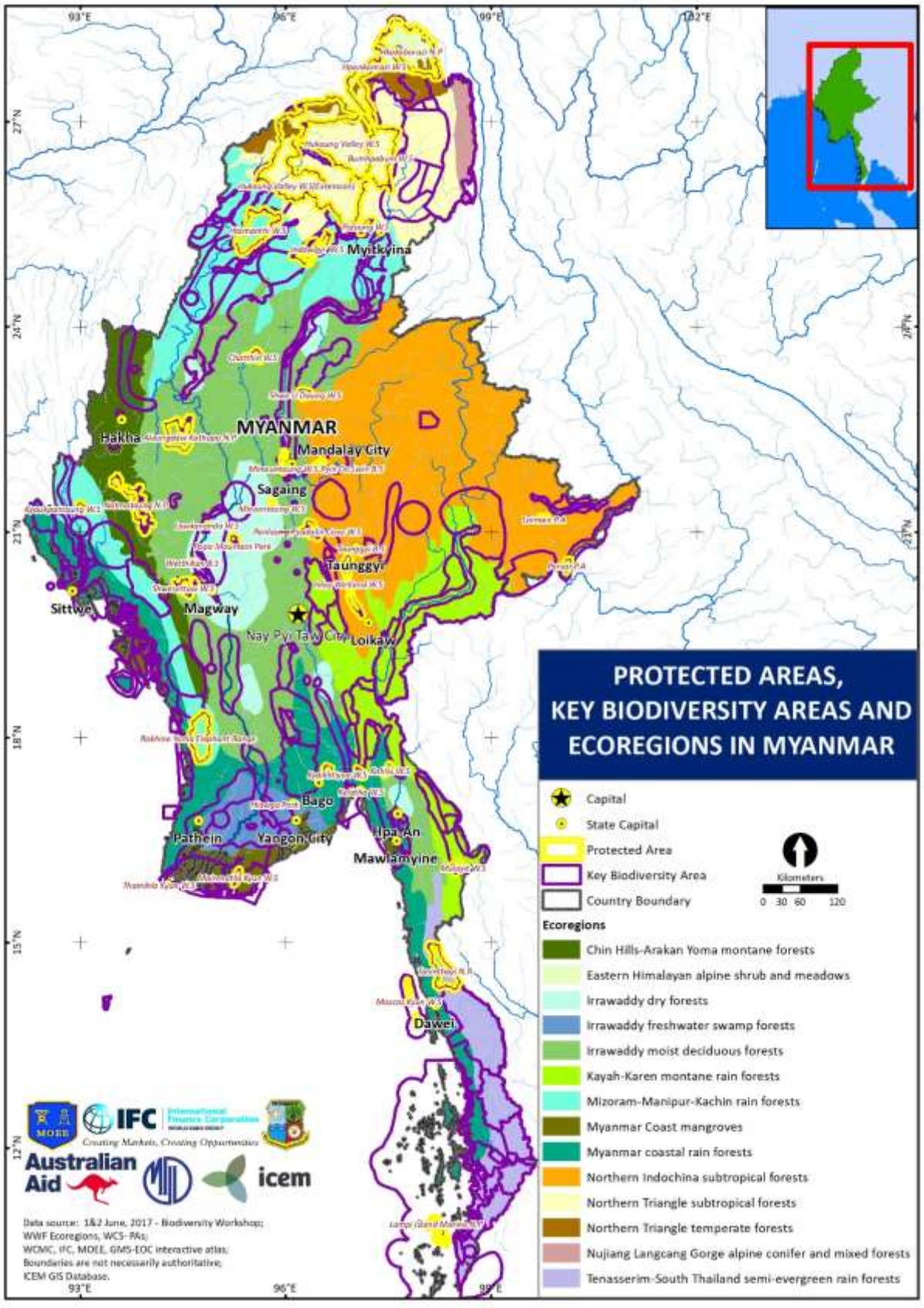
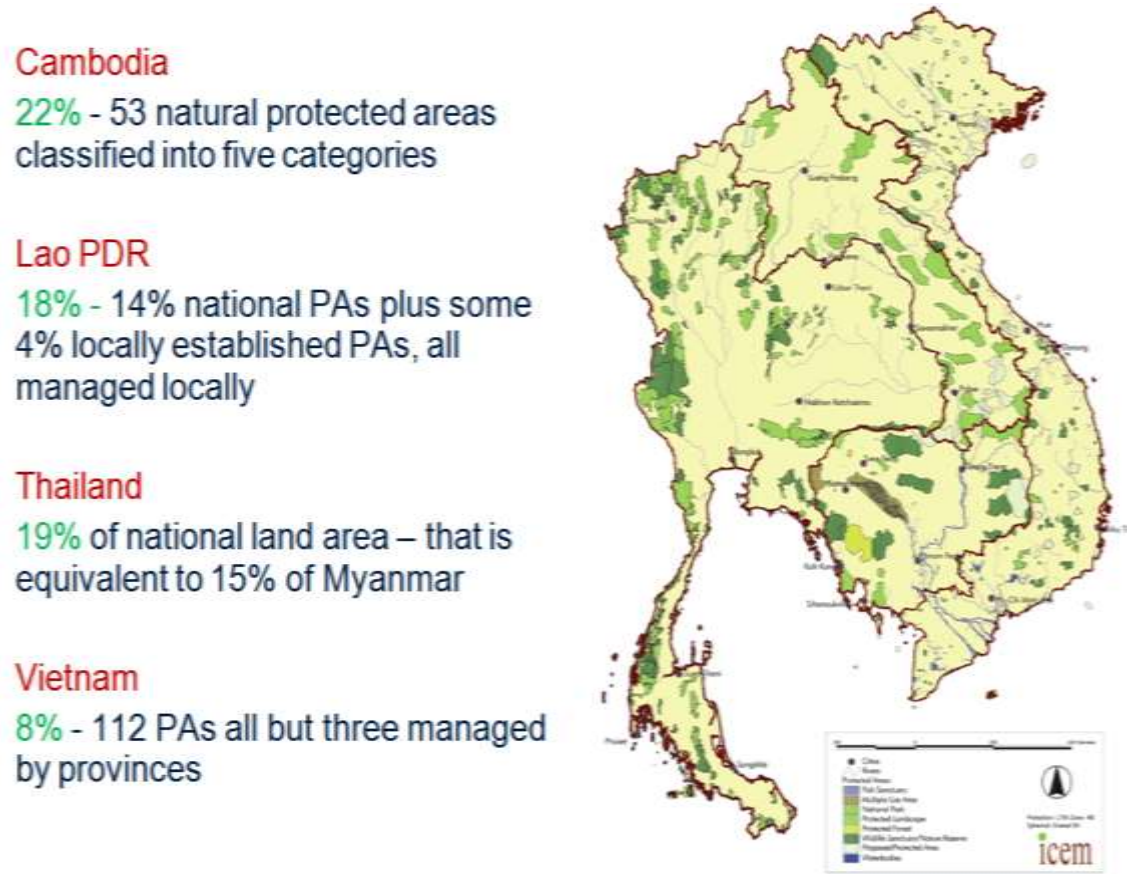


Figure 2.6: Protected area system coverage in the Lower Mekong countries



For all those reasons, the PA system does not represent Myanmar's ecosystems and species well with implications discussed in the sections to follow.

Table 2.4: KBAs and PAs by river basin in Myanmar

Main Basin	Basins Area (km^2)	KBAs Area (km^2)	PAs Area (km^2)	PAs within KBAs (km^2)	% KBAs	% PAs	%PAs within KBAs
Ayeyarwady	275,510	102,565	15,052	14,750	37.2	5.5	5.4
Ayeyarwady Headwaters	42,949	39,516	9,954	9,910	92.0	23.2	23.1
Low Ayeyarwady to Delta	100,871	38,998	1,534	1,453	38.7	1.5	1.4
Middle Ayeyarwady 1	29,881	10,688	2,529	2,503	35.8	8.5	8.4
Middle Ayeyarwady 2	101,809	13,364	1,036	885	13.1	1.0	0.9
Chindwin	97,393	49,762	19,889	19,831	51.1	20.4	20.4
Mekong	21,641	6,053	155	131	28.0	0.7	0.6
Sittaung/ Bilin	37,903	15,276	267	254	40.3	0.7	0.7
Tanintharyi Coastal Basins	44,314	28,668	1,856	1,851	64.7	4.2	4.2
Thanlwin	126,384	44,275	970	790	35.0	0.8	0.6
Rakhine Coastal Basins/ Surma-Meghna	55,691	25,342	2,003	1,983	45.5	3.6	3.6
Bago	10,247	4,316	1	1	42.1	0.0	0.0
Total	**669,083**	**276,256**	**40,193**	**39,591**	**41.3**	**6.0**	**5.9**

2.4.3 Size of Protected Area system

Myanmar's 30-year National Forestry Master Plan (2002-2031) set the national target for PA coverage at 10% of total land area by 2030 (NBSAP 2015). The National Biodiversity Strategy and Action Plan defines a strategy for establishing seven additional PAs taking total coverage from 5.75% to 7.82% by 2021. PA coverage of species and habitats would increase up to 2021 if the NBSAP Target 11.1 to expand the PA network is realized (Table 2.5). As a signatory to the Convention on Biological Diversity, the country has committed to protect 17% of terrestrial areas and 10% of coastal and marine areas - a commitment not yet expressed in national policy or plans.

In phase 1 of the NBSAP strategy, several species-focused PAs would be established: *Mahamyaing Wildlife Sanctuary* (home to 25% of the global population of the eastern Hoolock gibbon), *Lenya National Park* (Asian elephant, tiger[6], tapir) and *lnkhine Bum National Park* (Hoolock gibbon and gaur). In phase 2, the new PAs would include *Taninthayi National Park* and *Lenya National Park Extension* and *Pan Thi Taung National Park* in Kayah State where there is no PA. In phase 3 *lmawbum National Park*, the only known site of the Myanmar snub-nosed monkey, along with the Southern Extension (SE) of *Hkakaborazi National Park* and *Za Loon Taung Protected Area* of Sagaing Region would be established. The SE covers sub-tropical forest in the 900-1,500 m elevation range and is characterized by very high bird and plant diversity and endemism (NBSAP 2015).

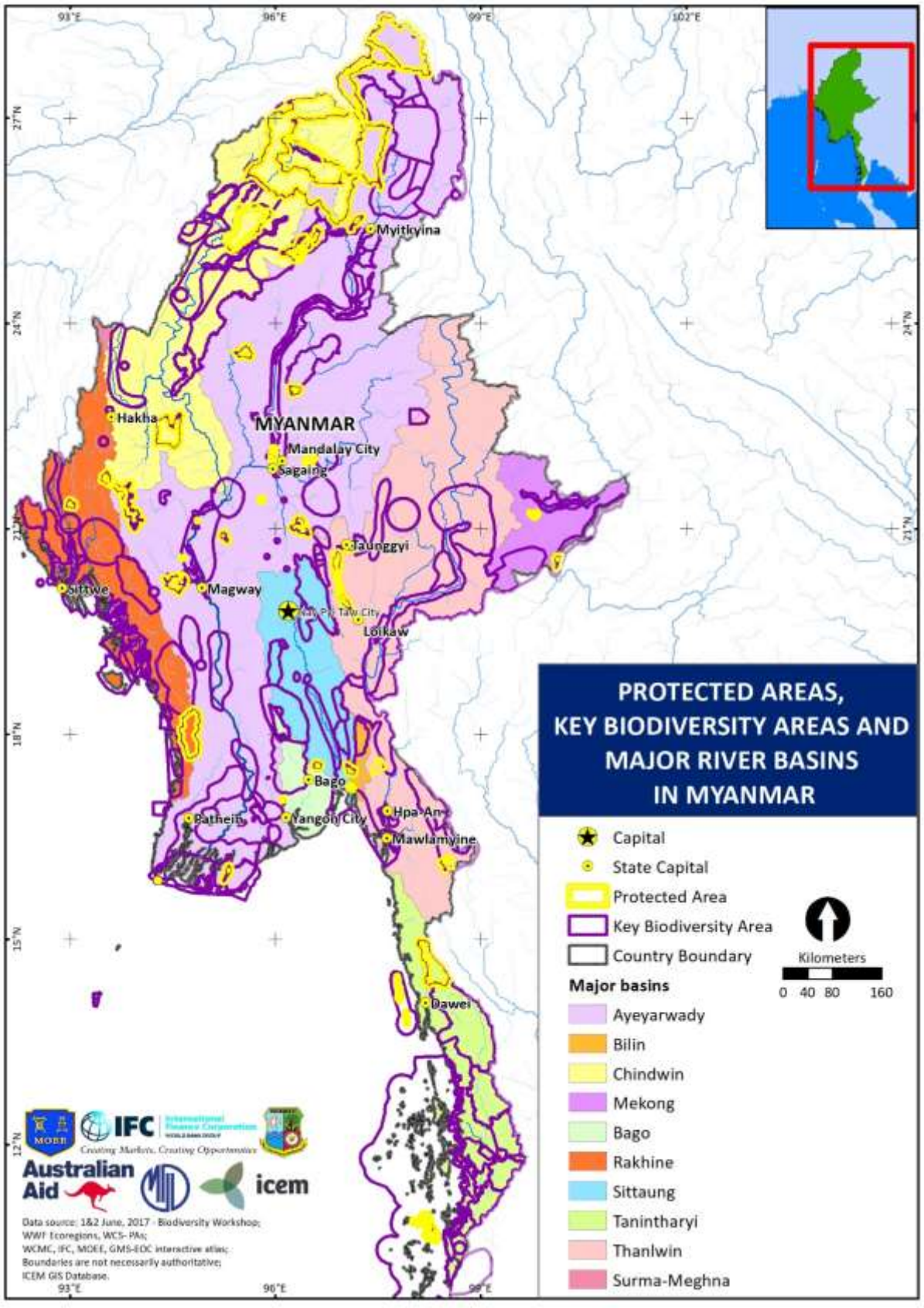
Table 2.5: NBSAP PA establishment plan to 2021

Phase	Name	Area (km^2)	Sub-total (km^2)	Coverage (%)	Cumulative Coverage (%)
1	39 existing PAs	38,906	38,906	5.75	5.75
	Lenya National Park	1,766	3,246	0.48	6.23
	Mahamyaing Wildlife Sanctuary	1,180			
	Inkhine Bum National Park	300			
2	Taninthayi National Park	2,590	4,223	0.62	6.85
	Lenya National Park (extension)	1,399			
	Pan Thi Taung National Park	234			
3	Imawbum National Park	1,563	6,557	0.97	7.82
	Za Loon Taung Protectd Area	216			
	Hkakaborazi National Park SE	4,778			
	Total	**52,932**	**52,932**	**7.82**	

Source: NBSAP 2015

[6] Two subspecies of tiger are found in Myanmar - the Bengal tiger Panthera tigris tigris and Indochinese Tiger Panthera tigris corbetti. The natural ecological divide for these two subspecies in Myanmar is assumed to be the Ayeyarwady River with the Bengal tiger to the west and the Indochinese tiger to the east.

Figure 2.7: Protected areas and KBAs by river basin in Myanmar



The NBSAP also calls for IUCN PA governance and management categories to be recognized in policy and practice. The NBSAP Target 11.3 requires that "by 2020, the management effectiveness of

Myanmar's PA system has significantly improved, with 15 PAs implementing SMART, at least five PAs implementing management plans, and local communities are involved in management activities in at least five PAs". Target 20.1 requires that "by 2020, the funding available for biodiversity from all sources is increased by 50%" (NBSAP 2015).

In summary,

(i) The PA network in Myanmar is small and does not adequately cover the full range of habitats and species.
(ii) The network suffers from uncontrolled exploitation and it is under-resourced with low capacity.
(iii) The approach to PAs in Myanmar does not formally recognize alternative management arrangements such as local government and community co-management, greatly restricting the potential for expansion and effective conservation and sustainable use.
(iv) Those failings are now widely recognized in Government policy and plans.
(v) Myanmar has established an exceptional complex of protected areas in the northern Chindwin and Ayeyarwady which are of global importance and require intensive conservation management.

4.5 Threatened and vulnerable species

Past trends and current situation	
Theme:	Threatened and vulnerable species
Issues:	• Conservation status • Lack of field survey information • Hunting and trade of wildlife • Habitat loss, degradation and fragmentation

2.5.1 Status and lack of field survey information

The IUCN Red List has assessed 3,849 species in Myanmar, 715 of which are globally threatened or data deficient (Table 2.6). The very high percentage of data deficient species reflects the serious lack of information on distribution and population status in many parts of the country. Relative to other countries in Southeast Asia, the biodiversity science base is weak due to Myanmar's long period of international isolation (NBSAP 2015).

Table 2.6: Species assessed on the IUCN Red List of Threatened Species

Global Status		Animals		Plants		Total	
Globally Threatened	Critical/endangered (CR)	22	3%	15	18%	36	5%
	Endangered (EN)	59	9%	15	20%	74	10%
	Vulnerable (VU)	157	25%	18	24%	175	24%
Data Deficient (DD)		401	63%	29	38%	430	60%
	Total	**639**		**76**		**715**	

Source: NBSAP 2015

Over 715 species are classified as globally Vulnerable, Endangered and Critical/endangered and remaining habitats in Myanmar are globally important for their survival. There are 76 globally threatened or data deficient plant species known to occur in Myanmar, a number that is sure to increase as more species are recognised. There are 47 globally threatened mammal species, five are Critical/endangered, 17 are Endangered and 25 are Vulnerable (IUCN Red List). Myanmar is recognized as likely to have the greatest diversity of bird species in Southeast Asia, with at least 1,096 avifauna species recorded including 6 endemic species and 46 species listed on the IUCN Red List.

Myanmar is home to globally significant but poorly known populations of herpetofauna, invertebrates, aquatic species and other taxa, many of which require urgent conservation. For several of these groups, identification of conservation priorities is impeded by the lack of baseline data currently available. While large mammals, birds, and reptiles have been relatively well surveyed, much less attention has been paid to plants, freshwater fish, amphibians and invertebrates (NBSAP 2015).

2.5.2 Hunting and wildlife trade

There are well recognized deficiencies in national capacity for PA management (NBSAP 2015). Protected areas are all under pressure from uncontrolled and illegal exploitative activities which are reducing biodiversity within the system. For example, plantation development is expanding and impacting on PAs and biodiversity hotspots (FAO 2011a). Large-scale sugar plantations in northern Myanmar have fragmented the Hukawng Valley and its Tiger Reserve near Tanai in Myitkyina District of Kachin State (Woods 2011). Uncontrolled hunting and wildlife trade occurs in around 70% of protected areas (Rao et al. 2002), with large volumes of wildlife and wildlife products transported to China's Yunnan Province and to Thailand, and some consumed domestically (Clarke 1999). The wildlife trade is decimating most protected areas, particularly those along international borders, creating large regions of "silent forest" where species such as elephants, Asiatic bears, sun bears, tigers, leopards, snow leopards, cloud leopards, turtles, tortoises, pangolins and many species of birds are being eliminated.

Two large mammals, the Asian elephant (*Elephas maximus*) and tiger (*Panthera tigris*) are threatened, mainly due to illegal trafficking, and their populations are decreasing (NBSAP 2015). Agriculture expansion into forests is leading to increasing human-elephant conflict, particularly in the Sago Yoma and Rakhine Yoma (NBSAP 2015). Once wide-spread in Myanmar, tigers are now restricted to small populations in Htmanthi and Hukaung Valley Wildlife Sanctuaries (50 tigers) both close to the border with India, and Tanintharyi bordering Thailand's Western Forest Complex, which is home to about 200 tigers (NBSAP 2015). Uncontrolled hunting within Myanmar continues to take its toll in both areas.

Black musk deer (*Moschus fuscus*), sun bear (*Helarctos malayans*), Malayan pangolin (*Manis javanica*) and Chinese pangolin (*Manis pentadactyla*) are also severely threatened by illegal trafficking.

Illegal logging for valuable timber species is a driver of deforestation. Rosewood species (*Padauk-Pterocarpus macrocarpus* and *Tamalan-Dalbergia oliveri*) are highly valued and increasingly sold illegally across the border as rosewood supplies are exhausted in neighbouring countries. Orchids are also threatened by unregulated collection and sale across the border (NBSAP 2015).

NSBAP Target 12.1 requires that by 2020 the conservation status of priority, globally threatened species in Myanmar has improved with three actions to: pilot and scale up conservation and research initiatives for priority species; expand programmes to establish assurance colonies, captive breeding and wild release for threatened tortoises and freshwater turtles; and integrate conservation of wide-ranging species and species with highly fragmented distributions into local, regional and national landscape planning (NBSAP 2015). NSBAP Target 12.4 also aims to improve the conservation of migratory species by 2020 (NBSAP 2015).

The NSBAP Target 12.2 requires that the illegal wildlife trade in Myanmar be substantially reduced by 2020 through: enforcing the requirements of CITES through national legislation (Action 12.2.1); building the capacity of law enforcement authorities to enforce wildlife trafficking regulations (Action 12.2.2); and implementing alternative livelihood programmes to reduce the dependence of key communities on illegal wildlife trade (Action 12.2.3) (NBSAP 2015).

In summary:

(i) Myanmar is becoming a last refuge for many species which are intensely traded throughout Asia - but in recent years the illegal export of wildlife from the country has become more systematic and better organized.

(ii) With mounting pressure from encroachment, habitat loss and hunting, populations of many species in all classes are diminishing and becoming more fragmented

(iii) Myanmar is facing a potential wave of species becoming locally extirpated and nationally endangered

(iv) With every wildlife survey, species new to science are being discovered in Myanmar

4.6 Forest health

Forests within the Permanent Forest Estate (PFE) are under the authority of the Forest Department and are classified as either PAs (i.e. conservation areas), reserved forests (production forests), or protected public forests (local natural resource supply areas). More than 20 million hectares (200,000 km^2), or approximately 30% of the national land area, are designated within the PFE, although significant parts of the estate are cleared or degraded.

2.6.1 Habitat loss, degradation and fragmentation

Forest clearing for the expansion of commercial agriculture is now the leading cause of deforestation in Myanmar (Woods 2015) and while this process has been occurring for many decades, the current rate of forest conversion for agriculture is unprecedented. In 2013-2014, concessions were issued for oil palm and rubber plantations within the PFE (NBSAP 2015). The laws, regulations, and procedures by which concessions are allocated, especially those involving de-gazetting of forest reserves or those located within forest reserves, are spread across numerous uncoordinated jurisdictions, and the use of legal loopholes, special permits, and exemptions is common (NBSAP 2015).

In Myanmar, about 300 km^2 of plantation is established each year, often on recently cleared forest land and involving poorly understood biodiversity losses (Blaser et al. 2011). Gurney's pitta in southern Myanmar, for example, is threatened by expansion of oil palm (Tordoff et al., 2012).

Since 2006, one of the main threats to Myanmar's northern frontier forests has been deforestation to make way for sugarcane, tapioca, castor oil and rubber plantations (Global Witness 2009). Habitat conversion to agriculture takes two main forms: conversion of forest to agro-industrial plantations; and agricultural encroachment by small holders. Although both have similar impacts, their socioeconomic and political drivers are distinct and require different responses (Tordoff et al., 2012).

The main threats to plant species are overexploitation by legal and illegal logging, conversion to agriculture, especially commercial plantations, and degradation and fragmentation from road construction and small scale agriculture (WCS 2012).

Rural communities in upland areas have long practiced various forms of shifting cultivation, typically involving rotational systems of swidden fields and regenerating fallows (Tordoff et al., 2012). This can have negative effects on forest integrity and continuity (Leimgruber et al. 2004). In Natma Taung National Park, for example, fires from shifting cultivation result in forest loss at higher elevations. Located in Chin State in western Myanmar, the Park was established in 1994 primarily to protect the upper watersheds of the Lemro and Myittha Rivers. Intensive hunting has reduced wildlife while tea plantations have encroached into some areas (Platt *et al.* 2012). Logging and clearing continues to have an impact on lower elevations of the Park.

Agricultural expansion is taking place along the edges of large forested regions, such as the northern edge of the Central Dry Zone and in the Ayeyarwady and Myitha River valleys in Myanmar (Leimgruber et al. 2004).

2.6.2 Forest cover status and change

An analysis of the current forest status and change was undertaken using data sourced from the *Myanmar Forest Cover Change (2002-2014)* study (2016).[7] Figure 2.8 maps degraded, intact and non-forest areas in 2014, providing a snapshot of forest cover and condition, with the area of

[7] Myanmar Forest Cover Change: 2002-2014. This report is based on a manuscript and data prepared by: Tejas Bhagwat, Andrea Hess, Ned Horning, Thiri Khaing, Zaw Min Thein, Kyaw Moe Aung, Kyaw Htet Aung, Paing Phyo, Ye Lin Tun, Aung Htat Oo, Anthony Neil, Win Myo Thu, Melissa Songer, Katherine LaJeunesse Connette, Asja Bernd, Grant Connette, and Peter Leimgruber. Entitled: "Losing a Jewel-Rapid Declines in Myanmar's Intact Forests from 2002-2014." In review, submitted February 2016

remaining intact forest concentrated in the north and far southeast of the country. Figure 2.9 and the linked table show the status of intact forest by township. Table 2.7 and Figure 2.10 show the status of intact and degraded forest cover in 2014 by river basin (refer to Annex 1 for details on the data categories used and their aggregation). Table 2.9 and Figure 2.11 show the trend in "changed forest cover" between 2002 and 2014.

The outstanding conclusion from this analysis is that while Myanmar still retains large areas of forests, the estate is not in good health and is under mounting pressure. Seventy-five percent of the country no longer has intact native forest cover or has degraded forests (Table 2.7). Remaining intact forests of canopy greater than 80% (or greater than 60% for dry forest) have been reduced to 24.2% of total land area.

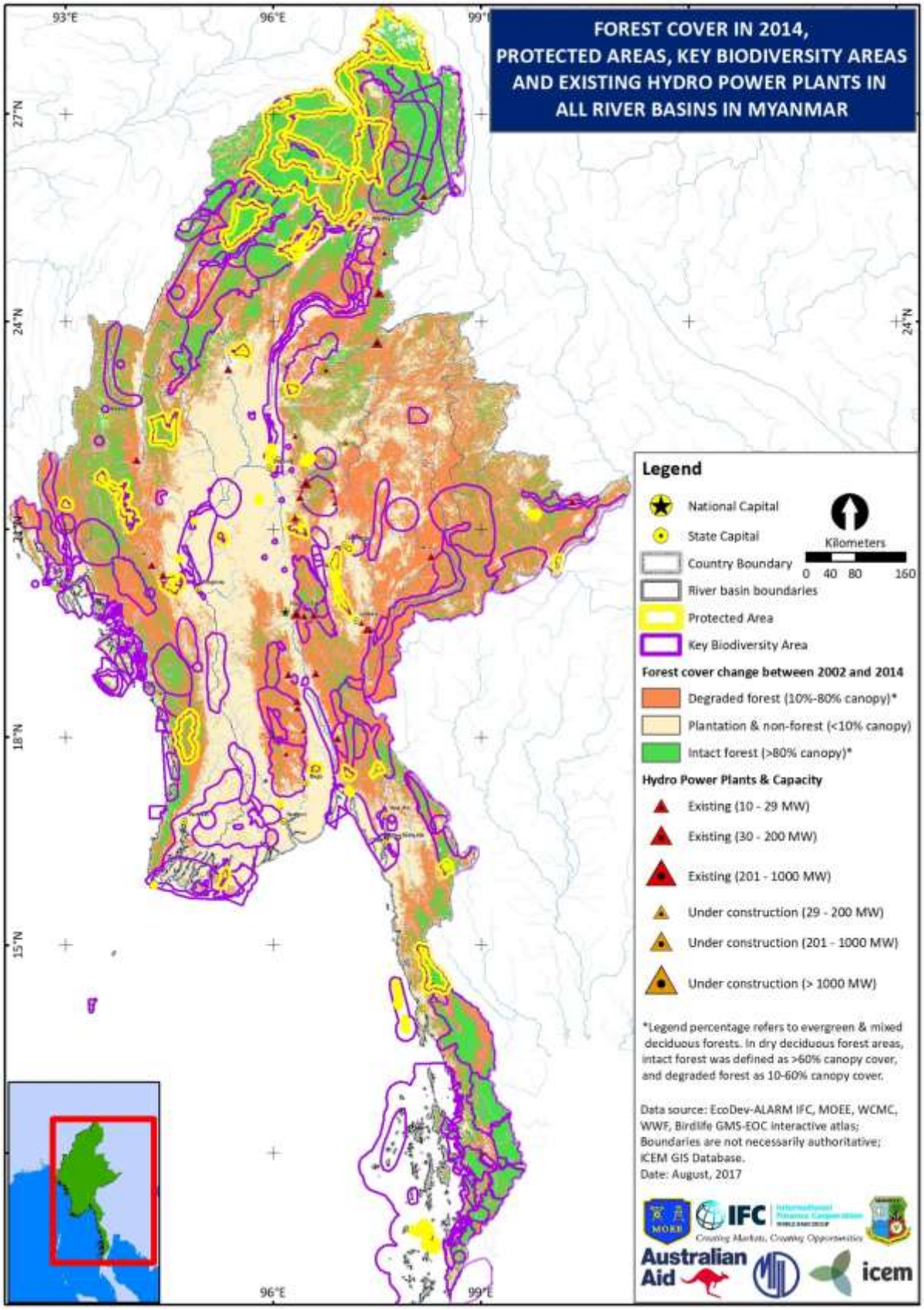
There are river basins that retain good forest cover - the Chindwin at 47.7% and the Tanintharyi coastal basins at 53.2%, but those are the exceptions (Table 2.7). The Headwater Ayeyarwady also retains good intact forest cover at 69.4% (Table 4.3), but overall this dominant and densely populated basin has less than the national average at 19.7% coverage. The Bago basin has only small pockets of intact forest with 2.3% total coverage, while others range from 10.6% to 26.8% coverage (Table 2.7). Forest cover is discussed in more detail in the basin-by-basin analysis in sections 3 to 11.

Table 2.7: Forest cover by river basin for Myanmar in 2014 (% cover)

Land cover category	Ayeyarwady	Chindwin	Mekong	Sittaung/ Bilin	Tanintharyi Coastal Basins	Thanlwin	Rakhine Coastal Basins/ Surma-Meghna	Bago	National
Intact forest (>80% canopy)*	19.7	47.7	18.5	10.6	53.2	11.3	26.8	2.3	24.2
Degraded forest (10-80% canopy)	29.3	31.7	62.1	36.0	30.9	56.9	50.6	26.5	39.1
Plantation & non-forest (<10% canopy)	49.0	19.8	19.3	51.7	14.3	31.1	21.2	68.1	35.2
Other (eg. open water, urban)	1.9	0.8	0.2	2.2	1.6	0.6	1.5	3.1	1.4
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 2.8: Forest cover 2014 in Myanmar



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 2.9: Remaining and lost intact forest (ha) for Myanmar townships between 2002 and 2014

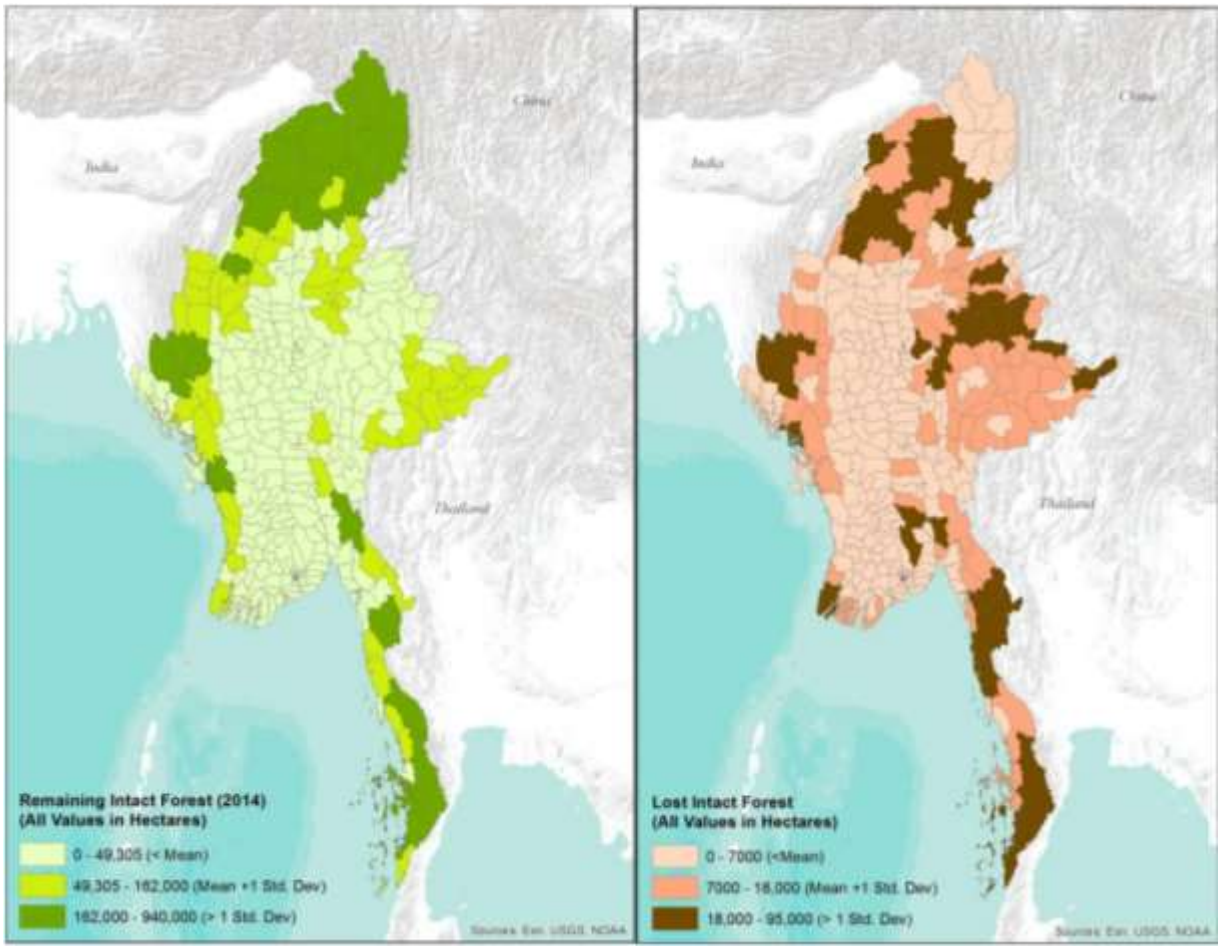


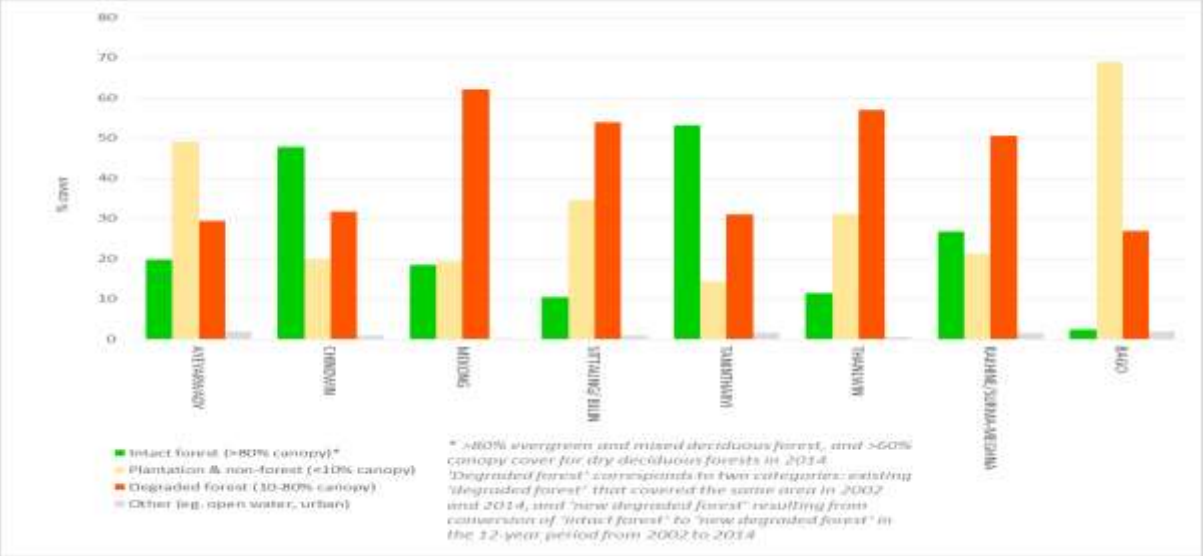
Table 2.8: Hotspot townships for forest loss

Township	State	Intact Forest cover 2002	Intact Forest cover 2004	Intact Forest Cover Change (Ha)	Annual Intact Forest Cover Change (%)
Homalin	Sagaing	594,158	507,042	-87,116	1.22
Bokpyin	Tanintharyi	490,181	433,603	-55,578	0.94
Hpakant	Kachin	398,764	359,675	-39,089	0.82
Myitkyina	Kachin	257,737	233,270	-24,467	0.79
Waingmaw	Kachin	258,896	234,279	-24,617	0.79
Lahe	Sagaing	283,799	260,152	-23,647	0.69
Matupi	Chin	308,132	285,755	-22,377	0.61
Tanai	Kachin	986,402	948,807	-37,595	0.32
Tanintharyi	Tanintharyi	841,929	821,307	-20,622	0.20

Source of map and table: Myanmar Forest Cover Change (2002-2014), 2016

It is difficult to provide a national level evaluation of the scale or severity of forest degradation in the large areas of "degraded forest" with canopy cover ranging from 10% up to 80%. To be categorized as "degraded" a forest area would need to have reduced canopy cover over a defined period - dropping for example from 85% to 65% canopy cover, or from 30% to 15%. Much of that area was already degraded prior to 2002. Yet, in 2014, some basins stand out as being in trouble when the combined area of degraded forest and non-forest is considered relative to remaining intact forest (Figure 2.10), including the Bago basin mentioned earlier, as well as the Sittaung and Thanlwin basins.

Figure 2.10: Forest cover in 2014 by river basin in Myanmar (% of basin area)



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Table 2.9, Table 2.10, and Figure 2.11 provide added insight into forest cover trends from 2002 to 2014. Average "changed forest cover" category as a percentage of each basin is quite low ranging from 2.1% for the Ayeyarwady, to 5.0% and 5.5% for the Tanintharyi and Mekong regions respectively. Changed forest cover relates to the area of intact forest which was transformed to new non-forest, degraded forest, plantations or water, over the twelve year period. Four factors need to be considered when interpreting those national figures. First, the level of degradation in most basins prior to 2002 was already very high, with five basins having more than 75% classified as "degraded regions" or "non-forest". The Smithsonian Institution reports a loss of 12,000 km^2 of forest of all types between 1990 and 2000 (NBSAP 2015). Second, the area of remaining intact forest was already relatively low. Third, the size of some basins means that even a relatively small percentage change amounts to a very significant forest area. For example, the 2% change in the Ayeyarwady represents 5,792 km^2 of forest (Table 2.10). Fourth, change in some endangered ecoregions or forest types, for example, mangroves, freshwater swamp forests and rainforests, was much higher than in others.

Table 2.9: "Changed forest cover" between 2002 and 2014 in river basins of Myanmar (% of basin area)

	% cover							
	Ayeyarwady	Chindwin	Mekong	Sittaung/Bilin	Tanintharyi Coastal Basins	Thanlwin	Rakhine Coastal Basins/ Surma-Meghna	Bago
Intact forest (>80% canopy)*	19.7	47.7	18.5	10.6	53.2	11.3	26.8	2.3
Changed forest cover**	2.1	3.2	5.5	3.1	5.0	4.0	3.4	2.5
Degraded regions***	76.3	48.2	75.9	85.6	40.2	84.0	68.3	93.4
Other (eg. open water, urban)	1.9	0.8	0.2	0.8	1.6	0.6	1.5	1.9
TOTAL	100	100	100	100	100	100	100	100

* 'Intact forest' (>80% canopy represents >80% canopy cover for evergreen/mixed deciduous forests, and >60% canopy cover for dry deciduous forests in 2014.

** 'Changed forest cover' is the sum of categories representing 'new plantations', 'new degraded forest', 'new non-forest' and 'new water' that were converted from 'intact forest' in the 12-year period from 2002 to 2014 (see Annex 1 for more details).

*** 'Degraded regions/non-forest' represent the sum of 'degraded forest', 'plantations', and 'non-forest' categories that remained unchanged from 2002 to 2014.

Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Global Forest Watch reports a loss of 15,000 km^2 of forest between 2001 and 2012, indicating an acceleration of forest loss, peaking at 2,162 km^2 in 2009. Over half the loss occurred in Kachin and Shan States and in Sagaing and Tanintharyi Regions (NBSAP 2015).

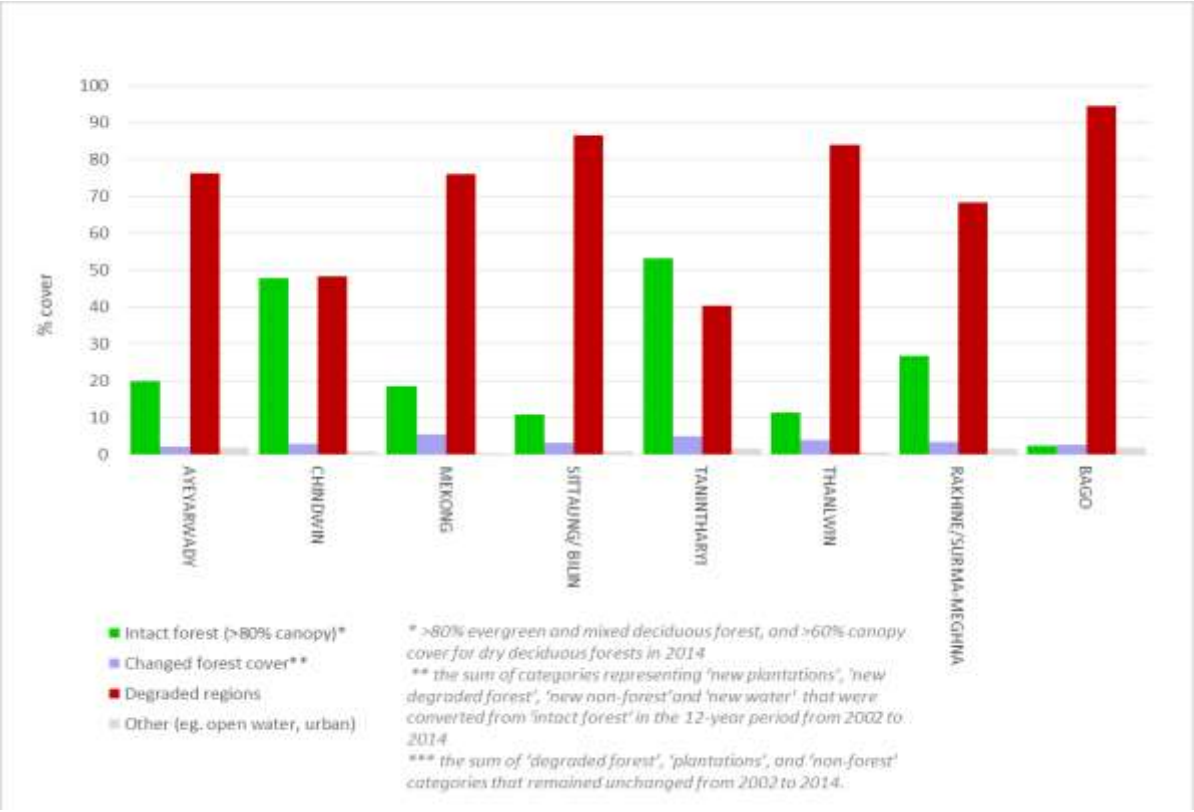
Table 2.10: "Changed forest cover" between 2002 and 2014 in river basins of Myanmar (km^2)

	Ayeyarwady	Chindwin	Mekong	Sittaung/ Bilin	Tanintharyi Coastal Basins	Thanlwin	Rakhine Coastal Basins/ Surma-Meghna	Bago
Intact forest (>80% canopy)	54,333	46,501	3,994	4,013	23,587	14,342	14,917	233
Changed forest cover	5,792	3,105	1,186	1,172	2,216	5,084	1,881	253
Degraded regions	210,138	46,975	16,427	32,431	17,818	106,163	38,064	9,566
Other (eg. open water, urban)	5,248	811	33	287	693	795	829	195
TOTAL	275,510	97,392	21,641	37,903	44,314	126,384	55,691	10,247

Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 2.11 shows that change over the 12 years from 2002 tended to be relatively higher in those basins which had a larger area of remaining intact forest.

Figure 2.11: Changed forest cover (from 2002 to 2014) by river basins of Myanmar



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Large areas of intact forest have been converted to tree and agricultural plantations and lost to mining, particularly in Sagaing Region. The largest remaining areas of intact forest are in northern Sagaing Region, Kachin State, and Taninthayi Region (NBSAP 2015).

In Myanmar, where rates of loss have been quantified, mangroves are one of the ecosystems most severely threatened by habitat loss (Leimgruber et al. 2004). Myanmar has the third largest area of mangroves in Southeast Asia (after Indonesia and Malaysia), however, a 2014 NASA study showed an annual decline in mangrove cover of over 50km^2 between 2000 and 2013, particularly in Rakhine State and Ayeyawady Region (Table 2.11).

Table 2.11: Mangrove cover changes between 2000 and 2013

Area	Mangrove cover (km^2)		Mangrove loss (2000-2013) (km^2)	Annual loss (km^2)	Rate
	2000	2013			
Rakhine Stae	1,734	1,470	-264	-20.31	-1.17%
Ayeyawady Region	818	462	-356	-27.38	-3.35%
Taninthayi Region	2,075	2,040	-35	-2.69	-0.13%
Total	**6,627**	**8,985**	**-655**	**-50.38**	**-0.76%**

Source: NBSAP 2015

Less than 5% of remaining mangroves are legally protected and there is growing pressure on the 137 km^2 Meinmahla Kyun Wildlife Sanctuary, the largest area of intact mangroves in the delta, for fuel wood and charcoal production.

Myanmar has 125,000 km^2 of dry mixed deciduous forest, half of the total in South-east Asia (Wohlfart et al. 2014). Dry deciduous forests in the northern edge of the Central Dry Zone are being lost at a rate of 0.7%/year (NBSAP 2015). The NBSAP emphasizes that more data on forest cover change and a well-documented, publicly available and spatially explicit forest cover change database are needed for conservation and development planning and management (NBSAP 2015).

Up-to-date information on the current status of Myanmar's biodiversity is a key issue, which reduces the ability of the NDWC and other conservation actors to effectively prioritize, manage and conserve habitats and populations. The NBSAP Target 19.1 calls for a Clearing-House Mechanism (CMH) web portal to be established by 2016 to provide a platform for multiple contributors to build the scientific knowledge base of Myanmar's biodiversity, but this target was not met. The NBSAP also set a target to develop a national publicly available forest cover change 2015-2020 database (Target 19.2) and post-graduate courses in leading Myanmar universities (Target 19.3), both by 2020 (NBSAP 2015).

In summary:

(i) *Intact forest has reduced substantially to 24.2% of national area and is a high priority for intensified conservation efforts and safeguards in each river basin.*

(ii) *The percentage of intact forest covered by the expanded KBA network is 62.3% which provides clear priorities for formal conservation investment.*

(iii) *Clearing and conversion of intact forest is continuing with the highest rates of change in regions which have the largest remaining areas of closed canopy forest (ie 11% loss since 2002)*

(iv) *Some forest categories and ecoregions are under more pressure of change than others providing another useful way of defining conservation priorities*

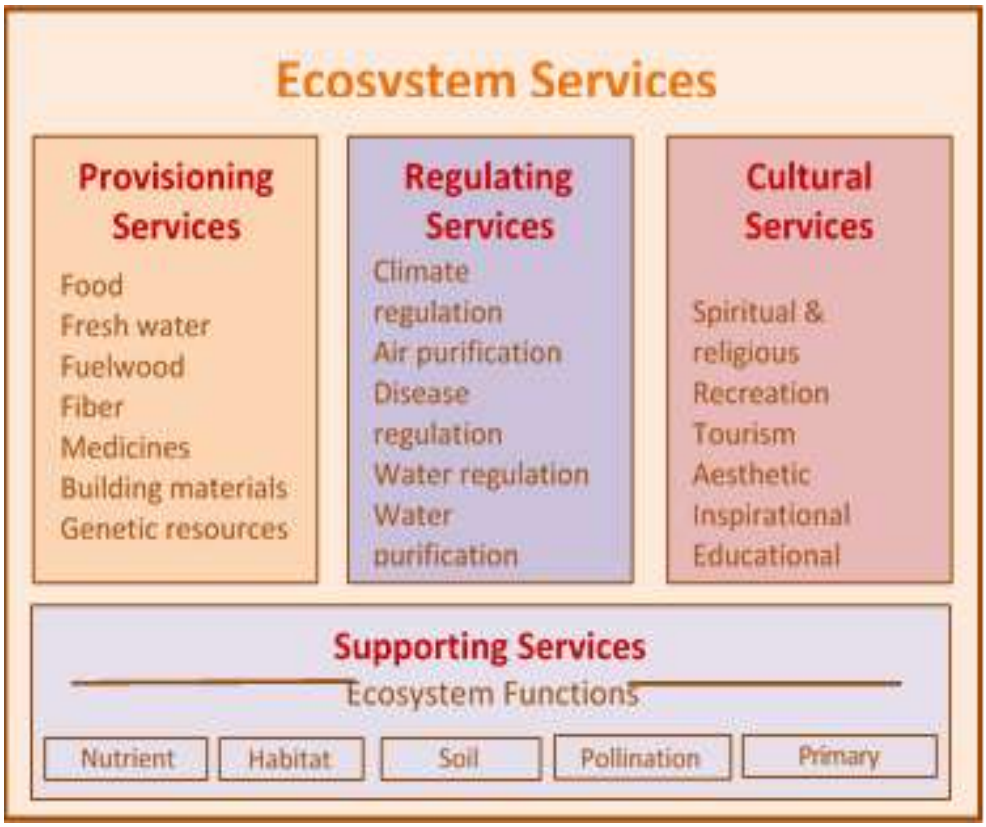
(v) *Large areas of degraded forest still provide important services and products, especially when close to remaining intact forest*

2.6.3 Ecosystem services

Past trends and current situation	
Theme:	Ecosystem Services and Products
Issues:	• Loss of forests ecosystem services • Poor and vulnerable communities are most affected by ecosystem service loss • Uncontrolled infrastructure development

Forests, aquatic systems, wetlands and their biodiversity provide ecosystem services. Ecosystem services are grouped into four broad categories: (i) provisioning, such as the production of food and water; (ii) regulating, such as the control of climate and disease; (iii) supporting, such as nutrient cycles and crop pollination; and (iv) cultural, such as spiritual, educational and recreational benefits (Figure 2.12).

Figure 2.12: Ecosystem service benefits



Source: ICEM 2017

Myanmar is highly dependent on ecosystem services and products, with 66% of the population working in agriculture, and much of the rural work force involved in natural resource dependent activities including fishing, mining and forestry. From an economic perspective, the annual value of forest ecosystem services in Myanmar is estimated to be US$ 7.3 billion (Emerton and Aung, 2013). National income earned directly from forest products accounts for only 15% of this estimated annual value, with the remaining 85% derived from forest ecosystem services that maintain the productivity of other sectors and help to avoid costs, losses, and damages throughout the nation.

Each forest type, wetland or river reach could be described in terms of the wide range of services and products provided and the implications for community wellbeing if those services are lost. The primary drivers of changes in ecosystem services in Myanmar are (i) illegal logging and related deforestation, (ii) agricultural encroachment, (iii) population pressure, and (iv) a substantial increase in infrastructure development.

Myanmar has the third largest area of mangroves in Southeast Asia (NBSAP 2015), with coastal mangrove forests providing valuable habitats for marine biodiversity, acting as a carbon storage, and helping to protect communities from flooding and storm surges. Coastal mangrove forests have been

estimated to contribute an annual value of US$707 million toward coastal protection services and US$1.13 billion to mangrove fisheries nursery and breeding habitat services (Emerton and Aung 2013).

Watershed protection services provided by terrestrial forests contribute an estimated US$ 721 million per year to the national and local economies (Emerton and Aung 2013). Another critical ecosystem services in Myanmar is the provision of freshwater resources (NBSAP 2015). While Myanmar is a country of low water stress, it remains vital to protect the quality and reliability of freshwater resources particular in regions which experience long periods of drought such as the Ayeyarwady dry zone.

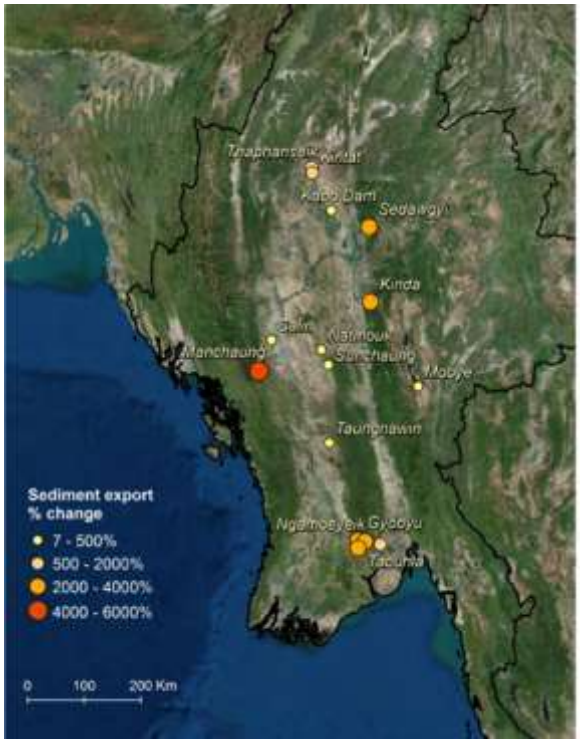
Hydropower plants depend on forested and intact watersheds to filter and moderate flow and retain soil. During the dry season, healthy forests play a key role in maintaining base flows and minimizing the low flow period when hydropower plants are unable to operate. Flow regulation also plays a key role in minimizing flood damage, as deforestation and land degradation on steep slopes and mountainous areas of upper catchments is a key risk in terms of increasing the incidence and impact of flooding (Nyo 2012). Forested watersheds are able to retain sediment and minimize the rate of sediment transport into hydropower reservoirs, thereby decreasing the loss of reservoir live storage and the likelihood of damage to machinery (Emerton and Aung, 2013). Of the 84 existing and planned hydropower projects over 10 MW in Myanmar all are located in remnant forest areas (ie forest with >10% canopy cover). Of these, 33 projects are located in intact forest (ie with canopy cover over 80%), and 51 are located in areas of forest with >50% canopy cover.

The importance of maintaining sediment retention ecosystem services in upstream forested areas for the efficient maintenance and operation of dam and reservoir infrastructure was highlighted in the WWF (2016) report on *Natural connections: How natural capital supports Myanmar's people and economy*.[8] It shows how increased operational costs and diminished hydropower generation may result from the accumulation of sediment behind dams that could result from loss of natural vegetation cover and future climate change. Based on a study of 15 existing dams, those at highest risk of increased sedimentation from the removal of natural vegetation within their upstream catchments were identified (Figure 2.13 and Figure 2.14) (WWF 2016).

Also, projected increases in rainfall with climate change will increase sedimentation at dams and reservoirs even without loss of natural vegetation. The percentage changes of sedimentation at each of the 15 dams under RCP 4.5 and RCP 8.5 emissions scenarios are shown in Table 2.12, where for the RCP 8.5 emissions scenario (75^{th} percentile) the percentage change in sediment load ranges from 15.1% to 19.9% by the 2020s and 18.5% to 28.8% by the 2040s. Increased sediment loads caused by deforestation and climate change have potential to impact the operation of hydropower infrastructure, and 'managing natural capital to promote sediment retention upstream of dams and reservoirs will continue to provide benefits to dam and reservoir function in the coming decades' (WWF 2016).

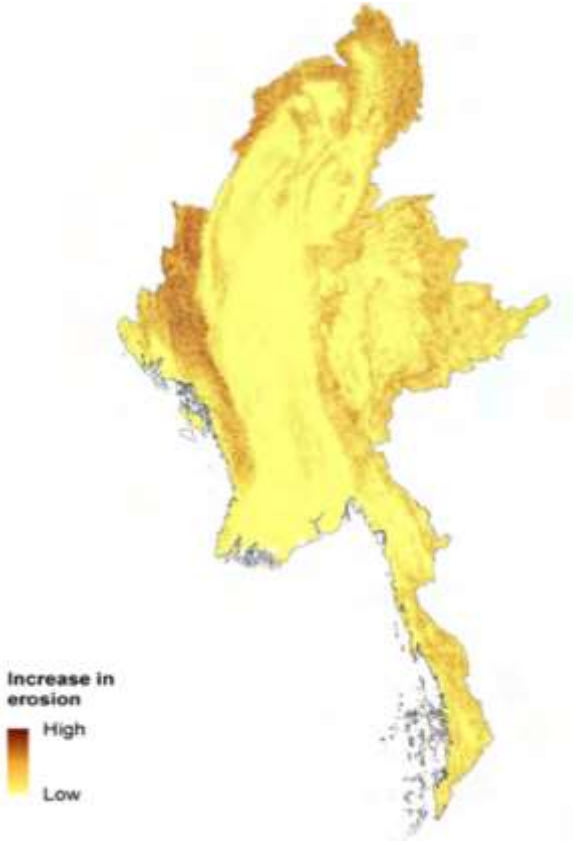
[8] WWF (2016) Natural connections: How natural capital supports Myanmar's people and economy.

Figure 2.13: Increase in sediment export for hydropower projects assuming all land cover is converted to agriculture within the catchment (WWF 2016).



Source: WWF 2016

Figure 2.14: Projected increases in erosion if all land cover replaced by agriculture.



Source: WWF 2016

Table 2.12: Projected sediment loads at major dams under RCP 4.5 and 8.5 emissions scenarios.

Dam	Percent Change in Sediment Loads under two emissions scenarios			
	RCP 4.5, 2020s, 25th percentile	RCP 8.5, 2020s, 75th percentile	RCP 4.5, 2040s, 25th percentile	RCP 8.5, 2040s, 75th percentile
Alaingai	-5.4	16.1	-2.0	18.5
Hyobyu	-5.8	16.5	-2.7	18.6
Kabo	-7.9	19.9	-5.0	24.7
Kinda	-8.7	15.2	-2.8	24.7
Kintat	-9.0	17.1	-5.5	28.6
Manchaung	-5.5	16.3	-4.7	22.3
Mobye	-8.9	15.1	-2.0	25.7
Natmouk	-7.7	16.4	-2.3	24.4
Ngamoeyeik	-6.0	16.6	-2.8	28.8
Salia	-6.1	16.4	-4.0	23.1
Sedawgyi	-9.2	17.2	-4.7	25.2
Sunchaung	-7.1	16.8	-2.0	25.1
Tabuhla	-5.7	16.6	-2.7	18.6
Taungnawin	-6.6	17.4	-3.1	22.2
Thaphanseik	-9.0	17.0	-5.4	28.8

Source: WWF 2016

There are potentially multiple direct and indirect impacts of hydropower development during both their construction and operational phases on ecosystem services (ICEM 2010).[9] Direct impacts on biodiversity resources include habitat fragmentation and loss, loss of populations and species, barriers to migration of species such as from construction of dams and roads, and the spread of invasive organisms (ICEM 2010). Indirect impacts include reduced water quality, altered sedimentation patterns downstream, changes to environmental flows and flooding regimes, increased pressure on natural resources (eg., wildlife consumption close to settlement areas), and development encouraged by improved access to power and water supplies (ICEM 2010). How these impacts may affect the four key categories of ecosystem services (refer to Figure 2.12) are highlighted in Table 2.13.

Table 2.13: Hydropower impacts and potential loss (indicated by 'X') of ecosystem services

	Ecosystem services			
Hydropower impacts	**Provisioning**	**Regulating**	**Supporting**	**Cultural**
Direct impacts				
Habitat loss	X	X	X	X
Habitat fragmentation	X	X	X	X
Loss of populations and species	X			X
Barriers to species migration	X			X
Genetic isolation of populations	X		X	
Spread of invasive species	X	X		X
Indirect impacts				
Water quality reduction	X	X	X	
Modified hydrological flows		X	X	
Sedimentation changes		X	X	
Altered flooding regimes		X	X	
Modified shorelines in riparian ecosystems	X	X	X	
Increased threats to natural resources	X	X	X	X
Expansion of development	X	X	X	X

An analysis of the impact of 29 existing hydropower projects and 6 under construction in Myanmar indicate that three existing hydropower plants (Paung Laung (upper), Yeywa and Kun Chaung) and 2 projects under construction (Shweli 3, Thahtay) received the two highest impact scores (4 and 5) (Table 2.15). Hydropower plants were scored through consideration of three parameters: direct forest loss, forest condition and wildlife consumption/threat. These three parameters and calculation of the project impact scores are further defined as follows:

1. **Direct forest loss** (proxy for habitat loss) - representing coverage of each project's upstream reservoir.
2. **Loss of forest condition** - area covered by KBAs and intact forest falling within the project's zone of influence in which access is facilitated (refer to the SEA impact assessment volume for more details).
3. **Increase in wildlife consumption/threat** - number of construction workers and camp followers.
4. **Project impact score** - each of the above three parameters are given a score from 1 to 5 which are summed and then divided by 3. The highest value (5) represents the highest impact.

The scores in Table 2.14 relate to impacts on terrestrial biodiversity - the aquatic ecosystems chapter provides an additional insight into the overall impacts of existing hydropower projects. For example, the Baluchaung cascade of three projects was intended as a partial diversion and run of river operation

[9] Carew-Reid, Jeremy, Josh Kempinski and Alison Clausen. 2010. Biodiversity and Development of the Hydropower Sector: Lessons from the Vietnamese Experience –Volume I: Review of the Effects of Hydropower Development on Biodiversity in Vietnam. ICEM – International Centre for Environmental Management, Prepared for the Critical Ecosystem Partnership Fund, Hanoi, Viet Nam. URL: http://www.icem.com.au/documents/biodiversity/bioHPdevt/Volume%20I%20Biodiversity%20and%20development%20of%20hydropower-Vietnam%20experience.pdf

but the natural river is effectively dead for the entire reach linked to the cascade. That impact is due to the upstream Baluchaung 1 project diverting 100% of river water in order to maximize power output from all three schemes. In this case all ecosystem services linked to environmental flows for example are lost.

Table 2.14: Impacts of existing hydropower plants and those under construction in Myanmar (a HPP impact score of 5 represents the highest possible impact)

	Project name	Direct forest loss	Forest condition	Wildlife consumption/threat	HPP impact score
Existing	Paung Laung (upper)	4	5	5	5
	Yeywa	4	5	5	5
	Kun Chaung	5	4	2	4
	Shwegyin	4	3	3	3
	Paung Laung (lower)	2	2	5	3
	Yenwe	5	3	1	3
	Chipwi Nge	1	4	3	3
	Dapein 1	1	2	5	3
	Kabaung	5	2	1	3
	Shweli 1	1	2	5	3
	Baluchaung 2	1	1	5	2
	Kyee Ohn Kyee Wa	3	1	3	2
	Mone Chaung	3	1	3	2
	Mongwa	1	4	2	2
	Thapanzeik	5	1	1	2
	Kinda	2	2	2	2
	Phyu Chaung	2	2	2	2
	Sedawgyi	3	2	1	2
	Thauk Ye Khat 2	1	1	4	2
	Zaungtu	1	4	1	2
	Zawgyi II	3	2	1	2
	Nancho	1	2	2	2
	Baluchaung 3	1	1	2	1
	Keng Tawng	1	1	2	1
	Mali	1	2	1	1
	Myittha	1	1	2	1
	Myogyi	1	2	1	1
	Zawgyi I	1	2	1	1
	Baluchaung 1	1	1	1	1
Under construction	Shweli 3	5	3	5	4
	Thahtay	4	5	3	4
	Yeywa (upper)	4	1	5	3
	Buywa	5	1	1	2
	Keng Tawng (upper)	4	1	1	2
	Baluchaung (upper)	1	2	1	1

Increased sediment in freshwater flows also decreases water quality and negatively impacts delicate freshwater ecosystems. Decrease in water quality has a direct impact on water supply systems, as most freshwater in Myanmar is distributed without treatment.

Timber harvesting has been an important source of livelihood support, commercial income, government revenues, and foreign exchange earnings in Myanmar (Emerton and Aung, 2013). A total production volume of 538,340 tonnes of teak and 2,725,700 tonnes of other hardwoods was recorded in 2009/10 (MOECAF 2011a). Along with the sale of wood products, biomass energy contributes more than 60% of total energy consumption in Myanmar and is used by 70% of the population (ADB 2012a). There is also a history of unlicensed, cross-border timber trade, with an estimated 1 million m^3 of unlicensed timber exported to China in 2003 (Forest Trends 2011). Excluding large-scale

unlicensed timber removals and exports, the annual value of industrial wood production is estimated to be US$ 582 million. The annual contributions of elephants alone providing draught power for harvesting operations is US$ 21 million (Emerton and Aung 2013).

The extensive forest network in Myanmar, even if largely degraded, constitutes an important global carbon sink. The 2010 Forest Resources Assessment provides an estimate of 1.65 billion metric tonnes of above and below-ground living forest carbon biomass, and 67 million tonnes of carbon in leaf litter (FAO 2010). The annual contribution of forest carbon sequestration and storage is estimated to be US$ 890 million (Emerton and Aung 2013).

The pollination of crops and natural ecosystems supports food security and the survival of many plant species throughout the country. The annual value of wild insect crop pollination services in Myanmar is estimated at US$ 2.73 billion per year (Emerton and Aung 2013).

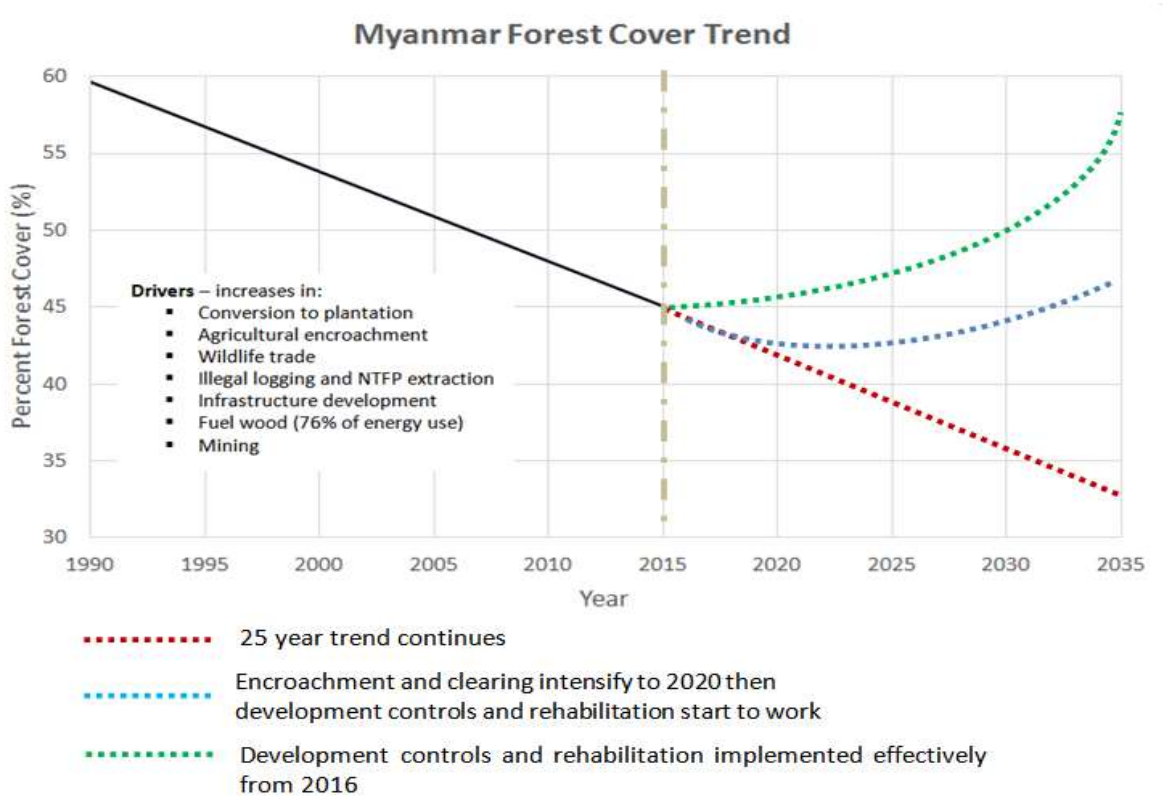
Non-timber forest products (NTFPs) are harvested at a commercial scale throughout Myanmar and include bamboo, rattan, barks, resins, oils, honey, beeswax, guano, orchids, edible bird nests and lac. NTFPs are an important source of subsistence and income for rural communities, providing food, construction materials, natural medicines and other products (Springate-Baginski and Thaun 2011). NTFP harvesting from terrestrial forests provides US$ 487 million per year and US$ 20 million per year from Mangrove forests (Emerton and Aung 2013).

Nature-based recreation and tourism is a growing sector in Myanmar, with recorded international arrivals rising by nearly 50% over the last five years, and leisure spending increasing by nearly a factor of three (MHT 2012). Nature-based tourism is expected to continue to grow as the tourism sector grows. The Tourism Master Plan for 2013-20 emphasizes the promotion of quality ecotourism in and nearby PAs (ADB 2013a), and highlights nature-based segments of the market as key components in a future diversified set of tourism products (ADB 2013c). The current low level of nature-based recreation contributes an estimated US$9 million annually to the national economy (Emerton and Aung 2013).

2.6.3.1 Loss of forests ecosystem services

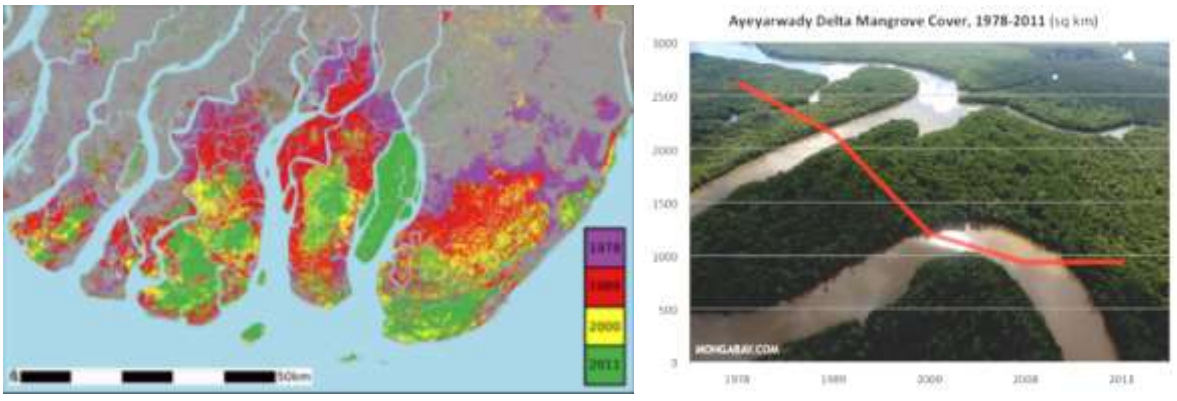
Myanmar's ecosystem services are dependent on the maintenance and rehabilitation of forest health. Since 1990, there has been a 15% decline in forests with more than 10% canopy cover (Figure 2.15) and, as shown earlier in this chapter, a very significant decrease in forest quality. The rate of timber exports from native forests has increased, with the volume of exported timber rising 18% in three years from 2.7 million m^3 in 2011 to 3.3 million m^3 in 2013, and export values increasing from US$ 1 billion to US$ 1.6 billion (Woods 2015). Additionally, agricultural land use has expanded 3% over the past 15 years to 19.4% of the total land area (World Bank Agricultural Statistics).

Figure 2.15: Myanmar past and future forest cover trends (forests of >10% cover)



Coastal mangrove forests, for example, have been on a steady decline from a mixture of deforestation and agricultural expansion. A 2014 satellite study demonstrated a significant decline in mangrove cover between 2000 and 2013 (Weber 2014). Figure 2.16 shows the relative extent of mangrove forests in the Ayeyarwady Delta over a four decade period beginning in 1978, with each decade experiencing a decrease in mangrove cover. The extensive clearing of mangroves is considered to be a significant factor behind the loss of life resulting from cyclones Nargis (2008) and Giri (2011), as well as the collapse of the shrimp sector in northern Rakhine State (NBSAP 2015).

Figure 2.16: Loss of mangrove land cover in the Ayeyarwady Delta in 1978, 1989, 2000 and 2011



Source: Weber 2014

The large island in Figure 2.16 that has remained forested is the Meinmahla Kyun Wildlife Sanctuary. When projected to 2030 these trends indicate a 60% mangrove loss in Rakhine State and lesser but still significant losses in the Ayeyarwady Delta and Tanintharyi region (Table 2.15).

Table 2.15: Actual and projected trends in Mangrove loss in Myanmar - 2000-2030

Location	Km^2			
	2000	2013	2030	
Rakhine	1,734	1,470	688	40%
Ayeyarwady	818	462	130	56%
Tanintharyi	2,075	2,040	1,778	85%

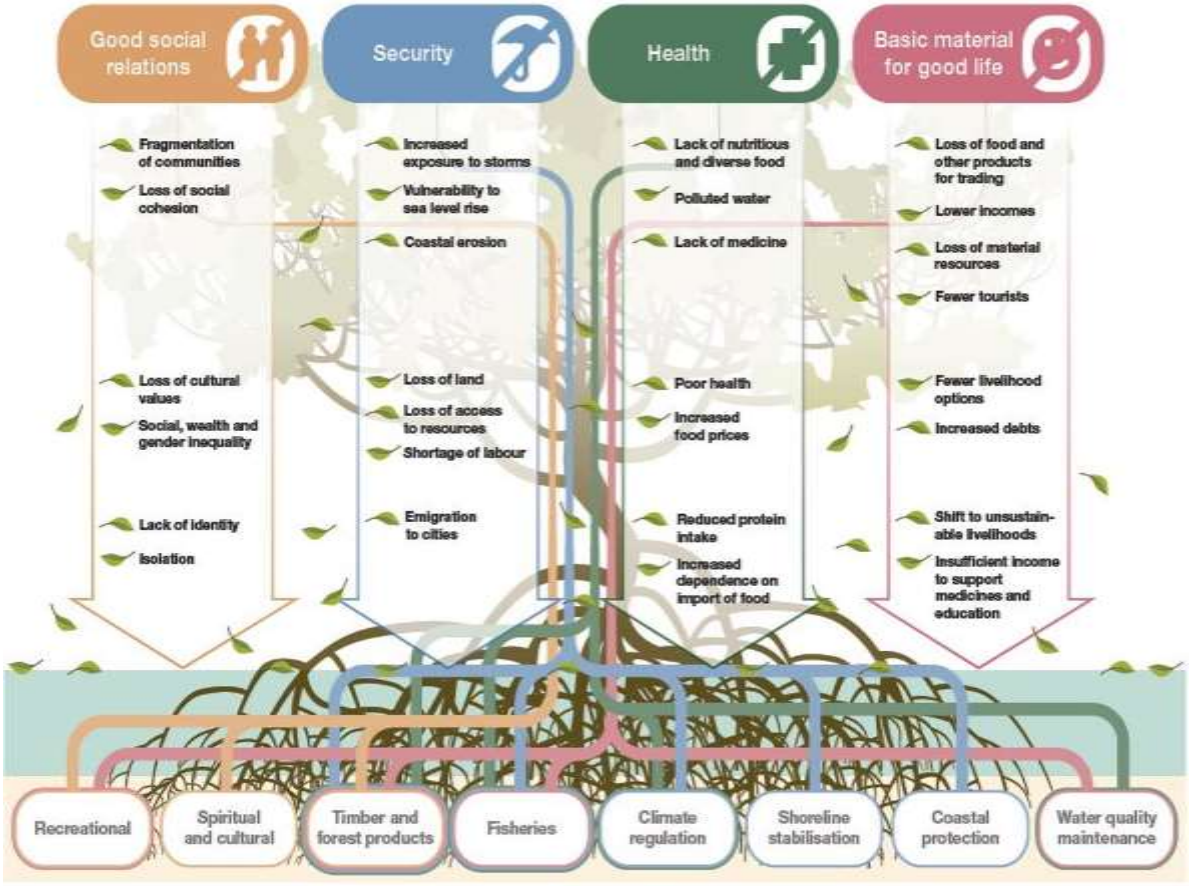
Source: Weber 2014

Past drivers of mangrove loss have been the expansion of rice production and timber extraction for construction and fuel. Future drivers of loss are likely to include the expansion of rice production, oil palm plantations, aquaculture and urban areas. Figure 2.17 illustrates how ecosystem service benefits to communities are lost as Myanmar's mangrove forests diminish.

A decline in pollinator species is a threat to agricultural success and national biodiversity, as many plant species are unable to survive without pollination from insects and animals. Pollinators include birds, beetles, rodents, and bees (NBSAP 2015). The Red List Index (RLI) for pollinators in Myanmar is declining, indicating faster relative population decreases and potential impacts to pollinated crop value (NBSAP 2015). Pollinator species are especially important for Myanmar's agricultural sector, from which the country derives 36% of its GDP and 60-70% of employment (MIMU Country Overview Statistics).

A "forest degradation" model of ecosystem management could incur losses to the year 2031 of US$ 17 billion to Myanmar's economy over the current situation. A "forest conservation" scenario, however, is estimated to add gains up to the year 2031 of more than US$ 22 billion to Myanmar's economy over the current situation (Emerton and Aung 2013). Figure 2.16 shows the past trend in forest loss, along with a range of options for forest cover regeneration based on three different forest rehabilitation approaches. The land area that has been deforested but not yet converted presents an important opportunity for forest regeneration and a resurgence of lost ecosystem services. That is the goal of the Government's and IUCN's Forest Restoration Initiative.

Figure 2.17: Impact of diminishing ecosystem services derived from mangroves on community well-being



Source: UNEP 2014

Agricultural expansion, however, is continuing to convert forest land and reduce the potential for forest regeneration. The government is strongly promoting agricultural expansion having earmarked 1.8 million ha of forest land for agribusiness projects (Woods 2015).

2.6.3.2 Poor and vulnerable communities are most affected by ecosystem service loss

Poor and vulnerable members of society, including marginalized ethnic nationalities and women, are especially dependent on ecosystem services due to limited economic opportunities, concentration in rural areas, and discrimination (NBSAB 2015). Rural communities, which comprise two thirds of the population in Myanmar (MIMU Country Overview Statistics), often depend on collecting NTFP species for income or a local source of sustenance. Past deforestation and infrastructure encroachment has posed a threat to NTFPs and local biodiversity for poor and vulnerable communities.

The ongoing ethnic conflicts in different parts of the country, combined with a lack of human rights and land security, have made it very difficult for local communities to manage and protect their own natural resources (Tordoff et al., 2012). On-going ethnic conflicts are one factor behind the weak controls over illegal activity in Myanmar, where deforestation may have increased recently in the north (Blaser et al. 2011). Official exports of logs from Myanmar to China fell from 1 million m^3 in 2005 to 270,000 m^3 in 2008, due mainly to measures put in place by the Chinese authorities; however a suspected 90% of that reported trade was still illegal (Global Witness 2009). It has been claimed that areas with ethnic insurgencies in Myanmar, along the borders with China, India and Thailand, play a major role in facilitating regional trade in big cats and other endangered species (Oswell 2010).

Migration in rural areas can have huge impacts on the ability of upland populations to live sustainably (Eberhardt 2003). Migration drivers include armed conflict, which has left an estimated 1 million people internally displaced within Myanmar (Tordoff et al., 2012), and climate change (FAO 2011b).

The recognition of customary tenure and traditional systems of governance is fundamental to the promotion of traditional practices that benefit conservation and encourage sustainable use of resources (NBSAP 2015). Systems in most upland areas of Myanmar are based on customary rights under local institutions (Eberhardt 2003), which are not upheld under national law. As a result, rural communities are vulnerable to losing access to land through such processes as the establishment of commercial plantations by agribusinesses (Tordoff et al., 2012). This is further compounded by the lack of a specific land-use policy to settle disputes over land tenure (Eberhardt 2003). Conservation activities, including management of PAs, must be conflict-sensitive, especially as many current and proposed PAs in Myanmar are in areas that are subject to overlapping and contested land claims (NBSAP 2015).

Conflict and lack of customary land tenure is a major issue for biodiversity conservation and management in Myanmar. Conflict makes control over illegal activities difficult while uncertainty over land tenure and natural resources ownership leads to short-term exploitation and degradation. There is also a lack of recognition and legal protection of customary land tenure and traditional knowledge and practices in biodiversity conservation in Myanmar, consequently neglecting an important opportunity for sustainable biodiversity management and conservation. Conflict has also made it difficult to develop the scientific knowledge base on Myanmar's biodiversity as large areas of the country have been off-limits to field work because of security concerns (NBSAP 2015).

The Government has placed resolving the country's armed ethnic conflicts as a top priority. The NSBAP Target 3.1 requires that the national legal framework on tenure encourages conservation and sustainable management by 2020 through:

- Finalising a National Land Use Policy and Land Law that strengthen smallholder and customary tenure rights;
- Developing implementing rules and regulations that recognize customary tenure of land, freshwater, and marine resources, including communal tenure and rotational and shifting *taungya*; and
- Mainstreaming conservation into national and district level Central land use planning, improving inter-ministerial coordination, and providing technical support to districts.

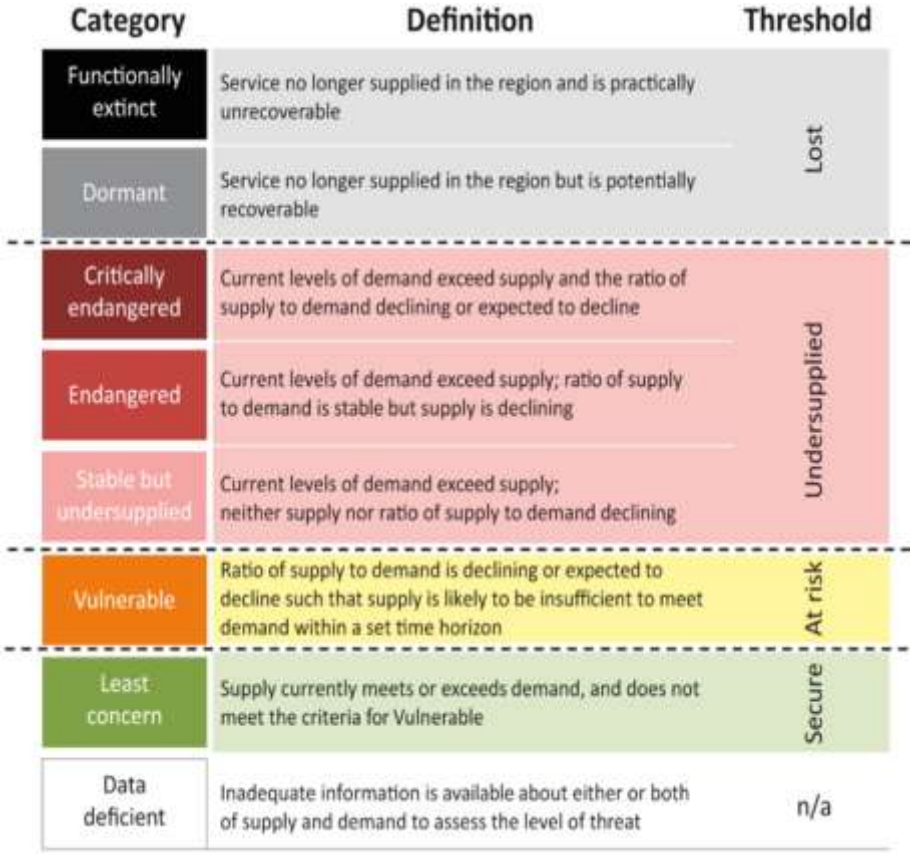
The NBSAP has also set targets for the recognition and protection of traditional knowledge and practices through incorporation into educational curricula (Target 18.3 and 18.4) and integration of customary land use tenure systems into Myanmar's legal framework (Target 18.1) (NBSAP 2015).

2.6.3.3 Increasing infrastructure development in biodiversity rich areas

Since the turn of the century, Myanmar has experienced unprecedented development as described in the economics chapter of this report. The country has seen a 90% rise in GDP from US$ 6.5 billion in 2001 to US$ 62.6 billion in 2015 (World Bank Country Statistics). That rise has been accompanied by a large wave of infrastructure development - particularly irrigation, hydropower and roads in the agriculture, power, mining and transport sectors.

Since 2002, Myanmar has seen a 62% increase in mining activity (La Jeunesse Connette et al. 2015). There has been an increasing number of hydropower dams built, with many dams falling within Key Biodiversity Areas. Expansion of the road network has resulted in losses in forest biodiversity, through direct impacts and improved access (Laurance et al. 2009). Roads have opened up forested regions to further exploitation in the development process. There are plans for expanding the road network by 34,400 km. In 2013 the World Economic Forum ranked Myanmar's infrastructure 136th out of 148 countries in the global competitiveness index, and roads were ranked 129th/148 (The Global Competitiveness Report 2013). According to goals of the Government and international finance agencies, the next decade in Myanmar will see infrastructure development on an unprecedented scale, with far reaching implications for the nation's biodiversity estate.

Figure 2.18: Ecosystem status assessment categories



Source: Martine Maron et al, 2016

In summary,

(i) *The productivity and sustainability of many sectors, including hydropower, which are the foundation for Myanmar's development, and the nation's success in continued poverty reduction, food security and well-being in poor communities, are dependent on the maintenance of healthy ecosystems.*

(ii) *Ecosystem services in Myanmar are in overall decline, a trend which is likely to accelerate over the next decade given continuing forest losses, an anticipated wave in infrastructure development and the limited protection in biodiversity rich regions.*

(iii) *Applying the ecosystem status categorization in Figure 2.12, this baseline assessment found that, in the expanding non-forest and degraded forest areas:*

- ***Provisioning services** are vulnerable, dormant or functionally extinct.*
- ***Regulating services,** relating to erosion and water regulation and other healthy watershed services, for example, are undersupplied and endangered.*
- ***Cultural services** are especially stressed, endangered and even functionally extinct in some areas.*

3. BASIN ASSESSMENT

The basin-by-basin assessment provides an analysis of the current status of biodiversity, trends and drivers of biodiversity change, and a summary statement of key trends. Based on consultations during implementation of the project, eight major basins or combinations of basins are included in this baseline assessment: two relatively small basins, Surma-Meghna and Bilin basins, are treated in combination with Rakhine coastal and Sittaung basins respectively. Subsequently, in section 12, these eight basins are further analysed at the sub-basin level, where each of 58 sub-basins are ranked according to their biodiversity value based on percentage KBA and intact forest coverage and taking the conservation status of ecoregions into account.

Two sets of maps are produced for each basin: (1) ecoregion distribution throughout the basin; and (2) the status of intact and degraded forest in 2014. Each map includes the relevant Key Biodiversity Areas (KBAs), Protected Areas (PAs) and hydropower projects (see Annexes 2 and 3 for maps and lists of PAs and KBAs in Myanmar). Graphs and tables are also provided to highlight remaining intact and degraded forest in 2014 (using the same data and aggregated categories as used for the second set of maps), and also the percentage of intact forest that became degraded and converted to plantation, non-forest and water from 2002 to 2014. Data used in this analysis came from the Myanmar Forest Cover Change (2002-2014)[10] study (more details on the data sources and their aggregation for the included maps and graphs on forest status and change are given in Annex 1).

An additional source of global forest loss data from Hansen et al. (2013)[11] was used to plot trends of cumulative annual forest loss for each basin, with forest loss determined for open canopy, medium-closed canopy cover, and intact forest. The canopy cover metrics adopted for these plots are based on those from the Myanmar Global Forest Resources Assessment 2015[12] and Myanmar Forest Cover Change (2002-2014) study. In this study, the term ‘open forest’ refers to forest with greater than 10% and less than or equal to 40% canopy cover; ‘medium-closed forest’ has a canopy cover of more than 40% and less than or equal to 80%; and ‘intact forest’ has greater than 80% canopy cover. The term ‘medium-closed’ canopy cover is used rather than ‘closed’ canopy cover (as defined in the Myanmar Forest Resources Assessment) as this helps better describe the three categories of canopy cover presented in this study: open, medium-closed, and intact forest.

[10] The Myanmar Forest Cover Change (2002-2014) report comes from a manuscript and data prepared by: “Tejas Bhagwat, Andrea Hess, Ned Horning, Thiri Khaing, Zaw Min Thein, Kyaw Moe Aung, Kyaw HtetAung, Paing Phyo, Ye Lin Tun, Aung Htat Oo, Anthony Neil, Win Myo Thu, Melissa Songer, Katherine LaJeunesse Connette, Asja Bernd, Grant Connette, and Peter Leimgruber. Entitled: ‘Losing a Jewel—Rapid Declines in Myanmar’s Intact Forests from 2002-2014.’ In review, submitted February 2016”.

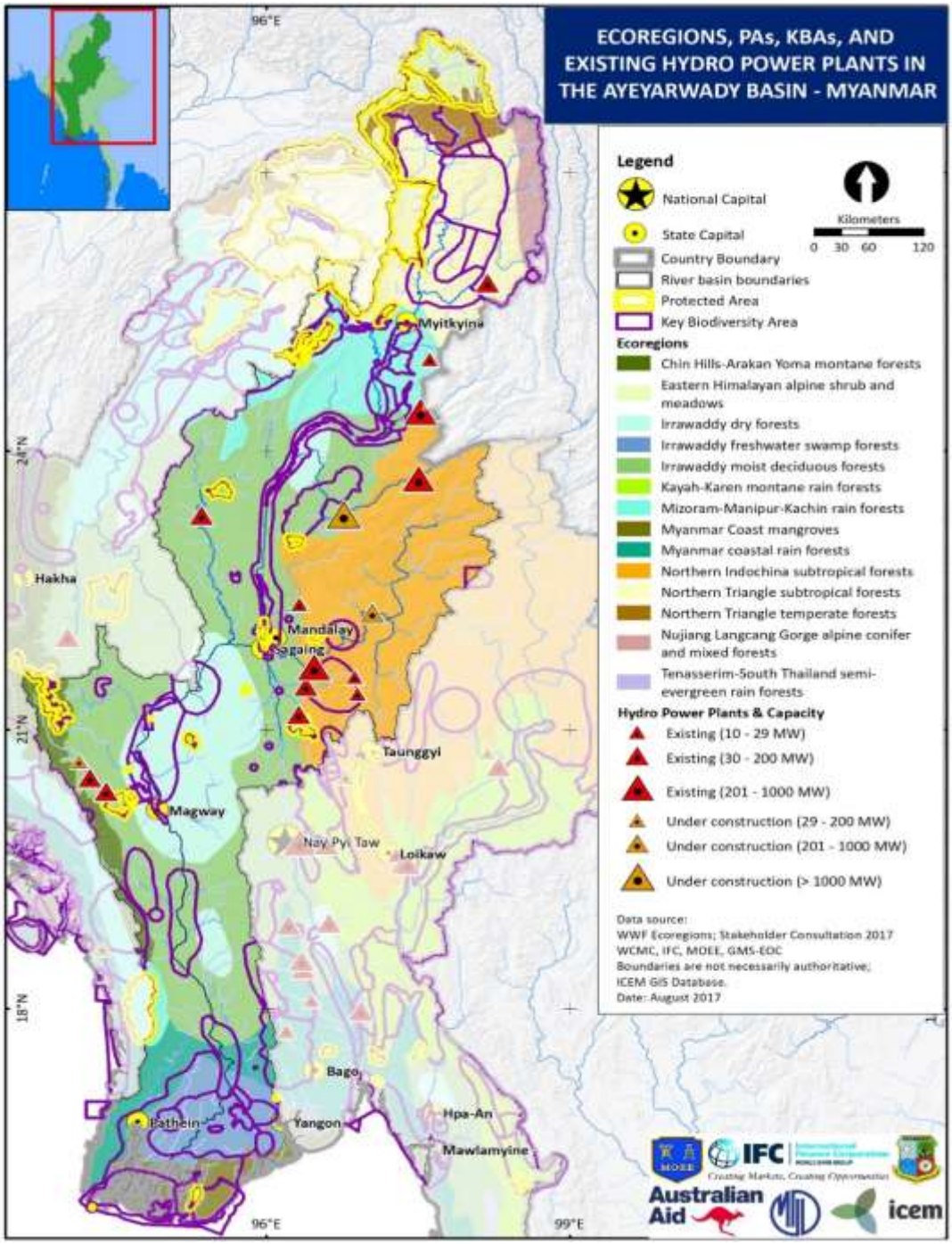
[11] Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. “High-Resolution Global Maps of 21st-Century Forest Cover Change.” *Science* 342 (15 November): 850–53. Data available on-line from:http://earthenginepartners.appspot.com/science-2013-global-forest. Accessed through Global Forest Watch on [date]. www.globalforestwatch.org

[12] FAO (2015) Global forest resources assessment 2015, Country report, Myanmar. URL: http://www.fao.org/3/a-az283e.pdf

4. AYEYARWADY RIVER BASIN

The Ayeyarwady basin contains portions of 12 ecoregions (of greater than 0.1% coverage) as reflected in its elevation range from 0 m to 5,578 m above mean sea level (AMSL) (Figure 4.1 and Table 4.1). The basin can be divided in three distinct parts: the mountainous upper Ayeyarwady catchment that extends to the Himalayas; the hilly and flood plain zone in the middle Ayeyarwady; and the delta landscape of the lower Ayeyarwady.

Figure 4.1: Ecoregions, KBAs and PAs in the Ayeyarwady Basin



Dominant ecoregions covering the upper Ayeyarwady include the *Northern Triangle subtropical and temperate forests*, with *Eastern Himalayan alpine shrub and meadows* at the highest elevations and *Mizoram-Manipur Kachin rain forests at lower regions*. The middle Ayeyarwady is dominated by

Irrawaddy moist deciduous forests and *Irrawaddy dry forests*, while the lower Ayeyarwady is dominated by *Myanmar coast mangroves*, *Irrawaddy freshwater swamp forests*, and *Myanmar coastal rain forests*. The basin spans a diverse range of habitats, biodiversity status, and biodiversity pressures (Table 4.1).

Table 4.1: Ecoregions in the Ayeyarwady Basin

Ecoregions	Basin Area Coverage (%)
Chin Hills-Arakan Yoma montane forests	2.7
Eastern Himalayan alpine shrub and meadows	1.9
Irrawaddy dry forests	11.0
Irrawaddy freshwater swamp forests	5.0
Irrawaddy moist deciduous forests	31.5
Kayah-Karen montane rain forests	0.1
Mizoram-Manipur-Kachin rain forests	7.5
Myanmar Coast mangroves	3.2
Myanmar coastal rain forests	3.9
Northern Indochina subtropical forests	17.6
Northern Triangle subtropical forests	11.6
Northern Triangle temperate forests	2.2
Nujiang Langcang Gorge alpine conifer and mixed forests	1.6
Total	**99.9**

4.7 Biodiversity status

The *upper Ayeyarwady* is home to some of the least travelled and scientifically researched territory worldwide. The remoteness of the region, inaccessible terrain and intact forests, including uncharted mountain forest to high alpine habitats, explain its rich species diversity. Nearly 140 mammalian species, including the threatened Asian elephant, tiger, red panda and leopard, range across the *Northern Triangle Subtropical forest* ecoregion. The *upper Ayeyarwady* has the largest of protected area and forest complex in Myanmar (Box 1). Yet, even with the region's inaccessibility, deforestation, shifting cultivation and mining are reducing forest area and quality.

The *middle Ayeyarwady* is substantially deforested. Large mammals have almost been fully extirpated from the region. Remaining intact forest pockets are found in the Pegu-Yoma mountain range, but limited wildlife is found outside of protected areas.

The *lower Ayeyarwady* has seen a general decline in biodiversity with much of the area converted to agriculture. The Myanmar coast mangroves ecoregion, for example, is endangered as a result of agricultural and aquaculture encroachment, urban expansion, and timber harvesting for fuelwood. The Irrawaddy freshwater swamp forests are listed as endangered and the Myanmar coastal rainforests are vulnerable.

Box 1. Ayeyarwady PA: Bumhpabum Wildlife Sanctuary

Background: The Bumhpabum Wildlife Sanctuary (BWS), located in Kachin State, was gazetted in 2004, covers an area of 1,854 km^2, and is contiguous with the Hukaung Valley Wildlife Sanctuary (Birdlife International 2017, UNESCO 2017, Istituto-Oikos, 2011). The habitat comprises evergreen and pine forests (Istituto-Oikos, 2011), and is part of the Northern Triangle subtropical forests ecoregion. **The Bumhpabum Wildlife Sanctuary forms part of the Northern Forest Complex (NFC),** which was established in 1996 to conserve the biodiversity of the Ayeyarwady and Chindwin river basins, and is of 'exceptional biological and cultural diversity' (MoF 2009). The Northern Forest Complex, covering an area of 30,105 km^2 (MoF, 2009), is located in the Upper Ayeyarwady and Chindwin river basins. Four protected areas constitute this complex: Hponkanrazi Wildlife Sanctuary (2,714 km^2), Hkakaborazi

National Park (3,827 km^2), Bumhpabum Wildlife Sanctuary (1,862 km^2), and the Hukaung Valley Tiger Reserve (21,802 km^2) (MoF, 2009).

Why it is important: Incorporating wetland, coniferous and lowland forest ecosystems, **the Northern Forest Complex is the most extensive and intact forest habitat in Southeast Asia** (WCS 2017b). Vegetation cover includes flooded plain grassland, open and closed mixed-deciduous forest, and hilly evergreen forest. Threatened species include the Asian elephant, clouded leopard, Asiatic golden cat, golden jackal, red goral, and various deer and bird species (Istituto-Oikos, 2011). Three-quarters of the combined Bumhpabum-Hukaung area comprise closed forest and of this approximately 20,000 km^2 is suitable as gibbon habitat (WCS 2017).

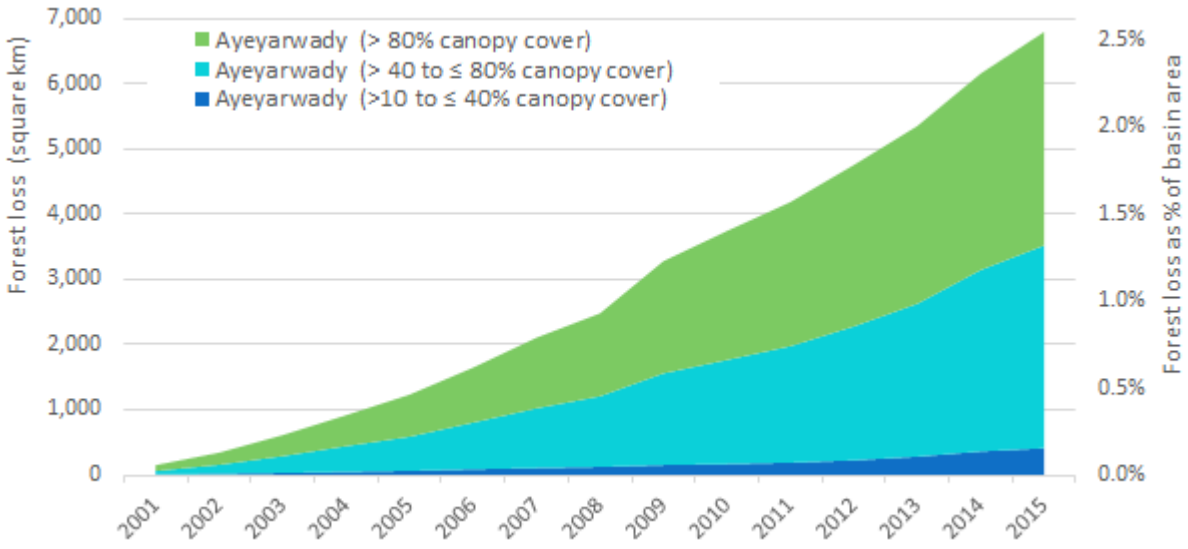
Current situation: A National Tiger Action Plan is in place (WGC, 2017). Tigers may range across forest reserves using corridors connecting the Hukaung Valley and Bumhpabum. Considerable trade in wildlife and wildlife products occurs across the Chinese border (Istituto-Oikos, 2011). Some religious tourism exists in the region (Istituto-Oikos, 2011). Effective management of the NFC requires raising awareness and will be especially challenging given that the Hukaung Valley is also home to 50,000 people (WCS 2017).

Drivers of change and key trends: The regional political environment deteriorated in mid-2011 and this brought biological monitoring programs in the Hukaung Valley Wildlife Sanctuary to a halt (WGC, 2017). Encroachment by local communities, including shifting agricultural practices, NTFP harvesting and hunting for subsistence and commercial purposes are the main ongoing threats to sanctuary biodiversity (Istituto-Oikos, 2011; MoECF, 2015). **Since this area borders a large expanse of contiguous forest with China and India, it plays an important role in transboundary conservation initiatives** (Istituto-Oikos, 2011) as well as on-going illegal trade in wildlife.

4.8 Trends and drivers of change

The biodiversity of the Ayeyarwady basin is at risk from multiple pressures. Deforestation presents a major ongoing problem throughout the region. Table 4.3 shows that, since 2002, the most significant forest loss has occurred in the middle Ayeyarwady region with the while basin losing 5,792 km^2 of forest overall during that 12 year period. The cumulative loss of open, medium-closed and intact forest is illustrated in Figure 4.2, indicating that over a 15-year period from 2000, the whole basin lost 2.5% of its remaining total forest.

Figure 4.2: Cumulative forest loss in the Ayeyarwady basin between 2001 and 2015



Source: ICEM analysis of data from Hansen et al. 2013

Table 4.2, Table 4.3 and Figure 4.3 indicated that 19.7% of intact forest remains and a further 29.3% of forest cover is degraded. Over the 12-year period from 2002 to 2014, 2.1% of the total intact forest in the basin was lost (Table 4.3). Species diversity has been lost from the middle and lower parts of

the basin through conversion of forests to agriculture and from shifting cultivation. The *FAO Country Programming Framework 2012-2016*, lists 'increased agricultural production to enhance food security' as one of its top priorities (GoRUM & FAO 2010).[13] While this will include increasing the production efficiency of existing agricultural land, it also means expanding agricultural lands into previously forested areas (GoRUM & FAO 2010). Wildlife is threatened through ongoing illegal trade. Mining is practiced across the basin and is anticipated to expand.[14] This basin hosts 14 of Myanmar's existing and under construction hydropower projects with reservoirs, transmission lines and access roads within Ayeyarwady River tributary sub-basins. Those projects are contributing to forest loss. They also benefit from the ecosystem services provided by healthy watersheds within which they are located. To date there has been no payments for the rehabilitation and conservation of those services or compensatory investments in biodiversity to sustain affected community livelihoods and subsistence uses.

Table 4.2: Intact and degraded forest in the Ayeyarwady Basin 2014

	Percentage of basin area					Area (km^2) of basin				
	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady2	**Ayeyarwady Basin**	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady 2	**Ayeyarwady Basin**
Intact forest (>80% canopy)	69.4	5.6	28.3	10.3	19.7	29,821	5,621	8,445	10,443	54,330
Plantation & non-forest (<10% canopy)	9.9	69.5	23.8	52.6	49.0	4,259	70,084	7,100	53,569	135,012
Degraded forest (10-80% canopy)	17.4	22.7	46.3	35.9	29.3	7,461	22,908	13,830	36,600	80,799
Other (eg. open water, urban)	3.3	2.2	1.7	1.2	1.9	1,407	2,259	506	1,197	5,369
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**42,949**	**100,871**	**29,881**	**101,809**	**275,510**

Breaking down the status and trends into parts of the basin, some outstanding features exist. The Headwater Ayeyarwady has 69.4% remaining intact forest - an exceptional biodiversity asset of global importance (Table 4.2). The remainder of the basin has relatively small pockets of intact forest, but it is fragmented and diminishing. Importantly, there is an opportunity for rehabilitation of degraded forests because relatively large areas remain in the Middle Ayeyarwady 1 (46.3%) and Middle Ayeyarwady 2 (35.9%) basins. The change in intact forest cover has been most extensive in the Middle Ayeyarwady 2 - with 2,925 km^2 lost from 2002 to 2014, representing 50% of intact forest lost in the whole Ayeyarwady basin. (Table 4.3).

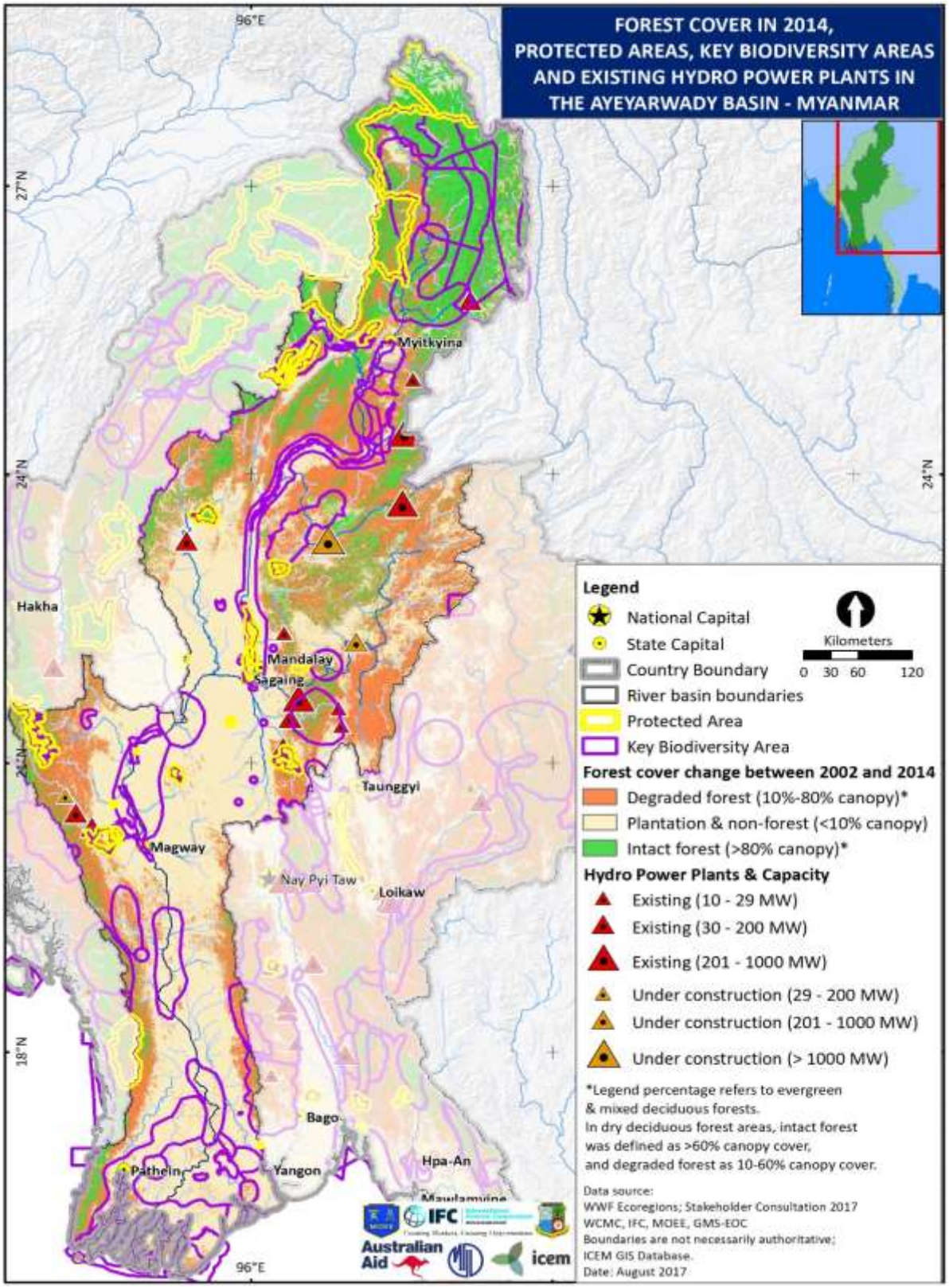
[13] GoRUM & FAO (2010) Country Programming Framework (2012–2016) for the Cooperation and Partnership between the Food and Agriculture Organization and the Republic of the Union of Myanmar, The Government of the Republic of the Union of Myanmar and Food and Agriculture Organization of the United Nations URL: http://www.fao.org/3/a-bc914e.pdf

[14] LaJeunesse Connette, K. J., Connette, G., Bernd, A., Phyo, P., Aung, K. H., Tun, Y. L., Thein, Z.M., Horning, N., Leimgruber, P., Songer, M. (2016). Assessment of Mining Extent and Expansion in Myanmar Based on Freely-Available Satellite Imagery. Remote Sensing, 8(11), 912.

Table 4.3: Changed intact forest cover (2002-2014) and degraded regions (2014) in the Ayeyarwady Basin

	Percentage of basin area					Area (km2) of basin				
	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady 2	**Ayeyarwady**	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady 2	**Ayeyarwady**
Intact forest (>80% canopy)*	69.4	5.6	28.3	10.3	19.7	29,821	5,621	8,445	10,443	54,330
Changed forest cover**	0.4	1.2	4.8	2.9	2.1	191	1,248	1,428	2,925	5,792
Degraded regions	26.8	91.0	65.3	85.7	76.3	11,530	91,834	19,505	87,268	210,137
Other (eg. open water, urban)	3.3	2.1	1.7	1.2	1.9	1,406	2,169	502	1,174	5,251
TOTAL	**100**	**100**	**100**	**100**	**100**	**42,949**	**100,871**	**29,881**	**101,809**	**275,510**

Figure 4.3: Forest cover in the Ayeyarwady Basin in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

KBAs cover 92% of the Headwater Ayeyarwady with 23.2% of KBAs designated as protected areas (Table 4.4). The middle and lower parts of the basin have little PA coverage although they contain important remaining biodiversity as reflected in the KBA coverage - 38.7% for the Lower

Ayeyarwady to Delta, 35.8% for the Middle Ayeyarwady 1, and 13.1% for the Middle Ayeyarwady 2 (Figure 4.3 and Table 4.4).

Table 4.4: KBAs and PAs by river basin in Myanmar

Areas of biodiversity	Bago	Chindwin	Headwater Ayeyarwady	Lower Ayeyarwady to Delta	Middle Ayeyarwady 1	Middle Ayeyarwady 2	Ayeyarwady[b]	Mekong	Rakhine Coastal	Surma-Meghna	Rakhine Coastal/Surma-Meghna[c]	Sittaung	Bilin	Sittaung/Bilin[d]	Tanintharyi	Thanlwin	National coverage
Key Biodiversity Areas (KBAs)	42.1	51.1	92.0	38.7	35.8	13.1	37.2	28.0	46.1	0.3	45.5	40.1	42.1	40.3	64.7	35.0	41.3
Protected Areas (PAs)	0	20.4	23.2	1.5	8.4	1.0	5.5	0.7	3.6	0	3.6	0.6	1.8	0.7	4.2	0.8	6.0
Ecoregions:																	

[a] ecoregions with minor coverage nationwide excluded (i.e., with total area of less than 150 km^2 per ecoregion)
basins with more than 25% and less than 50% KBA cover
basins with more than 50% KBA cover
Ayeyarwady[b]: combined Headwater Ayeyarwady, Lower Ayeyarwady to Delta, Middle Ayeyarwady 1, and Middle Ayeyarwady 2
Rakhine Coastal/Surma-Meghna[c]: combined Rakhine Coastal and Surma-Meghna basins
Sittaung/Bilin[d]: combined Sittaung and Bilin basins

4.9 Trends in summary

In summary:

(i) *The Ayeyarwady basin is experiencing increasing levels of agricultural expansion, mining and tourism. Additional pressures include the ongoing illegal wildlife trade and NTFP extraction.*

(ii) *The upper Ayeyarwady has exceptional remaining intact forest, much within PAs and recognized by KBAs, yet illegal logging, wildlife extraction, mining and agricultural encroachment are degrading these areas.*

(iii) *Critical/endangered ecoregions and remaining intact forest in the middle and lower Ayeyarwady have little formal protection.*

(iv) *Many existing hydropower projects and more than 200 irrigation reservoirs located in the Ayeyarwady sub-basins are likely to face challenges with sediment management as watersheds continue to degrade.*

5. CHINDWIN RIVER BASIN

The Chindwin basin is a sub-basin of the larger Irrawaddy River catchment. The Chindwin River originates in the Hukawng Valley and flows 1200 km to its confluence with the Irrawaddy River. The basin ranges in elevation from 25 to 3794 m AMSL. Six ecoregions are distributed across the basin, dominated primarily by *Mizoram-Manipur-Kachin rain forests* (32.6%), *Irrawaddy moist deciduous forests* (28.8%), and *Northern Triangle subtropical forests* (22.3%) ecoregions (Table 5.1). Mining is a key activity in the basin, which has led to expanding areas of forest clearing, polluted waterways and a heavy sediment influx (Daniel, 2015). Logging and agricultural encroachment is resulting in forest degradation and deforestation. Uncontrolled hunting for the wildlife trade is decreasing biodiversity (Daniel, 2015).[15]

Table 5.1: Ecoregions in the Chindwin Basin

Ecoregions	Basin Area Coverage (%)
Chin Hills-Arakan Yoma Montane Forests	9.4
Irrawaddy dry forests	1.9
Irrawaddy moist deciduous forests	28.8
Mizoram-Manipur-Kachin rain forests	32.6
Northern Triangle subtropical forests	22.3
Northern Triangle temperate forests	4.7
Total	**99.8**

5.1 Biodiversity Status

The Chindwin basin is rich in biodiversity with an exceptional remaining intact forest cover of 47.7% (Table 5.2). By area, 51.1% of the basin has been identified as KBAs with 20.4% designated as protected area (Table 4.4 and Table 5.1). The basin is home to large fauna, including Bengal tiger, and is host to a range of endangered reptiles, including the Burmese roofed turtle - one of the world's most endangered turtles (Phys.org, 2017).[16] The Htamanthi Wildlife Sanctuary (HWS) has the highest bird species richness of all ecoregions within the Indo-Pacific region (Box 2). A diverse array of forest types are found in the basin including montane, deciduous, temperate, subtropical, dry, and rainforest.

Box 2. Chindwin PA: Htamanthi Wildlife Sanctuary[17, 18 , 19 , 20 , 21, 22 , 23 , 24]

Background: The Htamanthi Wildlife Sanctuary (HWS), established in 1974 and situated in Hkamti District, is the largest protected area in the Sagaing region of Myanmar (2151 km²) (Istituto-Oikos, 2011). The HWS has a rugged mountainous landscape and is known for its diversity of birds and endangered species (BANCA, 2006). Its intact forests are a priority area for the long-term conservation of *Panthera tigris tigris*. Another special feature of this PA is the Mizoram-Manipur-Kachin Rainforests that the sanctuary lies within (BANCA, 2006; Istituto-Oikos, 2011). **The HWS has the highest bird species richness of all ecoregions within the Indo-Pacific region** (Carter, 1943; Plat, 2012, Istituto-Oikos, 2011).

Why it's important: The sanctuary protects a number of vulnerable, endangered and critical/endangered species (Istituto-Oikos, 2011), including the endangered tiger, Asian elephant, Shortridge's langur, white-

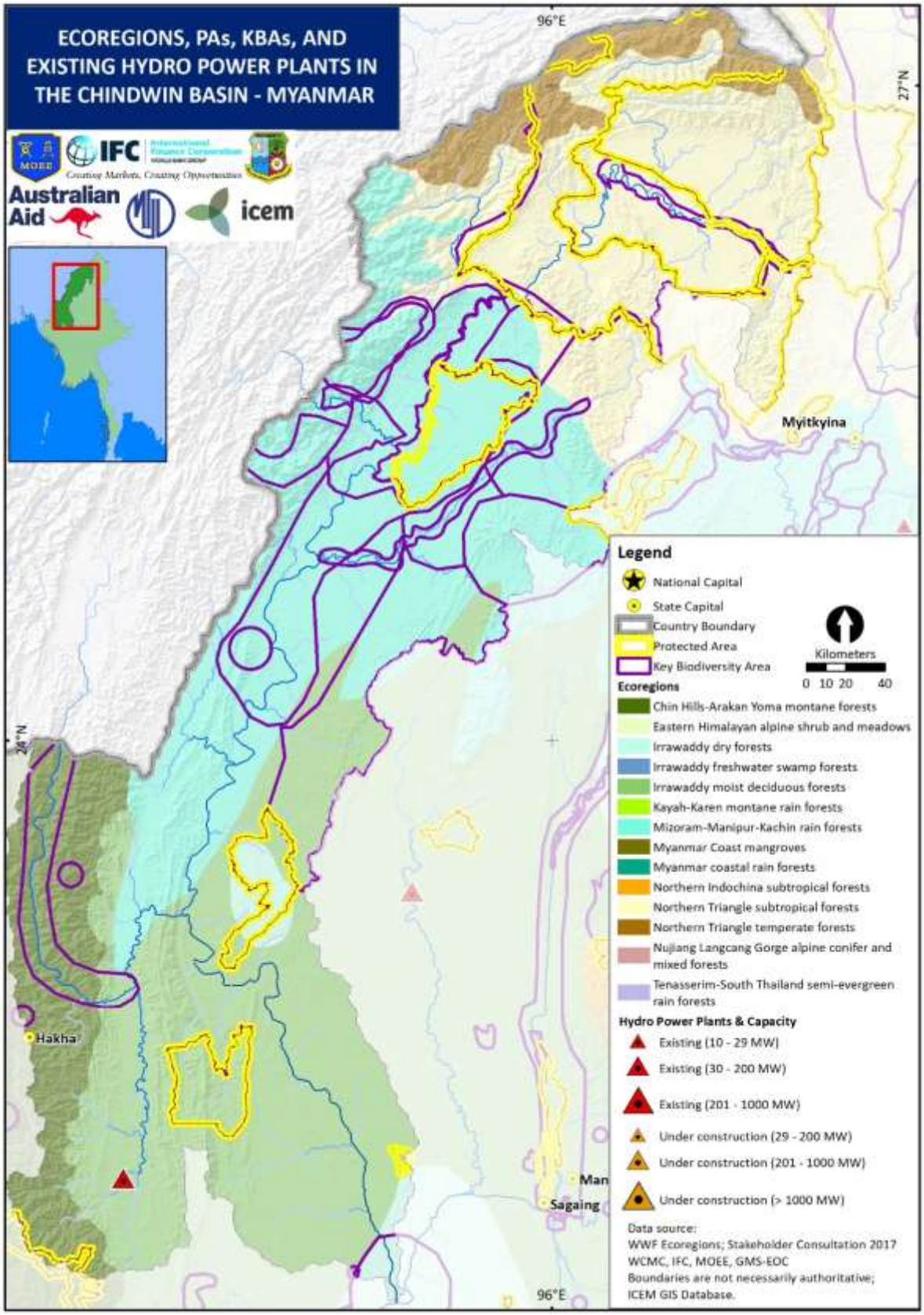
[15] Daniel, R (2015). Developing River Basin Management Solutions in Myanmar. URL: https://www.sei-international.org/-news-archive/3186
[16] Phys.org (2017) Scientists discover eggs of one of world's most endangered turtles. URL: https://phys.org/news/2017-04-scientists-eggs-world-endangered-turtles.html. Accessed on 17 May 2017
[17] Biodiversity And Nature Conservation Association (BANCA) (2006). Biodiversity Impact Assessment of Tamanthi Dam, Hydropower And Multipurpose Project Report.
[18] Carter, T. D. (1943). The mammals of the Vernay-Hopwood Chindwin Expedition, northern Burma. Bulletin of the American Museum of Natural History 82:95–114.
[19] Department of Meteorology and Hydrology & Ministry of Transport (2012). Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change.
[20] Leimgruber P. et al. (2011). Current Status of Asian Elephants in Myanmar. Gajah, 35, *76-86*
[21] Platt, Steven G. et al. (February-March 2012). Chindwin River Expedition
[22] Rabinowitz, A., Schaller, G. B. & U Uga (1995). A survey to assess the status of Sumatran rhinoceros and other large mammal species in Tamanthi Wildlife Sanctuary, Myanmar. Oryx, 29, 123-128.
[23] Than Zaw et al. (2008). Status and distribution of small carnivores in Myanmar. Small Carnivore Conservation, 38, 2-28.
[24] Than Zaw et al. (2014). Status and distribution of small cat species in Myanmar. Cat News Special Issue 8: 25-30.

winged duck and masked finfoot. The Nature and Wildlife Conservation Division of the Myanmar Forest Department together with the Wildlife Conservation Society list seven Asian wild cat species: Bengal tiger, leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*), golden cat (*Catopuma temminckii*), marbled cat (*Pardofelis marmorata*), Jungle cat (*Felis chaus*) and leopard cat (*Prionailurus bengalensis*) (Rabinowitz, 1995; Zaw, 2008; 2014). 32 threatened species are found on IUCN's Red List (13 mammals, 5 reptiles, 6 birds, 8 plants) (Leimgruber, 2011; Carter, 1943; Istituto-Oikos, 2011; Zaw, 2008; 2014).

Current situation: Future demand for land and other natural resources by local communities living in HWS border areas is likely to impact natural forests, though presently this is not considered a concern (BANCA, 2006; Istituto-Oikos, 2011). Anecdotal evidence from residents who reside along the eastern side of the Chindwin River indicates that there has been an increase in severe flooding and storms (NAPA, 2012). Weather-related damage was reported in May 2013 when a severe storm seriously damaged river banks in the area (BANCA, 2006).

Drivers of changes and key trends: Due to the lack of long-term monitoring and scientific studies in the HWS, data to formulate trends in species richness and occurrence are scarce (BANCA, 2006; Istituto-Oikos, 2011). However, there have been concerning declines in some species (Zaw, 2008; 2014). **The Htamanthi Hydropower Project will lead to the inundation of forested areas below 180 m AMSL** (BANCA, 2014), and together with commercial logging companies, endemic and endangered flora and fauna are threatened. Along with a loss of biodiversity, impacts such as flooding, soil erosion, and water pollution are expected to occur (Istituto-Oikos, 2011).

Figure 5.1: Ecoregions, KBAs and PAs in the Chindwin Basin



5.2 Trends and drivers of change

The basin has been impacted by deforestation, sediment deposition, and pollution from mining activities. Deforestation caused by illegal logging, agricultural encroachment, and shifting cultivation presents a persistent threat to biodiversity of the basin. Also, the illegal wildlife trade and harvesting of non-timber forest products is reducing basin biodiversity. Threats to freshwater ecosystems and surrounding habitats are expected to be under continuing pressure from mining without more effective regulation. Some 32% of forest areas exist in a degraded state, and over the 12-year period from 2002 to 2014 3.2%, or 3,105km^2, of intact forest in the basin was lost (Table 5.2). The increasing trend of loss in forests with open, medium-closed and intact canopy cover in the Chindwin basin is shown in Figure 5.2. However, given that almost half of basin forest cover remains intact and 32% degraded (Table 5.2, Figure 5.3), there is significant opportunity for productive conservation investments.

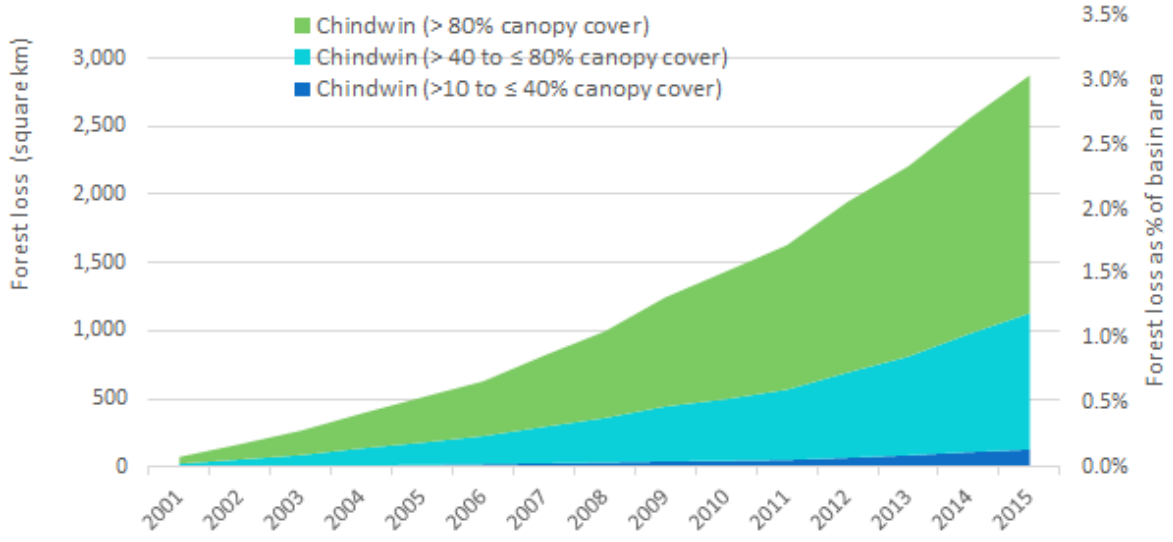
Table 5.2: Area (in km^2) of intact, degraded, and changed forest cover in the Chindwin Basin

Land cover category	% cover Chindwin	Area (km^2) Chindwin
Intact forest (>80% canopy)	47.7	46,501
Degraded forest (10-80% canopy)	31.7	30,839
Plantation & non-forest (<10% canopy)	19.8	19,238
Other (eg. open water, urban)	0.8	814
Total	100	97,392

Land cover category	% cover Chindwin	Area (km^2) Chindwin
Intact forest (>80% canopy)	47.7	46,501
Changed forest cover	3.2	3,105
Degraded regions	48.2	46,975
Other (eg. open water, urban)	0.8	811
Total	100	97,392

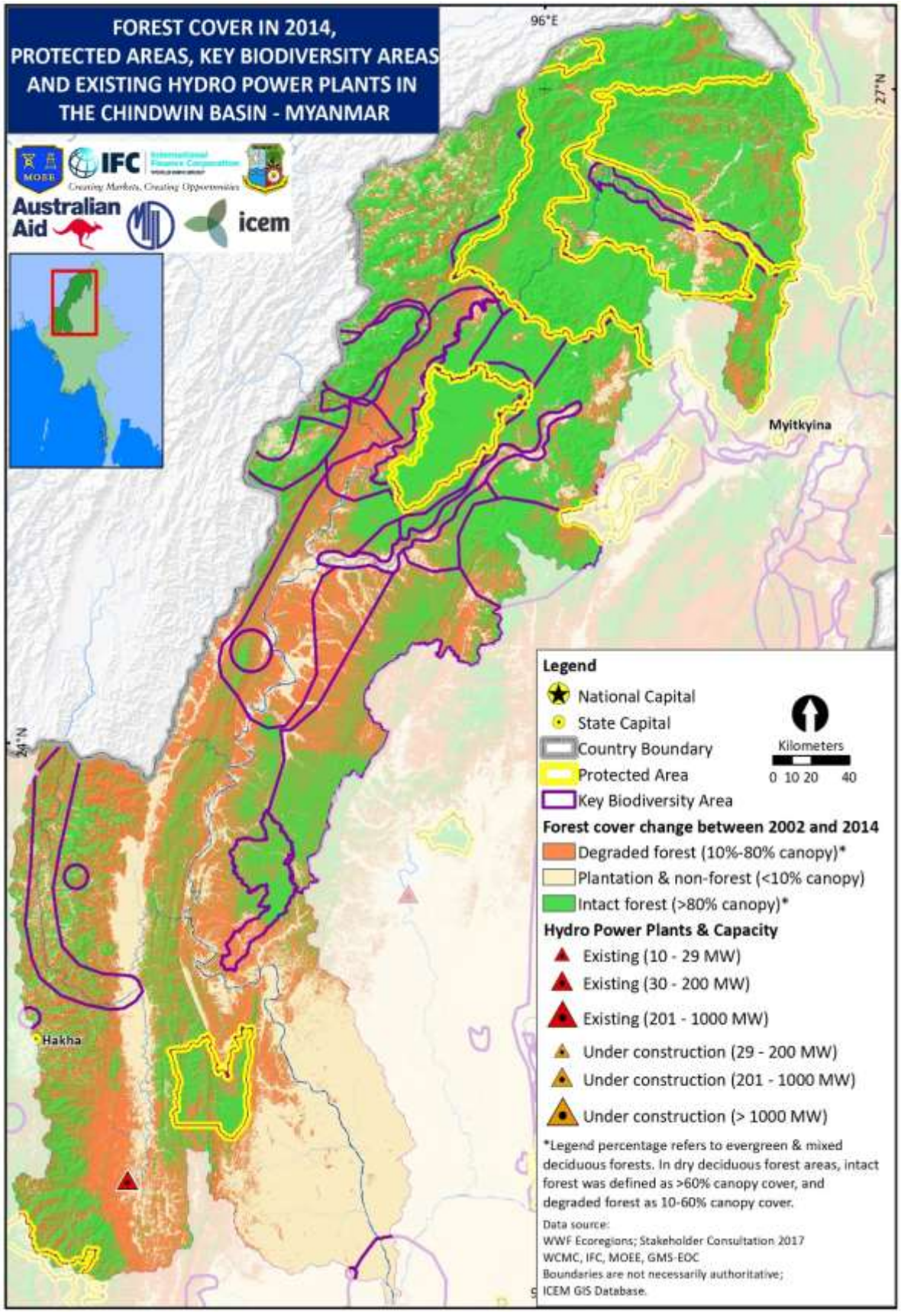
Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 5.2: Loss of forest in the Chindwin Basin from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

Figure 5.3: Forest cover in the Chindwin Basin in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

5.3 Trends in summary

In summary:

(i) *The Chindwin is an exceptional basin of global importance for biodiversity*.
(ii) *The Chindwin contains some of the most important PAs in the country, contiguous with those in the upper Ayeyarwady and international transboundary PAs.*
(iii) *The PAs are under increasing pressure from encroachment, forest loss and extraction of wildlife.*
(iv) *Deforestation of the basin is continuing from agricultural encroachment, illegal logging and shifting cultivation.*
(v) *Pressures from mining, as well as the illegal wildlife trade and illegal harvesting of non-timber forests is depleting biodiversity.*
(vi) *The basin is suffering from rapidly increasing erosion and sediment in river systems*
(vii) *One under construction hydropower project within degraded forest in the south of the basin (Figure 5.3) may face issues as sediment loads increase.*

6. THANLWIN RIVER BASIN

The Thanlwin River is one of the last free-flowing rivers in Southeast Asia. It is a transboundary basin with a total area of 320 000 km^2 distributed between China (53%), Myanmar (42%) and Thailand (5%). China has introduced a moratorium on dam construction of the upper Thanlwin within its territory. Seven ecoregions are represented in the Basin, primarily dominated by *Northern Indochina subtropical forests* (52.9%) and *Kayah-Karen montane rain forests* (33.9%) (Table 6.1 and Figure 6.1). The basin is host to 836 km^2 of PAs (the total area increases to 11,500 km^2 when including PAs in the Chinese and Thai regions of the basin).[25] The basin reaches an elevation of 2,625 m AMSL in Myanmar with the Thanlwin River flowing down to the Andaman Sea where it forms an estuary that has high species diversity. Agriculture, mining, and logging have been important sources of economic activity within the basin, which have impacted biodiversity.[26]

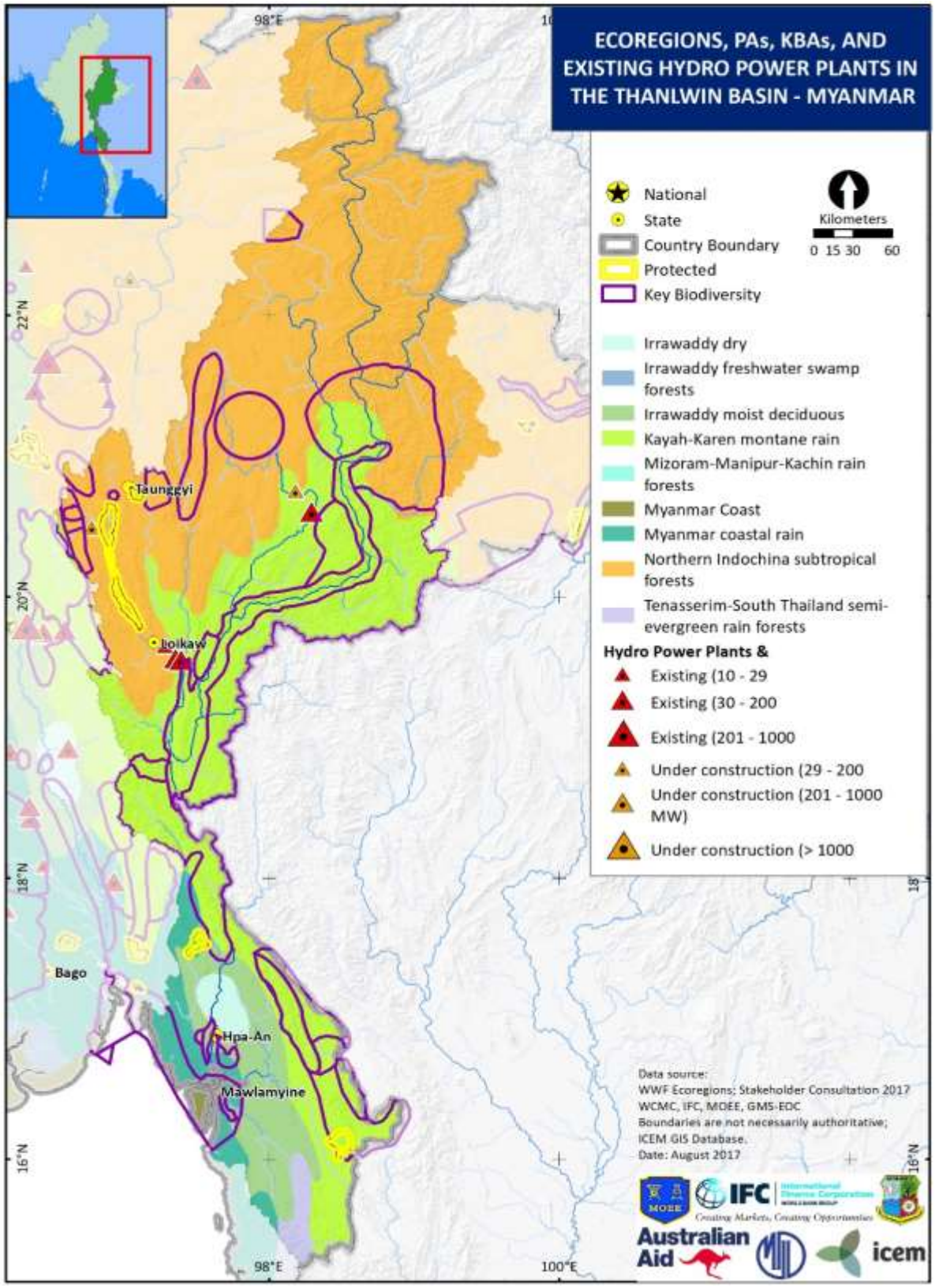
Table 6.1: Ecoregions in the Thanlwin Basin

Ecoregions	Basin Area Coverage (%)
Irrawaddy dry forests	1.1
Irrawaddy moist deciduous forests	6.6
Kayah-Karen montane rain forests	33.9
Myanmar coast mangroves	0.3
Myanmar coastal rain forests	3.9
Northern Indochina subtropical forests	52.9
Tenasserim-South Thailand semi-evergreen rain forests	1.1
Total	**99.9**

[25] International Rivers (2012) - The Salween River Basin Fact Sheet – Accessed on 09-May-2017 https://www.internationalrivers.org/resources/the-salween-river-basin-fact-sheet-7481

[26] http://www.csds-chula.org/project-blogs/2016/03/29/changing-land-cover-and-socio-economic-conditions-in-bawlakhe-district-in-the-thanlwin-river-basin

Figure 6.1: Ecoregions, KBAs and PAs in the Thanlwin basin



6.1 Biodiversity status

The Thanlwin basin is rich in biodiversity. The basin is dominated by subtropical forests, which are globally recognized for biodiversity with the highest species richness of birds among all ecoregions in

the Indo-Pacific region and ranking third for mammal richness. The *Kayah-Karen montane rain forests* ecoregion is the fourth richest in the Indo-Pacific region for mammals, with 168 known species. The region is also home to Inle Lake (Box 3), a wetland sanctuary that was established to protect migratory birds and their habitats, and additionally provides freshwater habitat for aquatic plants and fish (Instituto Oikos & BANCA 2011).[31] Some 35% of the basin has been designated as KBAs, and 0.8% as PAs that reflect more a lack of survey than absence of biodiversity wealth (Table 4.4, Figure 6.1)

An important initiative in Karen State is the commitment by local authorities and communities to establish the Salween Peace Park, a 5,200-km^2 locally-led sanctuary to protect indigenous cultural heritage and endangered wildlife.[27] The Salween Peace Park initiative is a collective effort involving some 300 community representatives from 23 village tracts in the 3 townships of Mutraw District, the Mutraw District's Forestry Department, and the Karen Environmental and Social Action Network (KESAN). The process of seeking national and international recognition of the park anticipates collaborative management agreements with Thailand's adjacent Salween National Park and Salween National Wildlife Sanctuary.[28]

Box 3. Thanlwin Basin PA: Inle Lake Wildlife Sanctuary (ILWS)[29]

Background: The Inle Lake Wildlife Sanctuary (ILWS) is located in Shan State, was established in 1985, and covers an area of 642 km^2 (Istituto-Oikos, 2011). This protected area is one of the top destinations for tourists in Myanmar and an ASEAN heritage site (Istituto-Oikos, 2011). It has been nominated as a UNESCO biosphere reserve (MoECF 2015).

Why it is important: The wetland sanctuary was established to protect migratory birds and their habitats. The sanctuary is known for its large number of migrant and resident birds, comprising 175 species, and its native aquatic vegetation and fishes. **Inle Lake Wildlife Sanctuary is also a key source of hydropower for Myanmar** (Istituto-Oikos, 2011).

Current situation: Three five-year action plans for the *Sustainability of Inle Lake and Environmental Conservation* have proved beneficial to the ILWS and a fourth plan is being drafted (MoECF, 2015). In 2014 around 300,000 tourists (200,000 domestic and 100,000 international visitors) visited, ILWS having the highest number of international visitors of all PA's in the country (MoECF, 2015).

Drivers of changes and key trends: The ILWS is described as being in a 'state of environmental emergency'. Current threats include water pollution caused by agrochemical runoff and expanding tourist facilities; soil erosion and sedimentation caused by forest loss in watersheds and expansion of agricultural land; poor fishing practices; and more localised impacts from gold mining, poaching, and gathering of wood and orchids (Istituto-Oikos, 2011). Furthermore, noise pollution and crowding have also been reported as excessive in the sanctuary (MoECF, 2015).

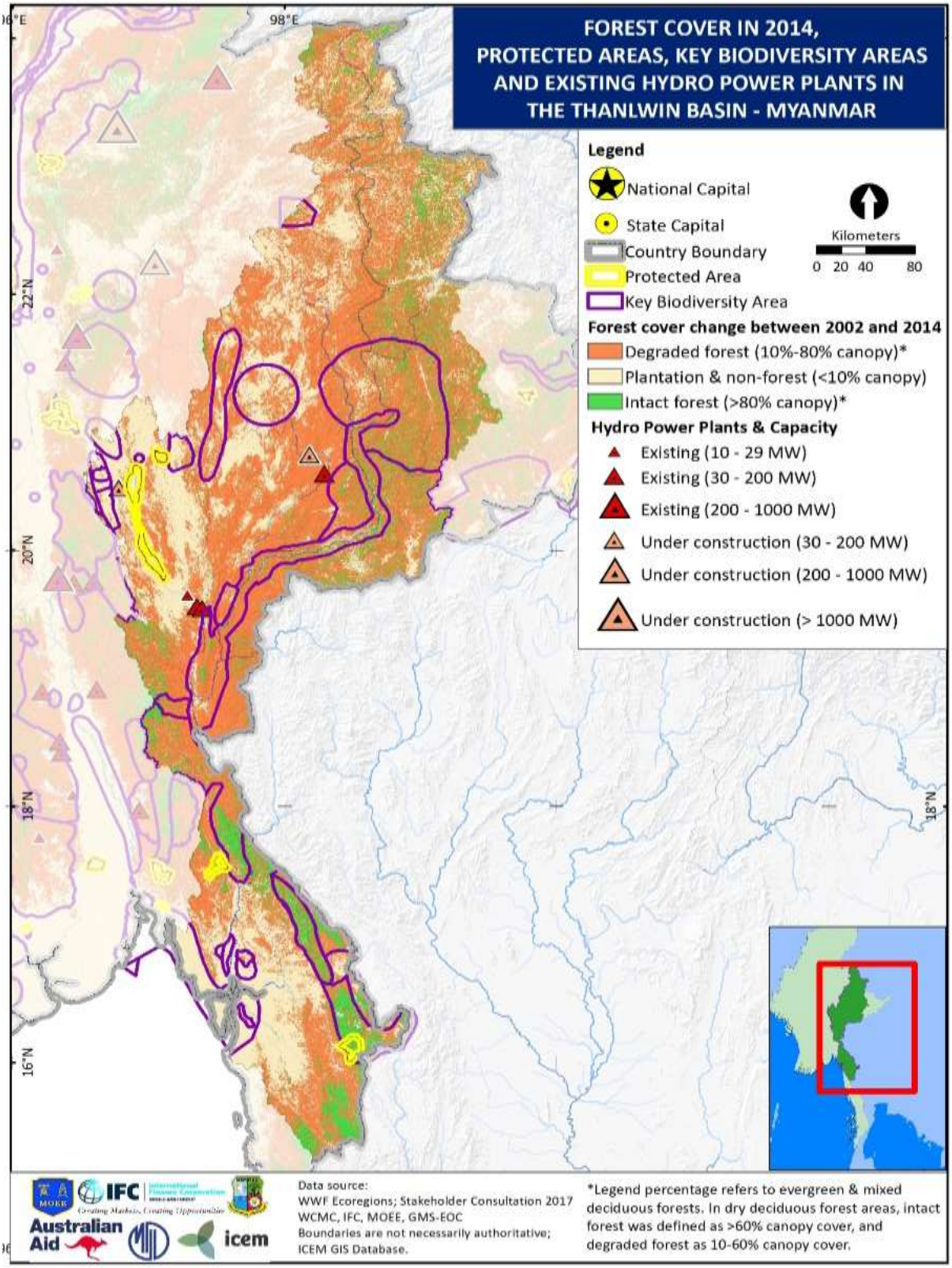
6.2 Trends and drivers of change

Widespread and expanding agriculture continue to threaten biodiversity in the Thanlwin Basin. Over the past 20 years, illegal logging has led to severe forest degradation. Illegal trade in wildlife is a persistent threat to rare and habitat restricted animal populations given the basin's proximity to China. Also, an expanding mining industry and its associated infrastructure pose threats to freshwater and forest biodiversity. In the basin, just over one-tenth (11.3%) of intact forest remains, while nearly 57% of forest cover is degraded (Table 6.2, Figure 6.2). According to the analysis conducted for this report, the Thanlwin lost 4% of its intact forest over the 12-year period from 2002 to 2014 (Table 6.2), with losses of forests with a canopy cover greater than 80% increasing (Figure 6.3).

The Basin hosts four existing hydropower projects with one under construction on tributary sub-basins to the Thanlwin River (Figure 6.2).

[27] http://karennews.org/2017/01/the-salween-peace-park-a-radical-grassroots-alternative-to-development-in-karen-state.html/
[28] https://www.irrawaddy.com/opinion/guest-column/the-salween-peace-park-a-radical-grassroots-alternative-to-development-in-karen-state.html
[29] MoECF - Myanmar Ecotourism Policy & Management Strategy 2015 - 2025, Ministry of Environmental Conservation and Forestry, and Ministry of Hotels and Tourism, the Republic of the Union of Myanmar

Figure 6.2: Forest cover in 2014 in the Thanlwin basin



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

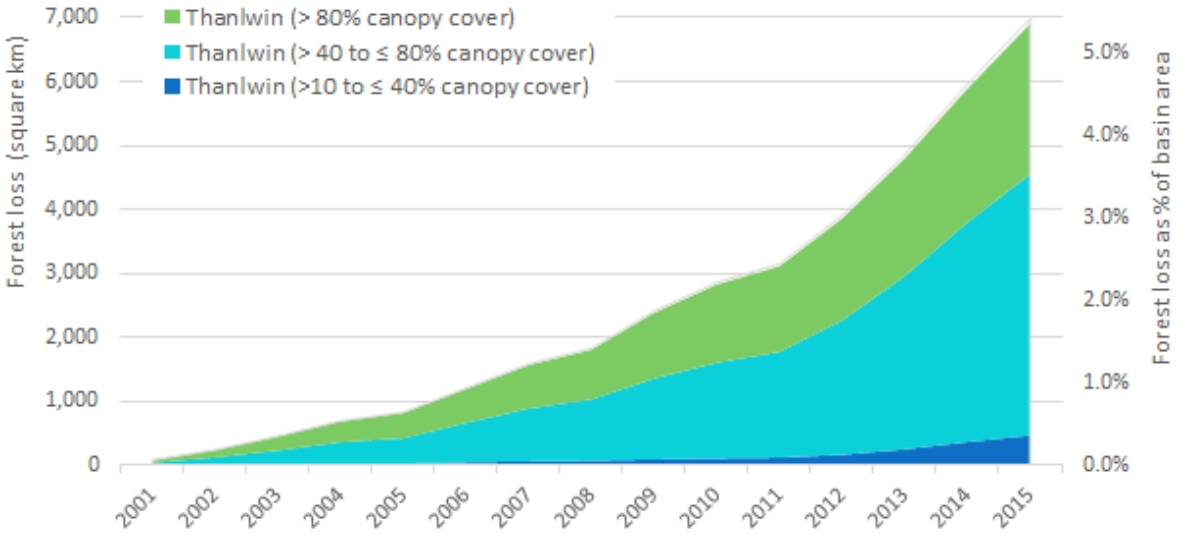
Table 6.2: Area of intact, degraded, and changed forest cover in the Thanlwin River Basin

Land cover category	% cover Thanlwin	Area (km²) Thanlwin
Intact forest (>80% canopy)	11.3	14,342
Degraded forest (10-80% canopy)	56.9	71,921
Plantation & non-forest (<10% canopy)	31.1	39,320
Other (eg. open water, urban)	0.6	800
Total	100	126,384

Land cover category	% cover Thanlwin	Area (km²) Thanlwin
Intact forest (>80% canopy)	11.3	14,342
Changed forest cover	4.0	5,084
Degraded regions	84.0	106,163
Other (eg. open water, urban)	0.6	795
Total	100	126,384

Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 6.3: Loss of forest in the Thanlwin basin from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

6.3 Trends in summary

(i) *The Thanlwin River is one of the last free flowing rivers in SE Asia.*

(ii) *The basin has a relatively low percentage of intact forest cover but together with degraded forest they cover 68% of the basin, which is high by national standards and provides a foundation for rehabilitation and conservation management.*

(iii) *Relative little area has been designated as PA, but this would substantially increase if the Salween Peace Park is formally recognized and established.*

(iv) *The long international border with China and Thailand provides opportunities for transboundary conservation initiatives.*

(v) *The expansion of agriculture, illegal logging, a growing mining industry, and trade in wildlife all continue to reduce biodiversity in the basin.*

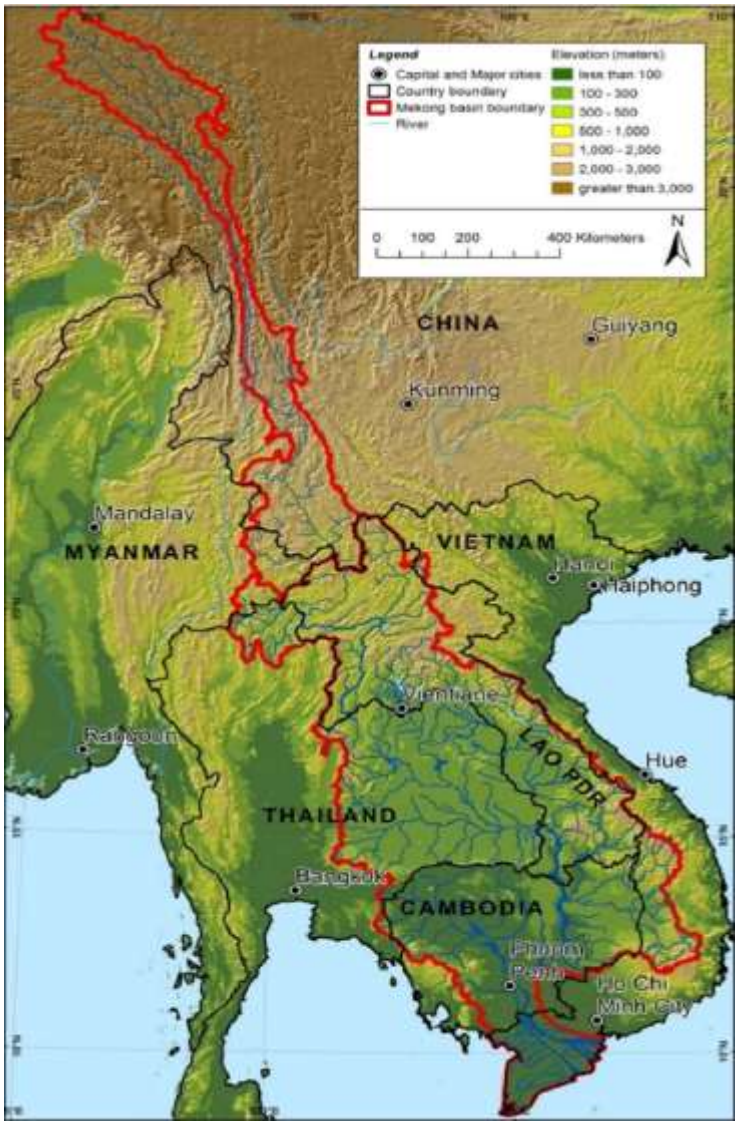
7. MEKONG RIVER BASIN

Part of the Mekong basin lies in Shan State of eastern Myanmar, sharing a border with Laos, Thailand, and China as part of this transboundary basin (Figure 7.1). The Myanmar section of the basin comprises about 4% of the country (FAO 2011) and 3% of the entire Mekong Basin.[30] It falls within the *Northern Indochina subtropical forests* ecoregion except for a small portion (2.5%) in a largely degraded section of *Kayah-Karen montane rain forest* in the south of the state (Table 7.1 and Figure 7.2).

Table 7.1: Ecoregions of the Mekong Basin, Myanmar

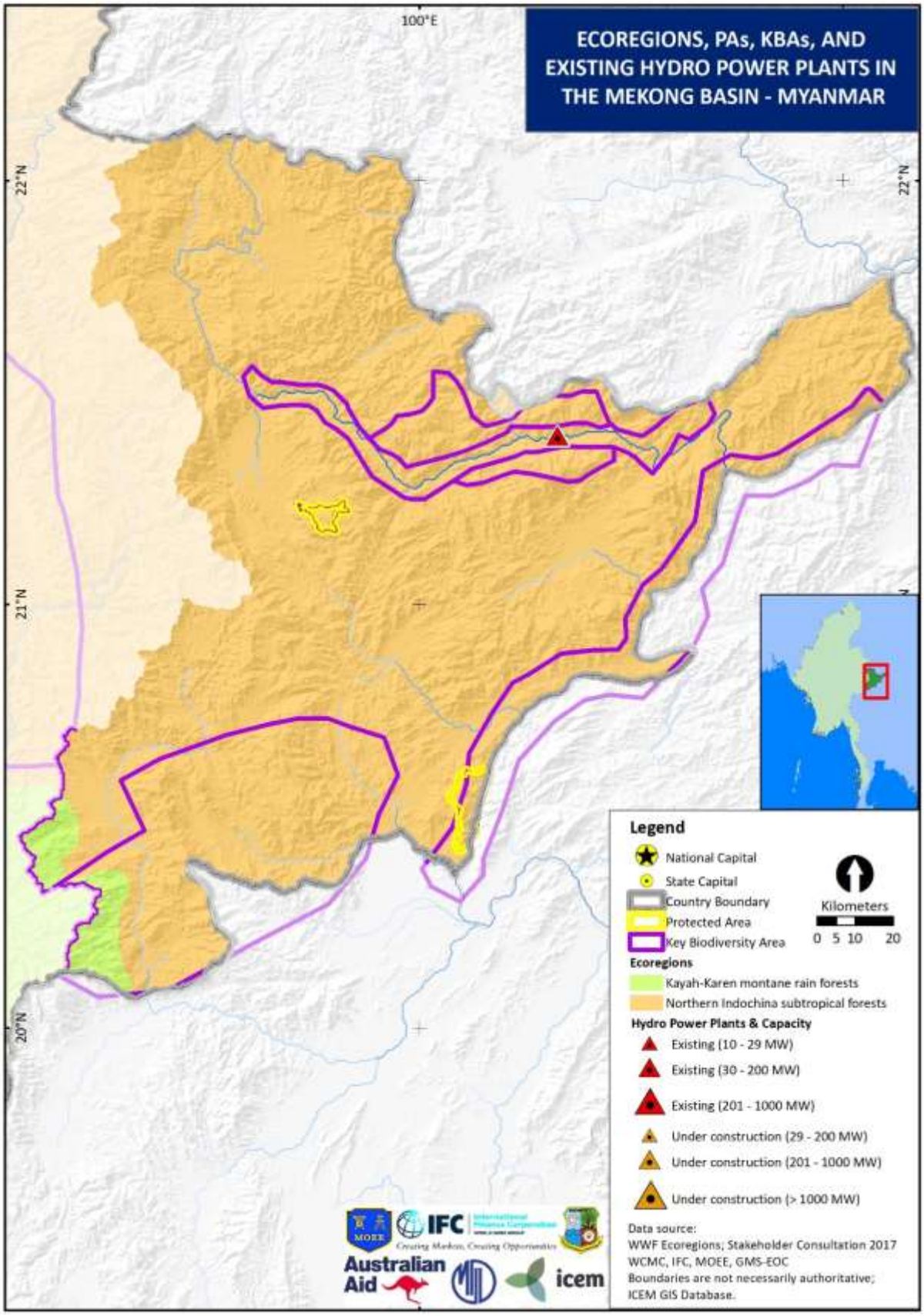
Ecoregions	Basin Area Coverage (%)
Kayah-Karen montane rain forests	2.5
Northern Indochina subtropical forests	97.5
Total	**100.0**

Figure 7.1: Mekong River Basin



[30] FAO (2011) Mekong River Basin. Aquastat. http://www.fao.org/nr/water/aquastat/basins/mekong/mekong-CP_eng.pdf Accessed on 17 May 2017

Figure 7.2: Ecoregions, KBAs and PAs in the Mekong Basin, Myanmar



7.1 Biodiversity Status

With the highest species richness for birds and the third highest ranking for mammals across Indo-Pacific ecoregions, the *Northern Indochina Subtropical Forests* are recognized worldwide for their rich biological diversity. Some 183 mammal species and 707 bird species are reported from the ecoregion as a whole, although not all found in Myanmar. WWF has designated the ecoregion as being 'vulnerable', yet, less than 1% of the basin is formally protected and 28.0% has been designated as KBA reflecting a major gap in biodiversity survey data (Table 2.3, Figure 7.2). Pressures from shifting cultivation and logging have resulted in extensive deforestation, though a small number of large areas of natural habitat remain (IUCN 1991, WWF 2017a). The Par Sar Protected Area (Box 4) and Loi Mwe National Park are both designated as a PA and KBA.

Box 4. Mekong PA: Par Sar Protected Area[31,32,33]

Background: Located in the eastern corner of Shan State, close to the Mae Sai (Thailand) - Tachileik (Myanmar) border, the Par Sar Protected Area (PSPA) covers an area of 77km^2, and is dedicated to conserving the natural and religious heritage of the area. In 1996, the area was upgraded from the status of reserved forest thanks to the influence of a famous Shan Buddhist monk who worked to protect the area around the pagoda (Istituto-Oikos, 2011).

Why it is important: Par Sar serves as one of only two protected areas in the Mekong Basin within Myanmar.

Current situation: Information is scarce on Par Sar. The sun bear (*Ursus malayanus*) has been sighted by park staff (Istituto-Oikos, 2011). The Township Forestry Department is responsible for managing the site, though there is currently no budget for conservation activities, with tree planting reported as the only related management activity (Emerton et al., 2015). As of 2011, there was no management plan or full time staff (Istituto-Oikos, 2011).

Drivers of changes and key trends: Increasing pressure from shifting cultivation, and forest conversion to wood and pulp plantations threaten the site's natural resources, with the poaching of forest wildlife and illegal logging possibly occurring given the close proximity of villages. Around the area plantations (eg. rubber trees and tea) may lead to encroachment of natural habitat (Istituto-Oikos, 2011). In recent years, mining for coal, zinc, gems and manganese has increased in eastern Shan. Unregistered logging is occurring in response to market demand in China (LNDOa, 2006; LNDOb, 2009). A major constraint to management is the security situation in the area (Istituto-Oikos, 2011).

7.2 Trends and drivers of change

Forests in the Mekong Basin are highly fragmented (Figure 7.4). Multiple pressures threaten biodiversity in the Basin, including shifting cultivation, poppy cultivation, logging, as well as hunting of wildlife for both consumption and trade, with trade driven by demand from China.[34] Pressure from unregulated mining in eastern Shan state is causing progressive forest loss and erosion.[35]

[31] Istituto-Oikos and BANCA (2011) – Myanmar Protected Areas – context, current status and challenges. Milano, Italy: Ancora Libri.
[32] L. Emerton, A. Kyin, R. Tizard. 2015. Sustainable Financing of Protected Areas in Myanmar. Yangon, Wildlife Conservation Society, p. 95.
[33] LNDOa, 2006- Undercurrents – Monitoring Development on Burma's Mekong – Issue 2 – July 2006 – Logging, Opium, manganese ming– Lahu National Developmnet Organization (LNDO)
[34] Nijman, V., Zhang, M. X., & Shepherd, C. R. (2016). Pangolin trade in the Mong La wildlife market and the role of Myanmar in the smuggling of pangolins into China. Global Ecology and Conservation, 5, 118-126.
[35] Shan Groups Call for Mining Halt in Eastern Shan State (2016). URL: http://english.panglong.org/2016/03/04/shan-groups-call-for-mining-halt-in-eastern-shan-state/ . Accessed 18 May 2017

The situation in Loi Mwe National Park illustrates the trends and drivers throughout this basin. The drivers undermining biodiversity there are extensive logging and wood harvesting, annual and perennial cropping with increasing shifting cultivation and conversion, and hunting and wildlife extraction (Istituto-Oikos, 2011).

The basin has 62.1% forest cover in a degraded state, with 18.5% remaining intact forest. Figure 7.3 shows a rising trend of loss in forests in the basin. Over the 12-year period from 2002 to 2014, 5.5% or 1,186km^2 of intact forest of greater than 80% canopy cover was lost (Table 7.2, Figure 7.4). The Myanmar Forest Assessment (2014) found that for Shan State overall, more than 6,326km^2 of intact forest was lost over that period, by far the greatest loss of any state.

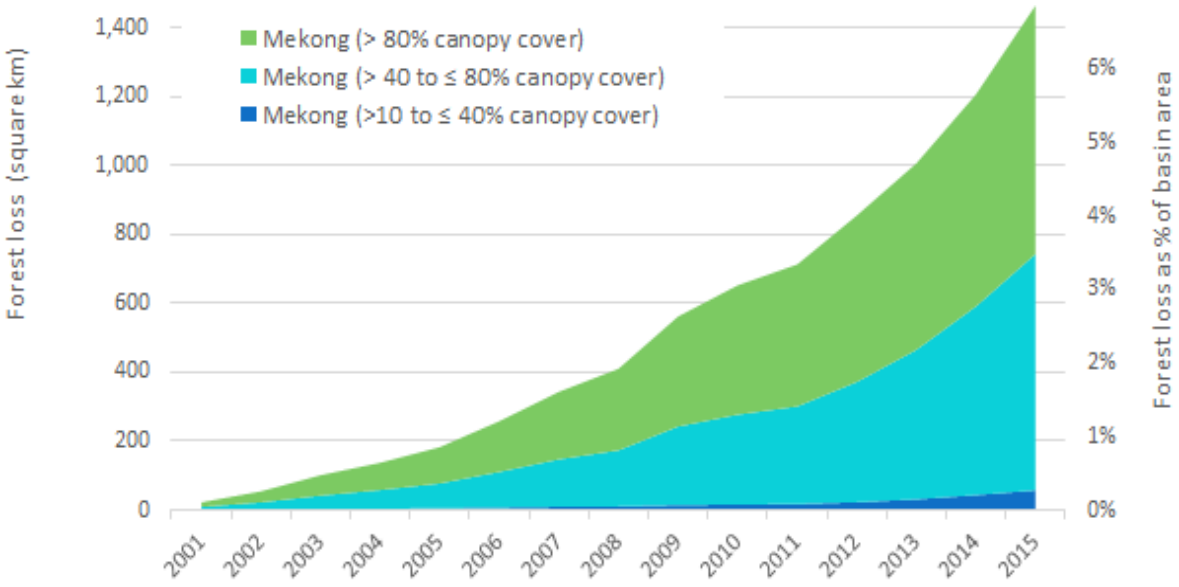
Table 7.2: Area of intact, degraded, and changed forest cover in the Mekong Basin, Myanmar

Land cover category	% cover Mekong	Area (km^2) Mekong
Intact forest (>80% canopy)	18.5	3,994
Degraded forest (10-80% canopy)	62.1	13,437
Plantation & non-forest (<10% canopy)	19.3	4,176
Other (eg. open water, urban)	0.2	33
Total	100	21,641

Land cover category	% cover Mekong	Area (km^2) Mekong
Intact forest (>80% canopy)	18.5	3,994
Changed forest cover	5.5	1,186
Degraded regions	75.9	16,427
Other (eg. open water, urban)	0.2	33
Total	100	21,641

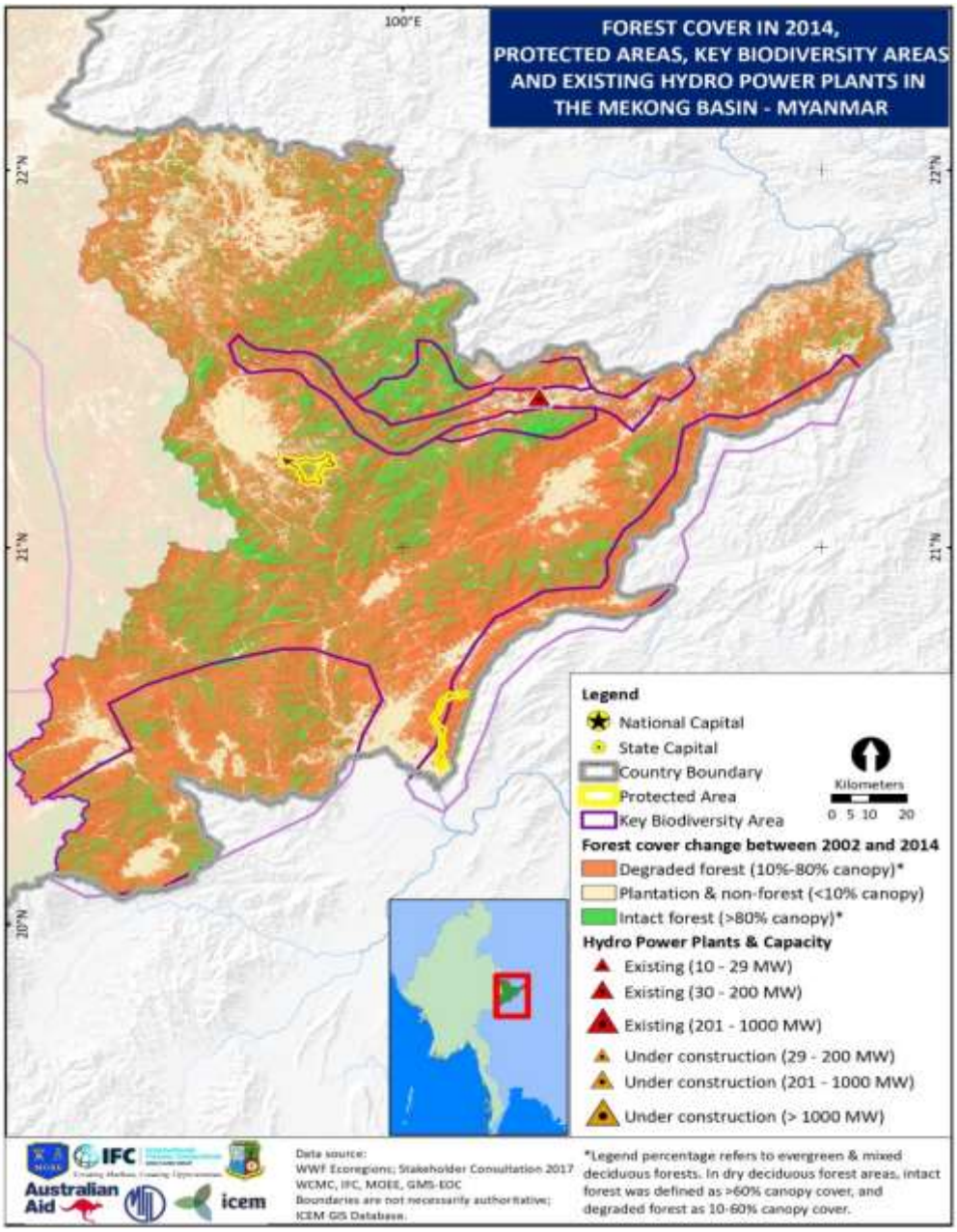
Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 7.3: Loss of forest in the Mekong basin from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

Figure 7.4: Forest cover in the Mekong Basin, Myanmar in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

7.3 Trends in summary

In summary:

(i) *18.5% of intact forest remains in the Mekong Basin within Myanmar, and although fragmented, some important interconnected blocks exist which are likely to be of international biodiversity importance.*
(ii) *Information on biodiversity in this basin is limited.*
(iii) *There is a continuing trend in loss of intact forest and in further degradation of other forest categories.*
(iv) *Less than 1% of the basin is designated for biodiversity conservation.*
(v) *The transboundary nature of this basin creates challenges and potential opportunities for international collaborative conservation initiatives.*

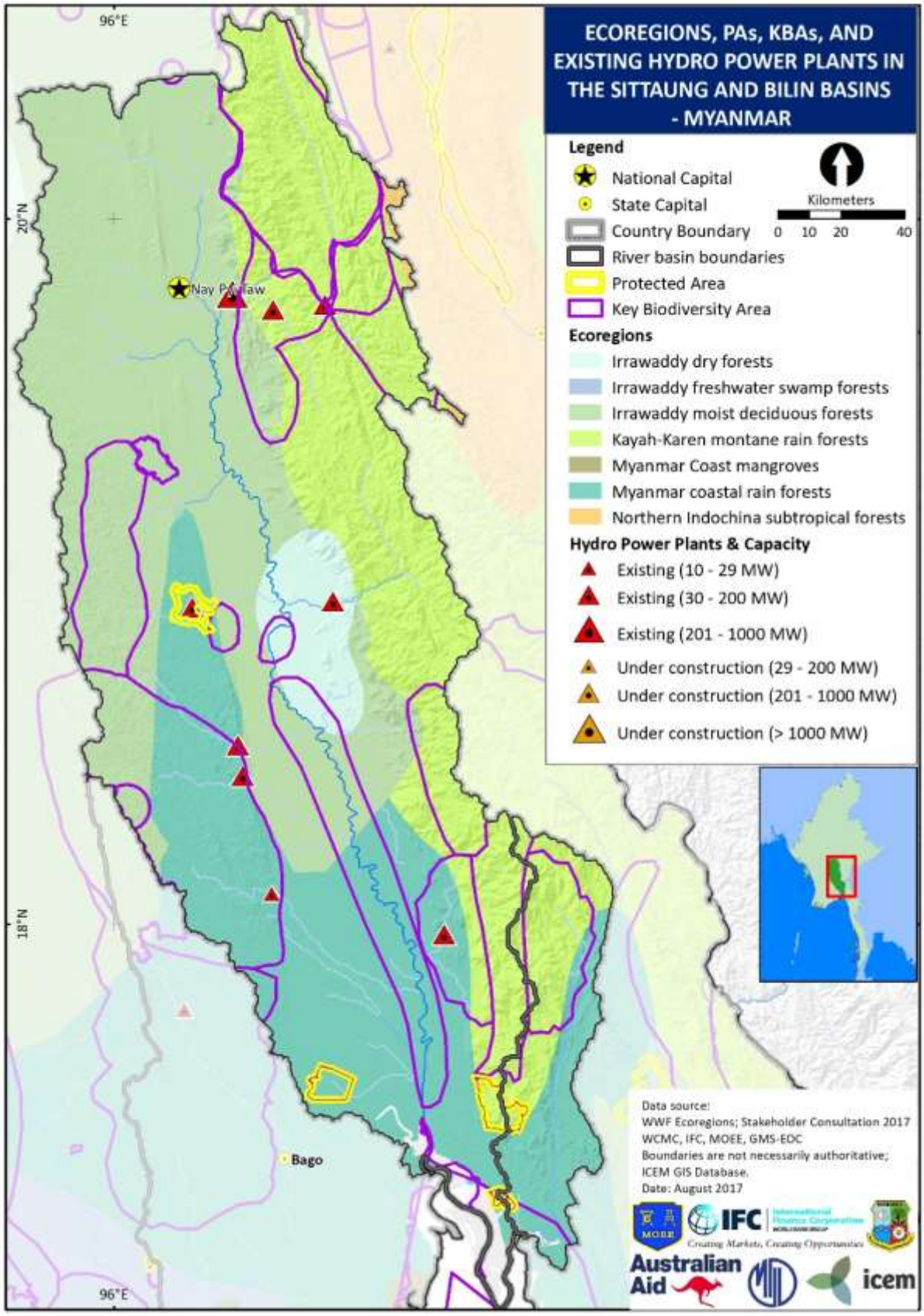
8. SITTAUNG AND BILIN BASINS

The Sittaung and Bilin basins are situated in south-central Myanmar, with the Sittaung River flowing into the Gulf of Martaban. Metrics for each basin and the combined area of both Sittaung and Bilin basins are provided in the following analysis. The highest point is 2,589 m AMSL and the mountainous region of the region is split fairly evenly between three forest dominated ecoregions - *Irrawaddy moist deciduous forests* (37.6%), *Kayah-Karen montane rain forests* (29.6 %), and *Myanmar coastal rain forests* (27.4%) (Table 8.1 and Figure 8.1).

Table 8.1: Ecoregions of the Sittaung and Bilin Basins

Ecoregions	Basin Area Coverage (%)
Combined Sittaung/Bilin basins	
Irrawaddy dry forests	3.9
Irrawaddy moist deciduous forests	37.6
Kayah-Karen montane rain forests	29.6
Myanmar coastal rain forests	27.4
Northern Indochina subtropical forests	0.4
Total	**98.9**
Sittaung basin	
Irrawaddy dry forests	4.3
Irrawaddy moist deciduous forests	40.9
Kayah-Karen montane rain forests	28.0
Myanmar coastal rain forests	25.3
Northern Indochina subtropical forests	0.4
Total	**98.9**
Bilin basin	
Kayah-Karen montane rain forests	48.0
Myanmar coastal rain forests	51.4
Total	**99.4**

Figure 8.1: Ecoregions, KBAs and PAs in the Sittaung and Bilin Basins



8.1 Biodiversity Status

KBAs have been identified for 40.3% of the Sittaung/Bilin basins, but only 0.7% is formally designated as PAs (Table 4.4, Figure 8.1). The dominant *moist deciduous forests* ecoregion and the montane and coastal rainforest ecoregions which make up close to 95% of the combined area of the Sittaung/Bilin basins are all threatened. The basin is dominated by agriculture, which has led to steep declines in biodiversity through the conversion of forest land. The Sittaung River is used to float timber, particularly teak, south for export. The main valley of the basin is surrounded by a mountainous forested landscape, but it is under pressure from logging, plantation expansion and agricultural encroachment. Globally threatened species of the basin include elephant, leopard, serow, and goral.[26] The Moeyingyi wetland, which lies between the Bago and Sittaung Basins, plays important roles by providing flood control, irrigation water, and wildlife habitat for freshwater wildlife, including migratory water birds (Box 5). However, increased sedimentation caused by deforestation and land degradation threaten the wetland.

Box 5. Sittaung PA: Moeyingyi Wetland[36,37,38]

Background: The Moeyingyi (Moyingyi) Wetland Area (MWA), designated in 2005, lies in Bago and Waw townships of the Bago Region and covers an area of 104 km^2 (Istituto-Oikos, 2011). The **MWA is the only Ramsar site in Myanmar** (AIT, 2015; Ramsar, 2012). The Moeyingyi wetland site was originally an artificial lake constructed in 1904, and now serves as an important habitat for migratory and resident birdlife (Istituto-Oikos, 2011). The wetland is supplied by water from the Bago River, with the flow controlled by five upstream dams. The wetland floods in the wet season, which occurs from May to October (Ramsar 2017).

Why it is important: MWA is an important Ramsar site for migratory and resident birds, which benefits from the diversity of different habitats (Istituto-Oikos, 2011). The site's species inventory includes large numbers of terrestrial birds (65 species), waterbirds (65 species), fishes (30 species), and reptiles and amphibians (29 species). **Fishing supports the livelihoods of half of the local community, with the catch consumed locally**, **as well as being traded in nearby Bago City** (Istituto-Oikos, 2011; Ramsar, 2015).

Current situation: Rice cultivation in the wetland is permitted by local authorities, against the advice of the Forest Department. Other threats to the MWA include the loss of habitats through fishing, hunting, and illegal trade of species (Istituto-Oikos, 2011; Ramsar, 2015).

Drivers of changes and key trends: Threats to aquatic life include electrofishing by approximately 18% of fishing households (BANCA, 2014) and the intentional introduction of new exotic species by fisherman. Avian and fish populations are threatened by use of cyanide and overfishing, and the environment is at risk from upstream discharges containing agrochemical fertilizers and pesticides (Ramsar, 2015).

8.2 Trends and drivers of change

For such a relatively disturbed and intensely developed basin, it is noticeable that still 36% or 20,157 km^2 has degraded forest cover with potential for rehabilitation and sound management. Also, 10.6% (4,013 km^2) of the basin is covered by intact forest surrounded by other forest categories which also is promising for biodiversity rehabilitation and watershed management (Table 8.2, Figure 8.2). The challenge is the highly fragmented nature of the remaining forest with so little under any form of protection.

Increasing pressures from illegal logging, agricultural encroachment and the trade in wildlife are the main threats to biodiversity of the basin.[39] Between 2002 and 2014, 3.1% of intact forest was lost (Table 8.2). As for the other basins, there is a consistent trend in loss of forests since 2000, with the

[36] BANCA, 2014. Rapid assessment on biodiversity and socio-economic status of Moeyingyi wetland wildlife sanctuary. Biodiversity and Natural Conservation Association
[37] NAPA, 2012. Myanmar's national adaptation programme of action (NAPA) to climate change. United Nations Environment Programme.
[38] Ramsar COP8 DOC.11, 2002. Climate change and wetlands: Impacts, Adaptation and Mitigation.
[39] Polidoro, B. A., Carpenter, K. E., Collins, L., Duke, N. C., Ellison, A. M., Ellison, J. C., ... & Livingstone, S. R. (2010). The loss of species: mangrove extinction risk and geographic areas of global concern. PloS one, 5(4), e10095.

rate of loss increasing in recent years and especially noticeable as a percentage of intact forest loss in the Bilin basin (Figure 8.3). The Ayeyarwady and Sittaung River basins are the location for most existing hydropower and irrigation dams in Myanmar. The Sittaung basin hosts 17 dams and 13 reservoirs, 9 of them linked to medium to large hydropower projects. One - the Kabaung project (30 MW) - falls within the proposed Shinpinkyetthauk W.S protected area (Figure 8.1). Each dam supports a reservoir where forest was removed, and involved the construction of an access road, and the hydropower projects the clearing of a transmission line corridor through forested land.

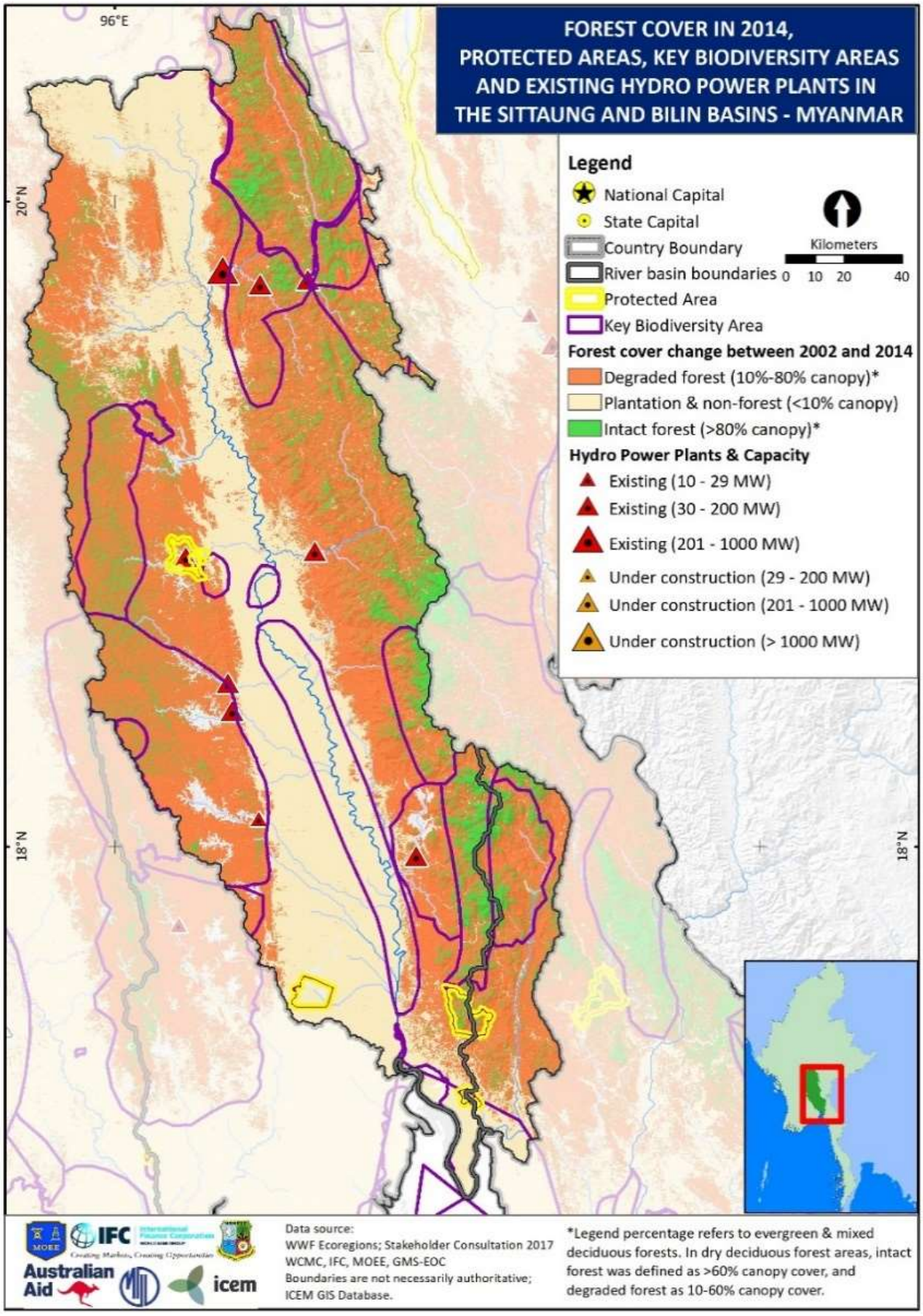
Table 8.2: Area of intact, degraded, and changed forest cover in Sittaung and Bilin Basins

Land cover category	% cover Sittaung/ Bilin	Area (km^2) Sittaung/ Bilin
Intact forest (>80% canopy)	10.6	4,013
Degraded forest (10-80% canopy)	36.0	20,157
Plantation & non-forest (<10% canopy)	51.7	12,969
Other (eg. open water, urban)	2.2	764
Total	100	37,903

Land cover category	% cover Sittaung/Bilin	Area (km^2) Sittaung/Bilin
Intact forest (>80% canopy)	10.6	4,013
Changed forest cover	3.1	1,172
Degraded regions	85.6	32,431
Other (eg. open water, urban)	0.8	287
Total	100	37,903

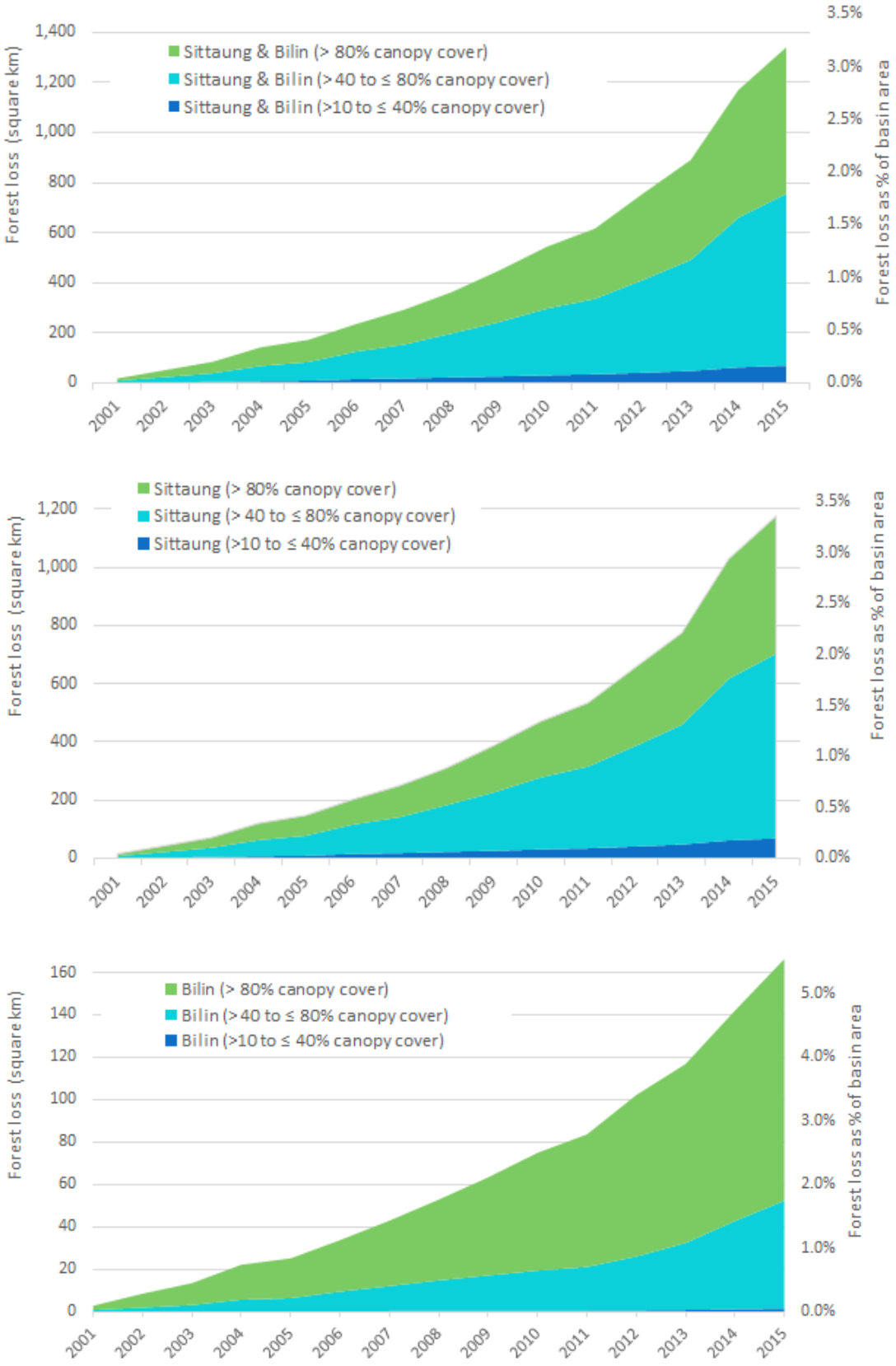
Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 8.2: Forest cover in the Sittaung and Bilin Basins in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 8.3: Loss of forest in the Sittaung and Bilin basins from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

8.3 Trends in summary

(i) *Some 90% of intact forest has already been lost in the basin with 3% lost over the past 12 years.*

(ii) *Continuing pressures from illegal logging and agricultural encroachment cause deforestation.*

(iii) *The expanding illegal wildlife trade presents another threat to biodiversity in the basin.*

(iv) *Given this basin is a focal area for existing hydropower projects, each with reservoirs in degraded forest areas - and one within a protected area, there are opportunities for private-public-community partnerships in forest rehabilitation and effective management.*

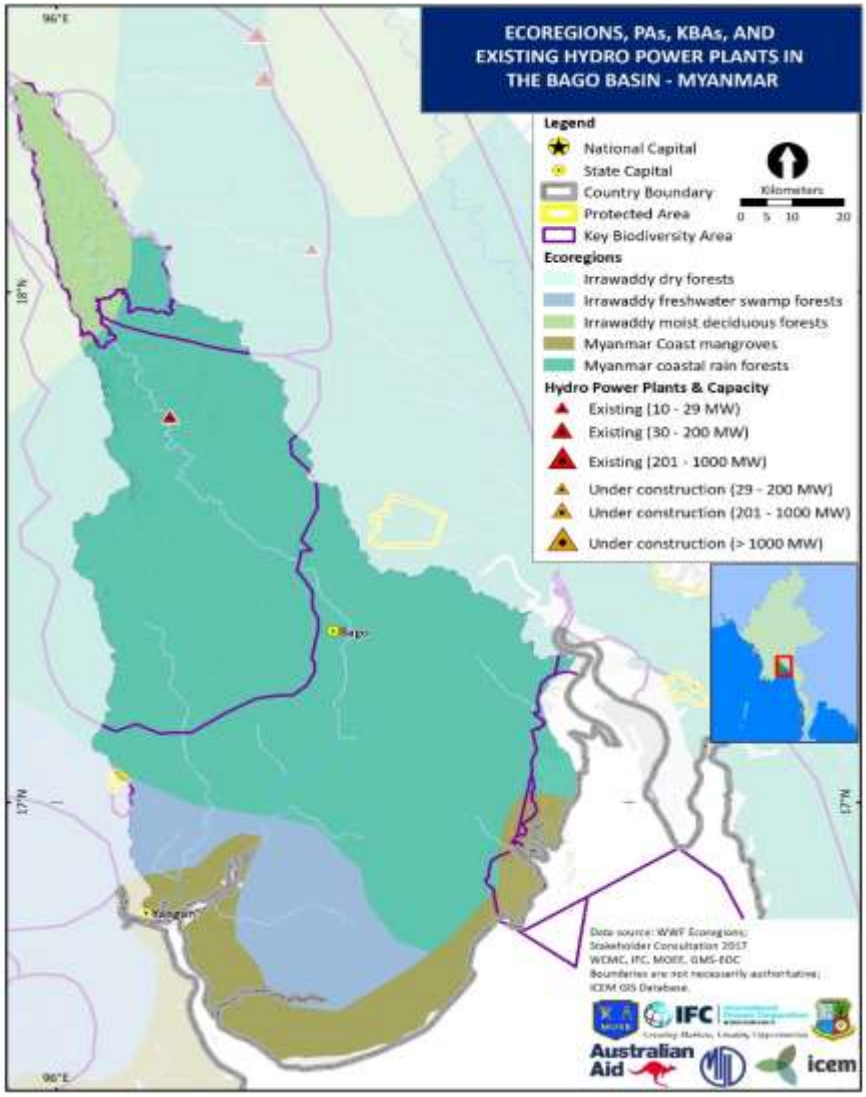
9. BAGO RIVER BASIN

The Bago Basin sits between the Ayeyarwady Delta and Sittaung Basin. The basin's topography ranges from 0 m to 784 m AMSL, and primarily consists of a delta landscape, which has been largely converted to agricultural land. The basin is dominated by the *Myanmar coastal rain forest* ecoregion (68.9%), and also contains an array of other coastal ecoregions, including the critical/endangered *Myanmar coast mangroves* (11.6%) and the critical/endangered *Irrawaddy freshwater swamp forests* (11.7%) (Table 9.1 and Figure 9.1). The basin also includes the major urban center of Yangon, which is surrounded by extensive agricultural and industrial developments.

Table 9.1: Ecoregions of the Bago basin

Ecoregions	Basin Area Coverage (%)
Irrawaddy freshwater swamp forests	11.7
Irrawaddy moist deciduous forests	5.8
Myanmar coast mangroves	11.6
Myanmar coastal rain forests	68.9
Total	**98.0**

Figure 9.1: Ecoregions, KBAs and PAs in the Bago basin



9.1 Biodiversity Status

Each ecoregion represented within the Bago basin is either critical/endangered or vulnerable. There has been a steady decline in biodiversity over hundreds of years of settlement, but particularly in the past 20 years. The basin ecosystem services have been impaired by intensive agriculture along the Bago River.[40] Even so, 42.1% of the basin is designated as KBA (Table 4.4, Table 9.1) covering moist deciduous forest, coastal rainforest and mangroves. Given the limited survey of the area, the status of forest and biodiversity needs to be confirmed. The small Hlawga Wildlife Park is the only PA that has partial coverage in the basin (Box 6).

Box 6. Bago PA: Hlawga Wildlife Park

Background: The only protected area in the Bago basin, the Hlawga Wildlife Park, located in the Yangon Region, covers just 6 km^2 (Istituto-Oikos, 2011) but there is potential for significant expansion. The park was gazetted in 1989, and includes three zoned areas: the 'open zoo' for wildlife tours and bird watching; 'mini zoo' providing educational facilities; and the 'buffer zone' which permits plantations (Istituto-Oikos, 2011). The park is situated close to the boundary between the Irrawaddy freshwater swamp and Myanmar coastal rain forests ecoregions.

Why it is important: The park was established to support conservation of vegetation in the watershed of Hlawga lake, including a collection of indigenous species characteristic of the region, and in promoting environmental awareness (Istituto-Oikos, 2011). Barking and hog deer, and wild boar, represent three of the 12 reported mammalian species. Dipterocarpus trees are common and teak (*Tectona grandis*) represent notable deciduous flora. Avian fauna include 191 species of resident and migratory species (Istituto-Oikos, 2011).

Current situation: The park is an important tourist site for local people, and is one of the most visited protected areas in Myanmar, with 227,542 visitors in 2014 (Istituto-Oikos, 2011; MoECF 2015). Management issues include the introduction of species that are non-native to the area, especially macaques, and the need for increased patrolling (Istituto-Oikos, 2011). Visitor entry fees are inadequate to cover all management-related costs (MoECF 2015).

Drivers of changes and key trends: Key threats include the introduction and increase in non-native species that may adversely impact the ecology of the site, extraction of wood and logging activity, and tourism-related activities and infrastructure (Istituto-Oikos, 2011). The growing population of macaques was highlighted by MoECF (2015) as being problematic.

9.2 Trends and drivers of change

Deforestation and agricultural encroachment continue to be the main threats to the biodiversity of this basin. Only 2.3% of intact forest (233 km^2) and 26.5% degraded forest (2,720 km^2) remains (Table 9.2, Figure 9.2). Over the 12-year period from 2002 to 2014, 2.5% of the total intact forest in the basin was lost, but by 2002 intact forest area had already been reduced to 238 km^2. Since 2000, there has been increasing losses in the small area of remaining forests particularly from 2010 onwards (Figure 9.3). Remaining teak forests are under continuing threat of logging and are progressively being replaced by agriculture. Remaining mangrove forests are under threat driven by the expansion of agriculture and aquaculture. Land degradation, particularly erosion, poses a threat to the basin's remnant wetlands. Continuing pressure from expanding urbanization and provision of agricultural produce and building materials is placing unsustainable demands on the basin's natural systems.

[40] Department of Environment and Natural Resources (DENR). Bago River Watershed Rehabilitation Project. URL: http://r6.denr.gov.ph/index.php/86-region-news-items/344-bago-river-watershed. Accessed on 18 May 2017

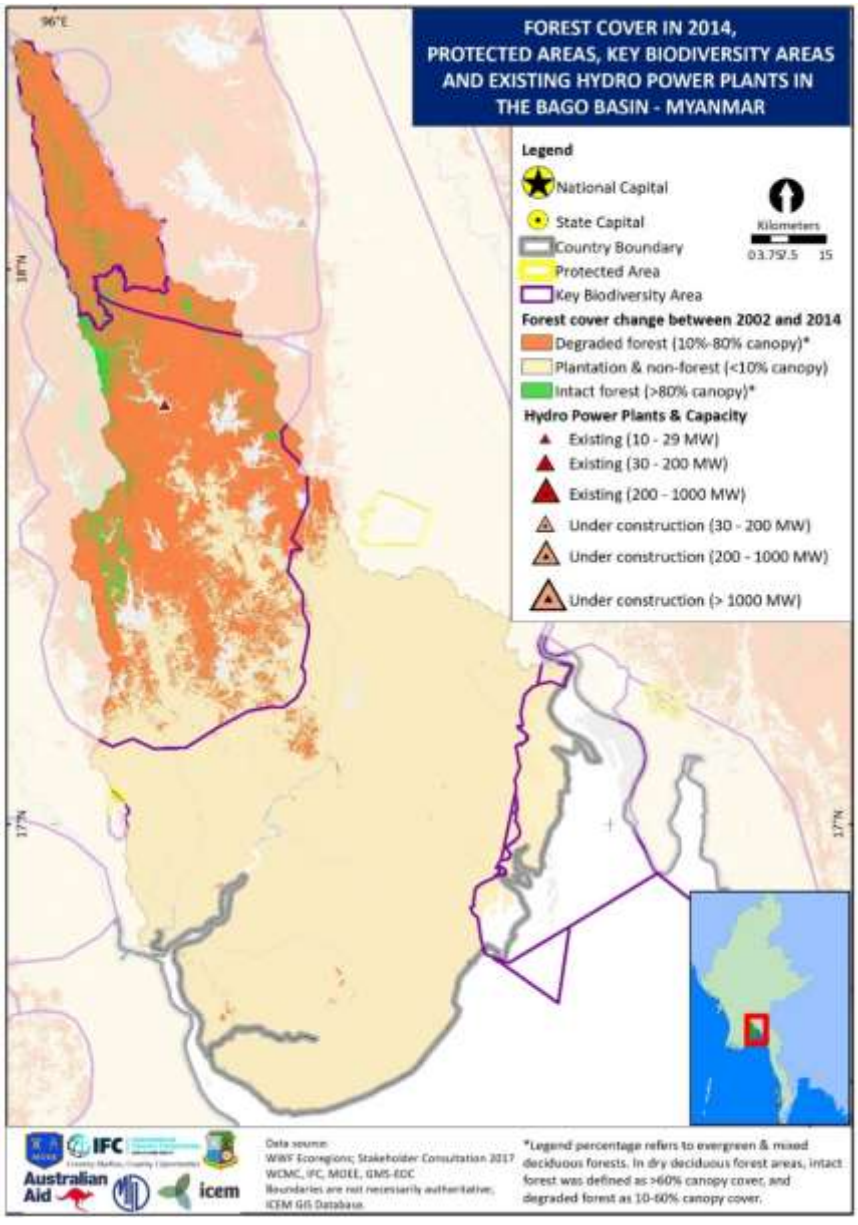
Table 9.2: Area of intact, degraded, and changed forest cover in the Bago Basin

Land cover category	% cover	Area (km^2)
	Bago	Bago
Intact forest (>80% canopy)	2.3	233
Degraded forest (10-80% canopy)	26.5	2,720
Plantation & non-forest (<10% canopy)	68.1	6,976
Other (eg. open water, urban)	3.1	318
Total	100	10,247

Land cover category	% cover	Area (km^2)
	Bago	Bago
Intact forest (>80% canopy)	2.3	233
Changed forest cover	2.5	253
Degraded regions	93.4	9,566
Other (eg. open water, urban)	1.9	195
Total	100	10,247

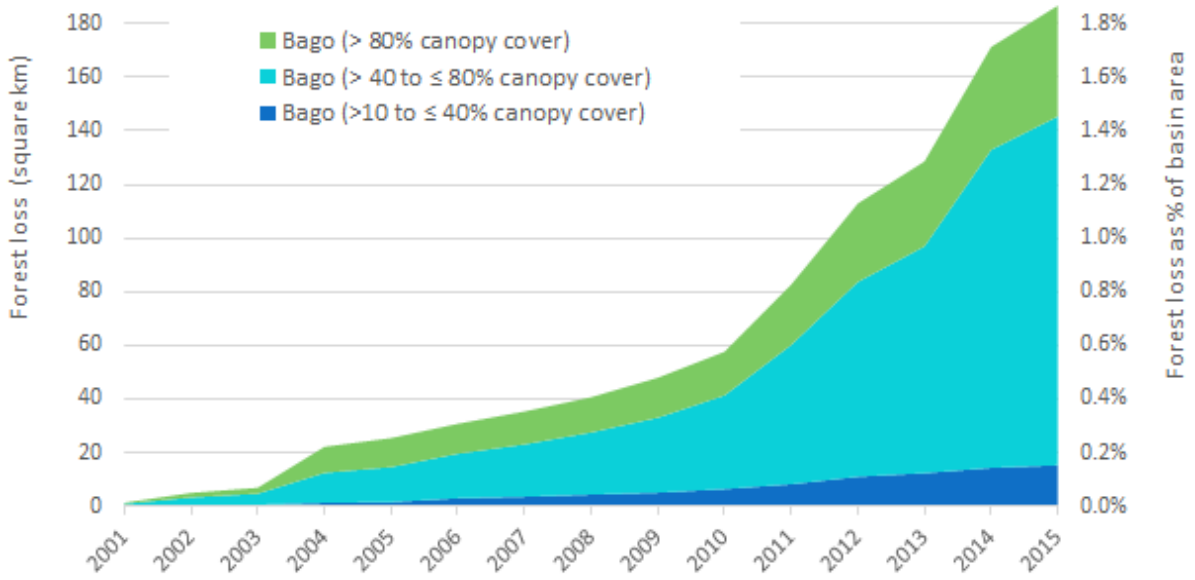
Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 9.2: Forest cover in the Bago basin in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 9.3: Loss of forest in the Bago basin from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

9.3 Trends in summary

In summary:

(i) *Remaining intact forest is highly fragmented in the Bago basin, but its concentration in the North East with surrounding degraded forests does provide opportunity for rehabilitation and protection.*

(ii) *The close proximity to Yangon and the needs of an expanding population make the remaining intact forest of special importance for conservation, recreational and education purposes.*

(iii) *One existing hydropower project within the degraded forest* area (Figure 9.2) will *experience increasing sediment issues if the forest losses continue.*

(iv) *Pressures from agriculture, aquaculture and urbanization are likely to maintain the threat to biodiversity in the remaining pockets of intact and degraded forested areas.*

10. TANINTHARYI RIVER BASIN

The Tanintharyi Basin is the southernmost basin in Myanmar. To the west, the basin supports coastal ecoregions such as *Myanmar coastal mangroves*, and becomes mountainous and forested on moving inland where it shares a long international border with Thailand (Table 10.1 and Figure 10.1). A diversity of ecosystems exist within the basin given its narrow north-south alignment and steep transition from a coastal biome to mountain rainforests. The basin is host to three ecoregions, with more than half of its area dominated by *Tenasserim-South Thailand semi-evergreen rain forests* (Table 10.1).

Recent international investment in the region includes construction of a new deep-water port, associated road networks along the coast, an industrial park, transport corridor to the port from the city of Dawei (WWF 2014), industries, and energy infrastructure.[41] There are plans for major transport corridors - the East-West Economic Corridor running from Da Nang Port in Viet Nam, through Lao PDR, Thailand, to the Mawlamyine Port in Myanmar. Another - the Western Economic Corridor, runs from India through Nay Piy Taw to the port and then on to Bangkok, creating a major new transportation link for trade and commerce across mainland Indochina (WWF 2014) (Figure 10.2).

Table 10.1: Ecoregions within the Tanintharyi Basin

Ecoregions	Basin Area Coverage (%)
Irrawaddy moist deciduous forests	0.1
Myanmar Coast mangroves	2.9
Myanmar coastal rain forests	29.9
Tenasserim-South Thailand semi-evergreen rain forests	64.3
Total	**97.2**

[41] Wallace, S. (2014). In-Depth Myanmar: All Roads. World Wildlife Fund. URL: https://www.worldwildlife.org/magazine/issues/spring-2014/articles/myanmar. Accessed on 18 May 2017

Figure 10.1: Ecoregions, KBAs and PAs within the Tanintharyi basin

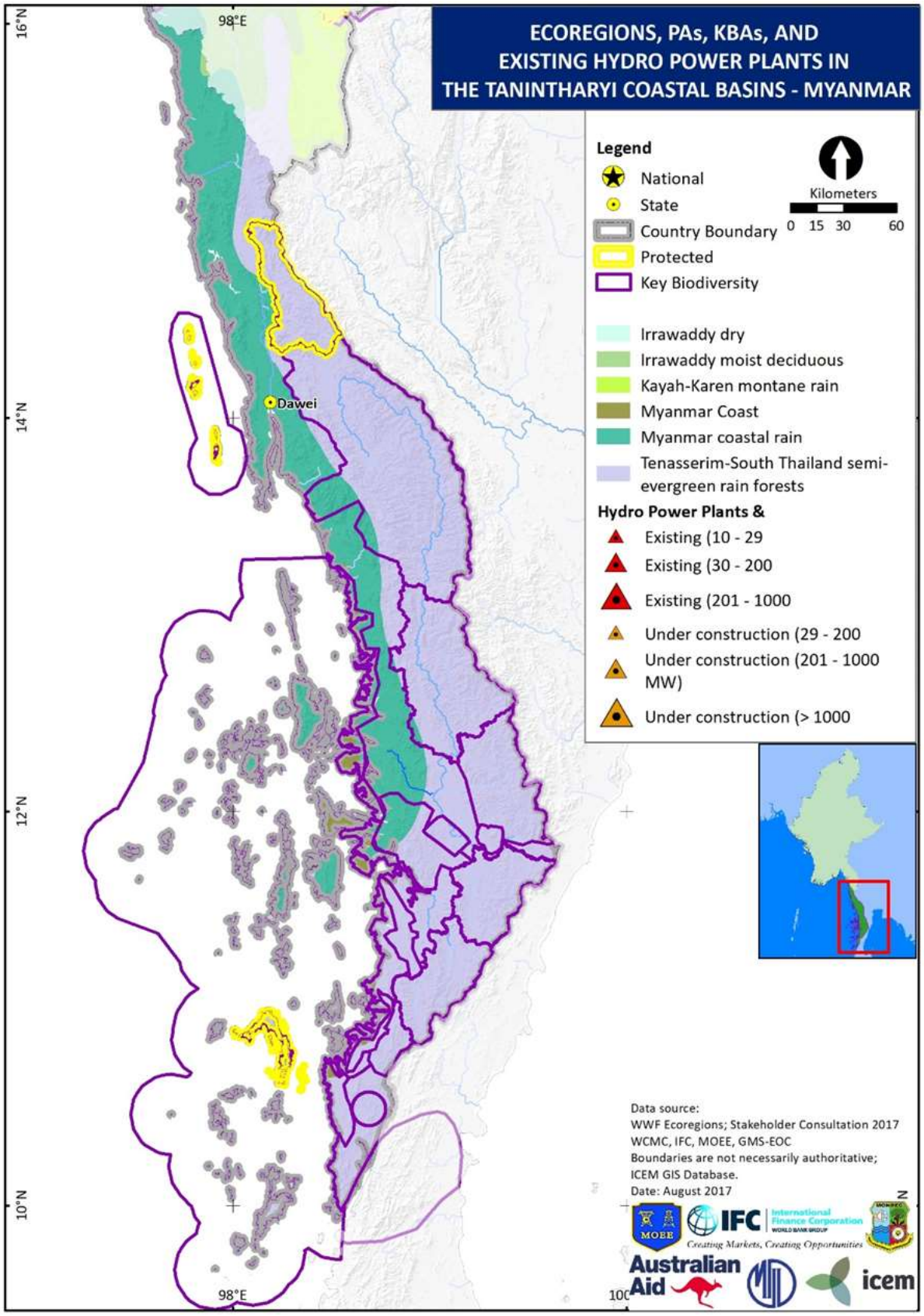


Figure 10.2: Greater Mekong Subregion East West and Western Corridors

Source: ADB. 2002. Building on Success: A Strategic Framework for the Next Ten Years of the Greater Mekong Subregion Economic Cooperation Program. Manila[42]

10.1Biodiversity status

[42] https://www.adb.org/sites/default/files/institutional-document/214361/configuration-gms-corridors.pdf

The Tanintharyi Basin is exceptional for its forests and biodiversity. WWF considers the basin to be 'one of the most biodiverse areas in the world' (WWF 2014). By area, 64.7% of the basin has been identified as KBAs. Protected areas cover 4.2% of the basin all of which are located entirely within KBAs (Table 2.4, Figure 10.1, Box 7).

A Taninthayi Forest Corridor (TFC) is being considered as a World Heritage site with one of the largest remaining areas of unprotected low and mid-elevation, seasonal evergreen forest in Southeast Asia. It is located in the Tanintharyi Range that straddles the southern Thai-Myanmar border and contains many globally threatened species including the Indochinese tiger, Asian elephant, gibbon, langur, Gurney's Pitta, and Sunda Pangolin. Tanintharyi and Lenya National Parks were proposed in 2002, followed by a Lenya National Park Extension in 2004, but none of these areas have been gazetted. If those parks and linked reserved forest were formally recognized as a protected area corridor it would form a contiguous 1 million-hectare (10,000 km^2) conservation zone stretching for 280 km.[43] The corridor is large enough to preserve ecosystem processes and provide habitat for wide ranging species, especially with the contiguous protected areas across the border in Thailand (Figure 10.3).

Some 53.2% of intact forest remains in the basin making it a hotspot region for conservation. That area is interwoven with a further 30.9% of degraded forest cover (Table 10.2, Figure 10.4).

Box 7. Tanintharyi Basin PA: Tanintharyi Nature Reserve[44,31 ,45,46]

Background: The Tanintharyi Nature Reserve (TNR) was established in 2005 with the main purpose of protecting tropical rain forest ecosystems. The reserve covers an area of 1,700 km^2, and is located in the Yebyu and Tavoy townships of the Tanintharyi Region (Istituto-Oikos, 2011). The reserve's forests are representative of the *Tenasserim-South Thailand semi-evergreen rain forests* ecoregion.

Why it is important: Evergreen forest extends over three-quarters of the TNR and supports a rich diversity of wildlife. Nearly 70 species of mammals, including numerous that are threatened globally are found in the TNR, as well as the native Gurney's Pitta (*Pitta gurneyi*) (Istituto-Oikos, 2011).

Current situation: The management plan of 2013 is focused on large mammals (ie. primates, Sunda pangolin, tiger, Asian elephant, sambar, Asian tapir and Chinese serow); species of hardwood trees; and three main habitat types (bamboo, primary forests, and hilltop grasslands) (Pollard et al. 2014). The reserve has been zoned to facilitate more effective conservation, which delineates a core zone, buffer zone, and transportation corridor (Pollard et al., 2014). Local infrastructure includes one access road and gas pipelines in the transportation corridor, but no infrastructure is allowed in the core zoned area (Istituto-Oikos, 2011; Pollard et al., 2014). The Total and Petronas companies have provided long-term support of conservation and management since 2004 (Htay et al., 2014).

Drivers of changes and key trends: Main threats to the conservation of the TNR come from shifting cultivation, illegal hunting and logging, forest fires, and catastrophic floods and landslides (Istituto-Oikos, 2011, Pollard et al. 2014). Outside and adjacent to the reserve, the forest is rapidly being replaced by rubber plantations (Istituto-Oikos, 2011). In the past, armed conflict discouraged commercial mining interests, but following a ceasefire access is now relatively easy (Pollard E., 2014). Destruction of forest habitat by logging has resulted in severe erosion and flooding (Istituto-Oikos, 2011; Pollard E., 2014).

[43] http://whc.unesco.org/en/tentativelists/5876/

[44] Pollard, E. H. B., Soe Win Hlaing& Pilgrim, J. D. (2014) Review of the Taninthayi Nature Reserve Project as a conservation model in Myanmar. Unpublished report of The Biodiversity Consultancy, Cambridge, England.

[45] TRIP Net, RKIPN and RECOFTC (2014) - We Will Manage Our Own Natural Resources – Karen indigenous people in Kamthway demonstrate the importance of local solutions and community-drive conservation. Tenasserim River and Indigenous People Networks (TRIP)

[46] UNESCO - World Heritage Convention - Proposed project - Tanintharyi Forest Corridor

Figure 10.3: Tanintharyi Forest Corridor and proposed protected areas

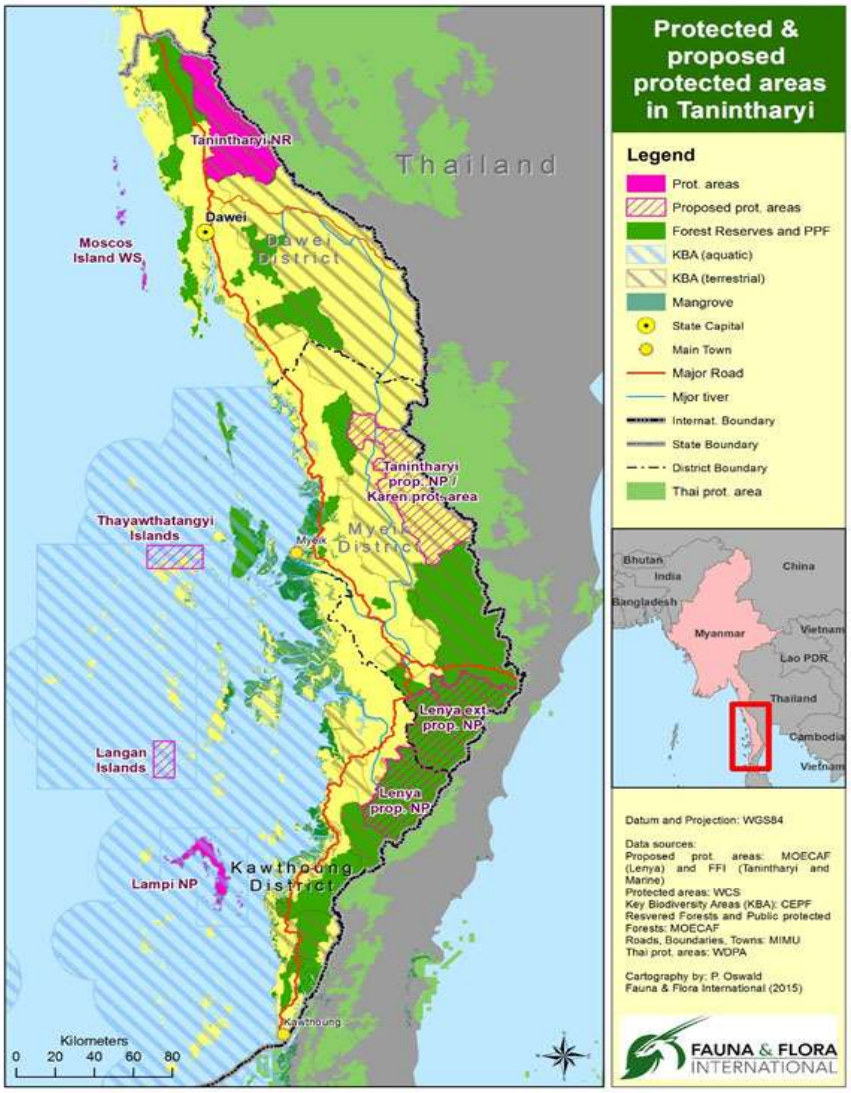


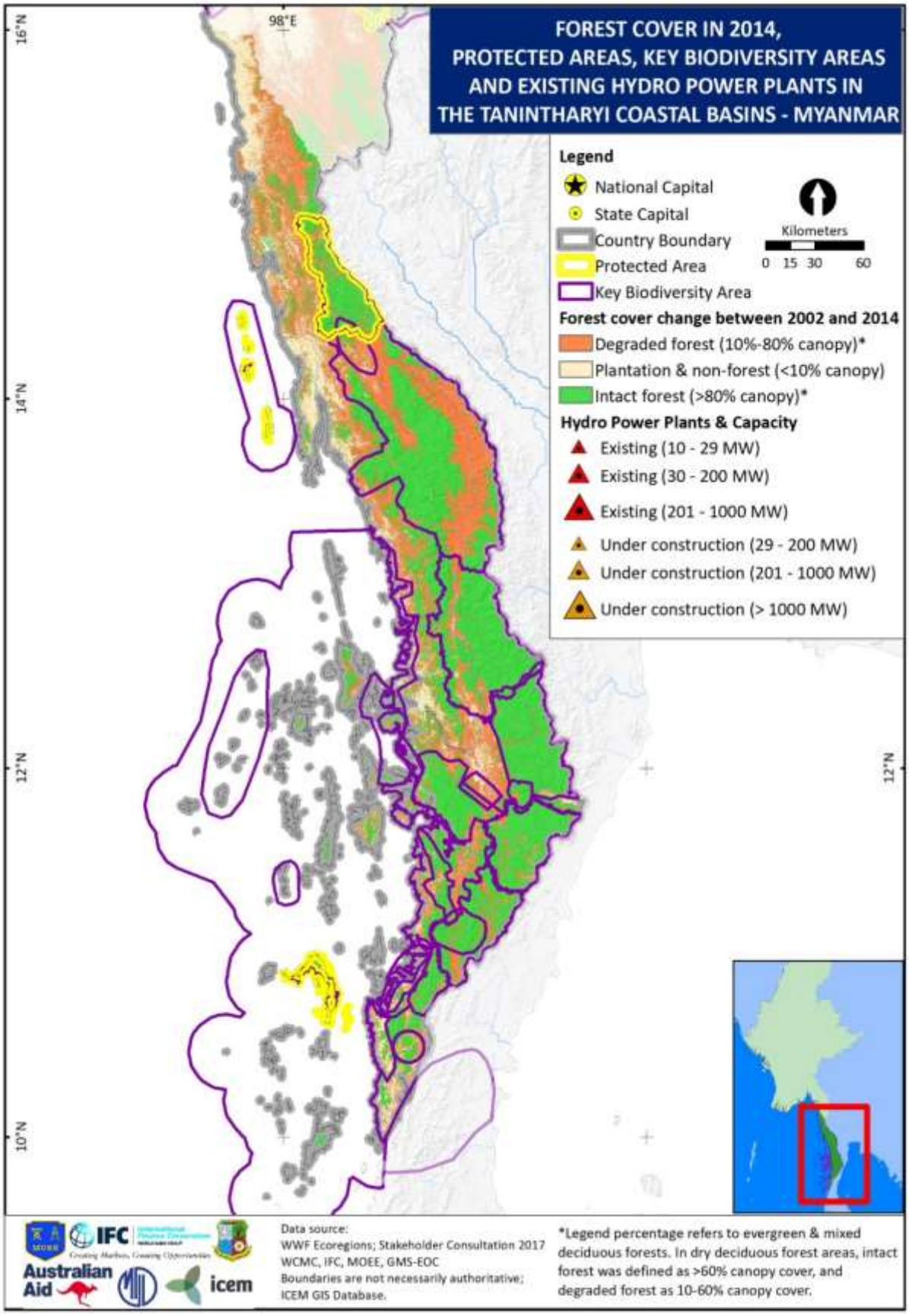
Table 10.2: Area of intact, degraded, and changed forest cover in the Tanintharyi Basin

Land cover category	% cover Tanintharyi Coastal Basins	Area (km²) Tanintharyi Coastal Basins
Intact forest (>80% canopy)	53.2	23,587
Degraded forest (10-80% canopy)	30.9	13,699
Plantation & non-forest (<10% canopy)	14.3	6,335
Other (eg. open water, urban)	1.6	693
Total	100	44,314

Land cover category	% cover Tanintharyi Coastal Basins	Area (km²) Tanintharyi Coastal Basins
Intact forest (>80% canopy)	53.2	23,587
Changed forest cover	5.0	2,216
Degraded regions	40.2	17,818
Other (eg. open water, urban)	1.6	693
Total	100	44,314

Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 10.4: Forest cover in the Tanintharyi basin 2014

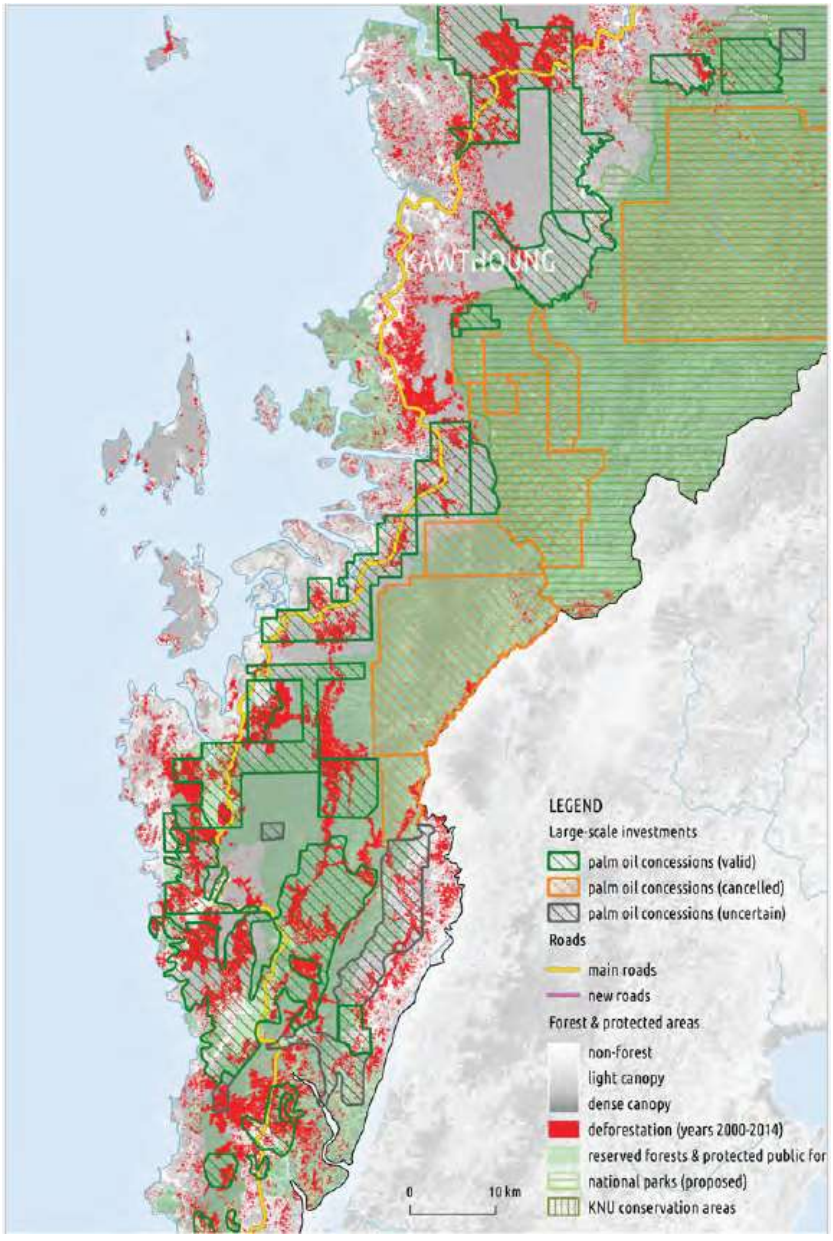


Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

10.2Trends and drivers of change

Deforestation and wildlife trade are key causes of biodiversity loss in the basin, with major pressures coming from the development of palm oil and rubber plantations inside and outside proposed protected areas (Myanmar Times 2015).[47] Land clearing for palm oil and rubber plantations has been a driving force of deforestation and loss of biodiversity in Tanintharyi with palm concessions reportedly granted to about 40 Myanmar businesses (Figure 10.5).[48] Other threats include conversion to agriculture, mining (eg. the 400-hectare Nong Bwa coal mine), the extension and upgrading of road networks and major timber concessions.

Figure 10.5: Palm oil concessions, deforestation and protected areas in the Tanintharyi Basin



Source: Woods 2015[49]

[47] Dinmore, G., Lone, W. (2015). Vast agribusiness concessions mask unprecedented deforestation: report. Myanmar Times. URL: http://www.mmtimes.com/index.php/business/13507-vast-agribusiness-concessions-mask-unprecedented-deforestation-report.html. Accessed on 18 May 2017

[48] https://www.mmbiztoday.com/articles/sustainable-palm-oil-myanmar-could-access-premium-markets

[49] Kevin Woods, 2015, Commercial Agriculture Expansion in Myanmar: Links to Deforestation, Conversion Timber, and Land Conflicts, http://forest-trends.org/releases/uploads/Conversion_Timber_in_Myanmar.pdf

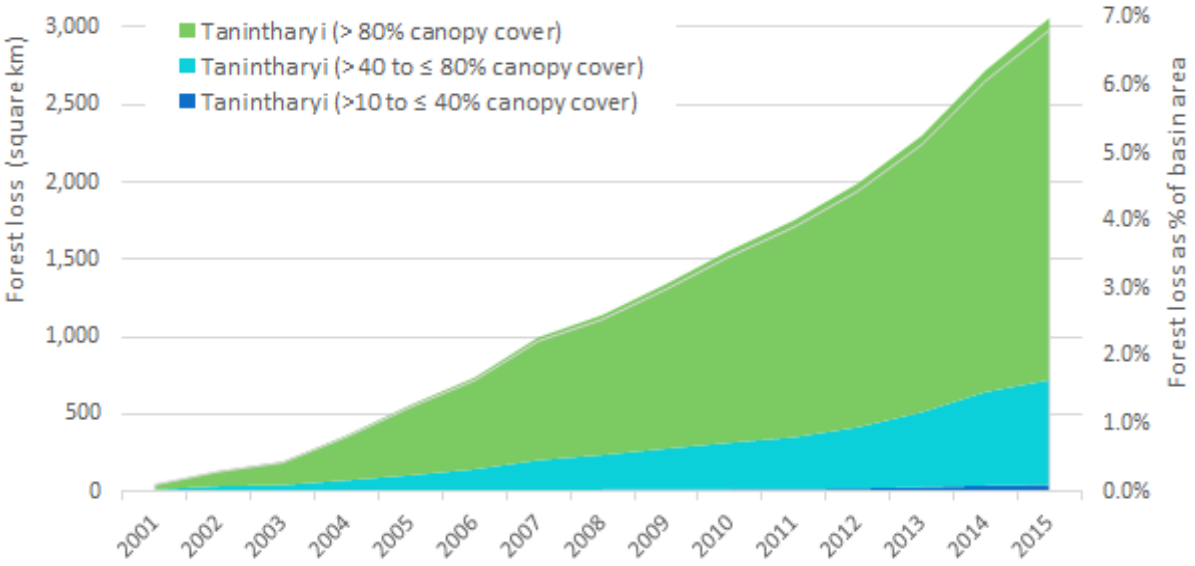
Since 2001, there has been an increasing trend in the loss of intact forest with a canopy cover greater than 80% (Figure 10.6). *The Tanintharyi basin has the highest rate of deforestation compared to any other Myanmar catchment area over the 12-year period from 2002 to 2014, with 5% of total intact forest lost* (Table 10.2**Error! Reference source not found.**).

Expanding infrastructure presents another threat to biodiversity in the region. The new port in Dawei and related road and industrial infrastructure projects could displace forested land and sever natural forests corridors that are important for wide ranging wildlife, and especially tiger and elephant. Tunnels and viaducts have been proposed to maintain habitat connectivity.[50]

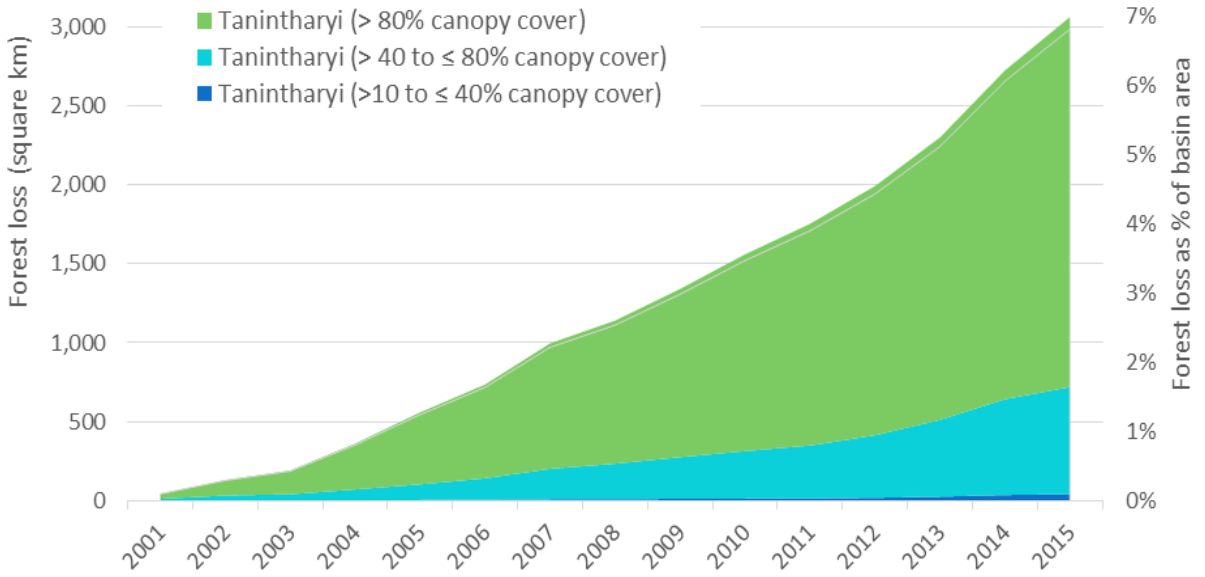
The wildlife trade is another key driver reducing biodiversity. The pressures on biodiversity from human activity in the Tanintharyi Nature Reserve (TNR) illustrate problems arising from illegal logging and shifting cultivation and direct threats to wildlife from illegal hunting (Box 7).

Coastal mangrove ecosystems in the basin are threatened by conversion to aquaculture. The recent opening of the region to mining due to a decline in conflict and development of road infrastructure[51] poses a new threat to freshwater ecosystems. However, the improved political climate may also offer scope to 'designate Tanintharyi and Lenya proposed National Parks, creating a globally outstanding trans-boundary cluster of World Heritage Sites together with Kaeng Krachen National Park in Thailand' (Myanmar Business Review, 2014).[52]

Figure 10.6: Loss of forest in the Tanintharyi Basin from 2000 to 2015



[50] http://www.naturalcapitalproject.org/natural-capital-approach-in-myanmar-interview-with-mark-gough/
[51] TRIP Net, RKIPN and RECOFTC (2014) - We Will Manage Our Own Natural Resources – Karen indigenous people in Kamthway demonstrate the importance of local solutions and community-drive conservation. Tenasserim River and Indigenous People Networks (TRIP)
[52] https://www.mmbiztoday.com/articles/sustainable-palm-oil-myanmar-could-access-premium-markets



Source: ICEM analysis of data from Hansen et al. 2013

10.3Trends in summary

In summary:

(i) *The Tanintharyi basin has the highest rate of deforestation in Myanmar.*

(ii) *A multitude of interacting pressures threaten biodiversity in the basin.*

(iii) *Along with the conservation corridor in the upper Ayeyarwady and Chindwin Basins, it retains the most extensive and important forests and biodiversity in Myanmar - of exceptional international significance.*

(iv) *Recent reduced conflict in the area provides an opportunity for the development of transboundary conservation zones, including locally managed peace parks.*

(v) *Cross border hunting and wildlife trade are having a serious impact on remaining flagship species such as tiger.*

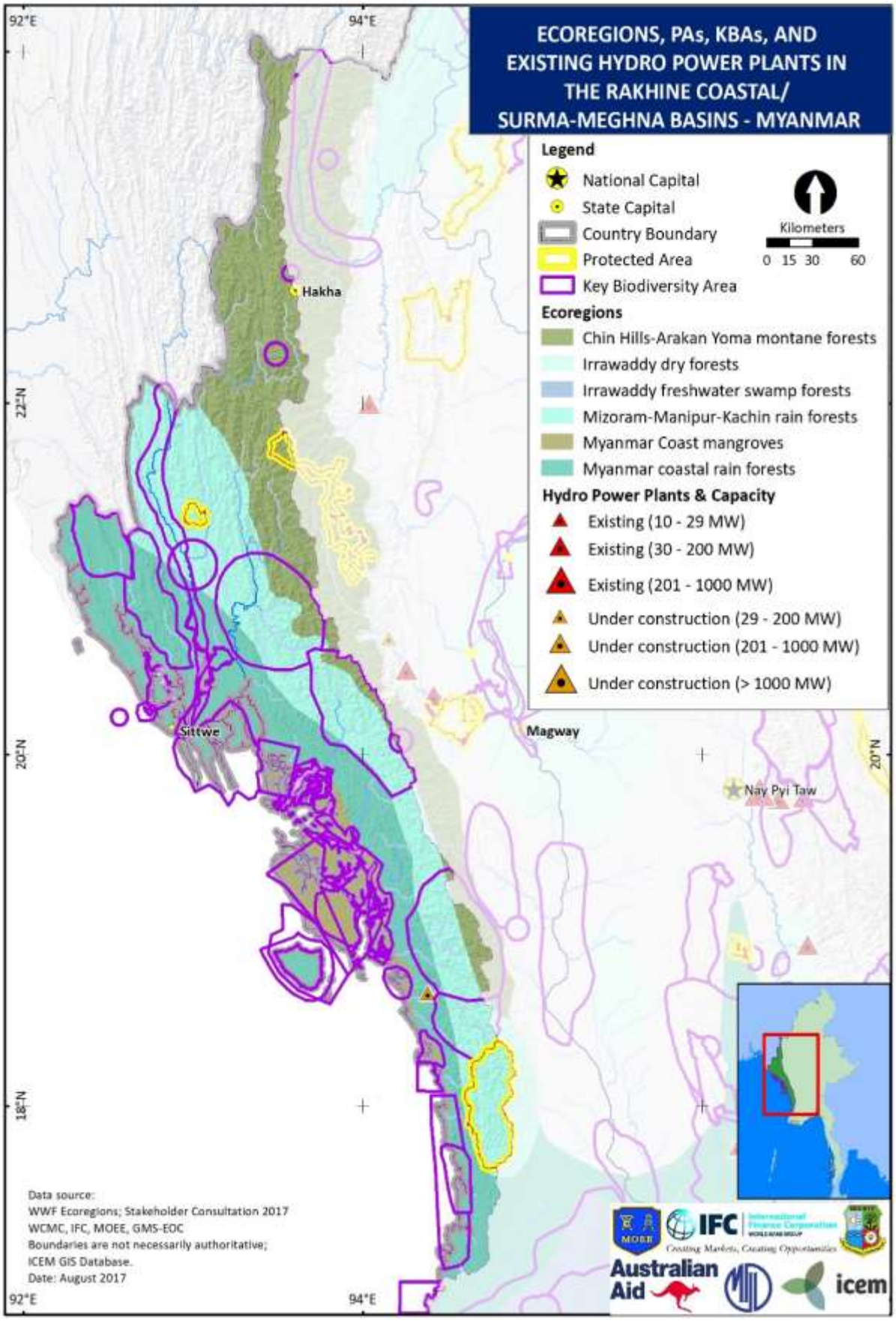
11. RAKHINE COASTAL BASINS

The Rakhine Coastal Basins lie along the western coast of Myanmar, forming a border with India, Bangladesh, and the Bay of Bengal, and includes the Surma-Meghna sub-basin which is situated at the northern tip of the Rakhine Coastal Basins region. The basins are dominated by rain forests, with 66% rain forest-classified ecoregions. The basin also includes 23.1% montane forests, and harbor an important coastal mangrove habitat within the *Myanmar coast mangrove* ecoregion comprising 7.4% of the area (Table 11.1 and Figure 11.1). The shrubbery-dominated landscape above 2,500 m changes to montane forest habitat below this elevation.

Table 11.1: Ecoregions of the Rakhine Coastal/Surma-Meghna Basins

Ecoregions	Basin Area Coverage (%)
Combined Rakhine/Surma-Meghna basin	
Chin Hills-Arakan Yoma montane forests	23.1
Mizoram-Manipur-Kachin rain forests	32.3
Myanmar Coast mangroves	7.4
Myanmar coastal rain forests	33.7
Total	**96.5**
Rakhine basin	
Chin Hills-Arakan Yoma montane forests	22.0
Mizoram-Manipur-Kachin rain forests	32.7
Myanmar Coast mangroves	7.5
Myanmar coastal rain forests	34.2
Total	**96.5**
Surma-Meghna basin	
Chin Hills-Arakan Yoma montane forests	98.1
Mizoram-Manipur-Kachin rain forests	0.9
Total	**99.0**

Figure 11.1: Ecoregions, KBAs and PAs in the Rakhine Coastal/Surma-Meghna basins



11.1 Biodiversity Status

Protected areas cover 3.6% or 2,003 km^2 (Table 2.4 and Table 4.4) and KBAs have been identified over 45.5% of the Rakhine Coastal/Surma-Meghna Basins (Table 2.4 and Table 4.4) representing all ecoregions (Figure 11.1). The PAs fall entirely within the KBAs. The coastal region has three wetland sites of international importance, which support both freshwater biodiversity and threatened bird species (NBSAP 2011).[53] The coastal habitats also support five of the seven known species of marine turtles and are rich in marine invertebrates and marine flora.

The rainforests of the coastal hinterland benefit from heavy monsoonal rains and support an array of large mammal species, including tiger, leopard, and Asian elephant. Dominant semi-evergreen forests and bamboo stands provide habitats for a large number of avian and flora species. The Rakhine Basin is home to the Rakhine Yoma Elephant Range, which protects the largest remnant population of wild Asian elephants in Myanmar (Box 8).

Much of the montane forest area below about 2,500 m has been deforested.[54] Pressures from agriculture and aquaculture have destroyed much of the natural mangrove and forest habitats. Large mammals in the region are threatened by the illegal wildlife trade.

Box 8. Rakhine Coastal Basin PA: Rakhine Yoma Elephant Range

Background: The Rakhine Yoma Elephant Range is situated in Thandwe and Gwa townships and covers an area of 1,756 km^2 (Istituto-Oikos, 2011). The PA was gazetted in 1997, lies in the southern part of the Rakhine Yoma mountain range, and is vegetated primarily by bamboo brakes, and evergreen and mixed deciduous forest. The site is represented by the *Mizoram-Manipur-Kachin rain forests* ecoregion.

Why it is important: The site provides protection for the largest remnant population of wild Asian elephants (150 animals) in Myanmar, as well as eight other mammal species, the critical/endangered native Rakhine forest turtle (*Heosemys depressa*), and 123 avian species (Istituto-Oikos, 2011).

Current situation: The annual management plan is not implemented, and conflict between the local communities and elephants outside of the PA has been documented (Istituto-Oikos, 2011). Current resources are inadequate for site management with more rangers, boats, motorbikes and infrastructure needed (Istituto-Oikos, 2011). The Spatial Monitoring and Reporting Tool (SMART) designed to facilitate patrolling by rangers has been implemented in the reserve (MoECF 2014).

Drivers of changes and key trends: Conservation of the Asian elephant is the main purpose of the reserve but elephants are hunted at the site for trade (MoECF 2015; Istituto-Oikos, 2011). Other key threats include hunting of gaur, barking deer, Malaysian sun bear, and otter; and poison fishing within the reserve. The reserve is being encroached by shifting cultivation and removal of trees for charcoal production (Istituto-Oikos, 2011).

11.2 Trends and drivers of change

Illegal logging and the wildlife trade are two of the main pressures on this basin. Conversion to agriculture and aquaculture, and fuelwood collection remain a threat for mangrove wetlands and inland rainforest ecosystems. Wildlife trade in the region continues to pose threats for threatened wildlife species.[55] Remaining intact forest covers a significant 26.8% of the basin (Table 11.2, Figure 11.2). Although 3.4% of intact forest was lost between 2002 and 2014 (Table 11.2), the rate of loss has been increasing since the turn of the century with an escalation in the past decade, and especially as a percentage of intact forest in the smaller Surma-Meghna basin (Figure 11.3). Degraded forests cover 50.6% or 28,161km^2 of the basin (Table 11.2).

[53] NBSAP (2011) National Biodiversity Strategy and Action Plan, Myanmar. UNEP. URL: https://www.cbd.int/doc/world/mm/mm-nbsap-01-en.pdf
[54] Myint, S.W. (2016). Deforestation in Myanmar—Land and Atmospheric Effects. URL: http://lcluc.umd.edu/sites/default/files/lcluc_documents/Deforestation_Soe_Myint.pdf. Accessed on 18 May 2017
[55] Hanoi Conference on Illegal Wildlife Trade (2016). URL: http://iwthanoi.vn/wp-content/themes/cites/template/statement/Hanoi%20Statement%20on%20Illegal%20Wildlife%20Trade.pdf. Accessed on 18 May 2017

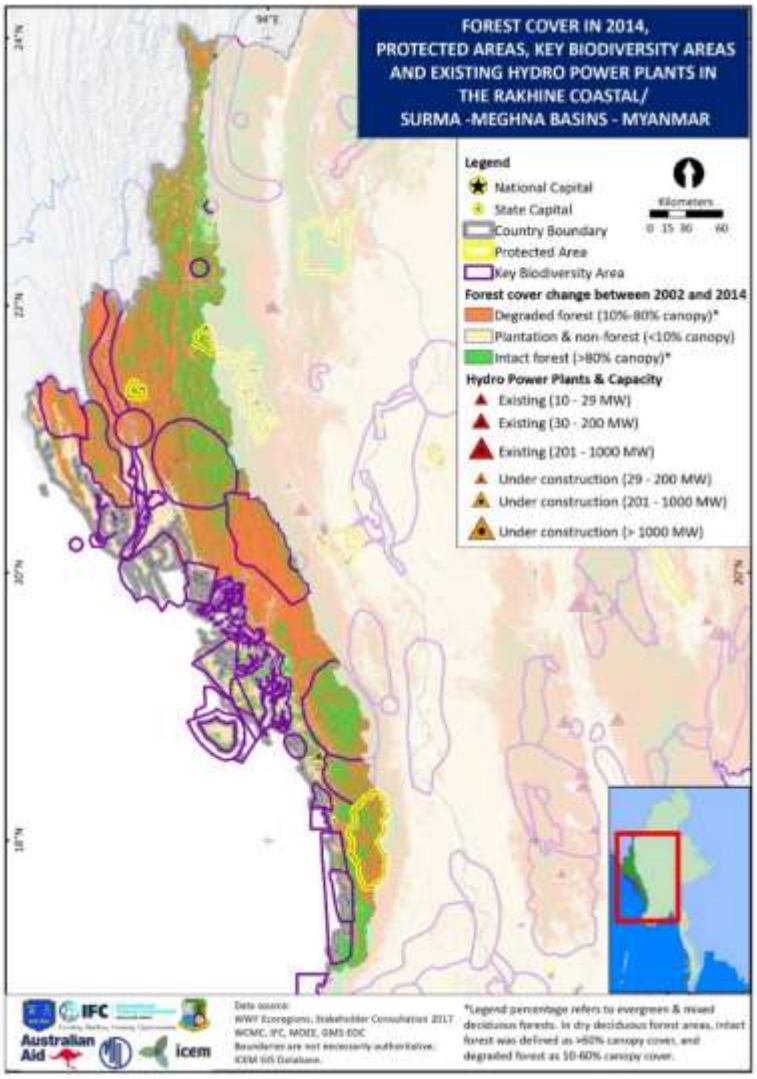
Table 11.2: Area of intact, degraded, and changed forest cover in the Rakhine Coastal/Surma-Meghna Basins

Land cover category	% cover Rakhine Coastal Basins/ Surma-Meghna	Area (km^2) Rakhine Coastal Basins/ Surma-Meghna
Intact forest (>80% canopy)	26.8	14,917
Degraded forest (10-80% canopy)	50.6	28,161
Plantation & non-forest (<10% canopy)	21.2	11,781
Other (eg. open water, urban)	1.5	832
Total	100	55,691

Land cover category	% cover Rakhine Coastal Basins/ Surma-Meghna	Area (km^2) Rakhine Coastal Basins/ Surma-Meghna
Intact forest (>80% canopy)	26.8	14,917
Changed forest cover	3.4	1,881
Degraded regions	68.3	38,064
Other (eg. open water, urban)	1.5	829
Total	100	55,691

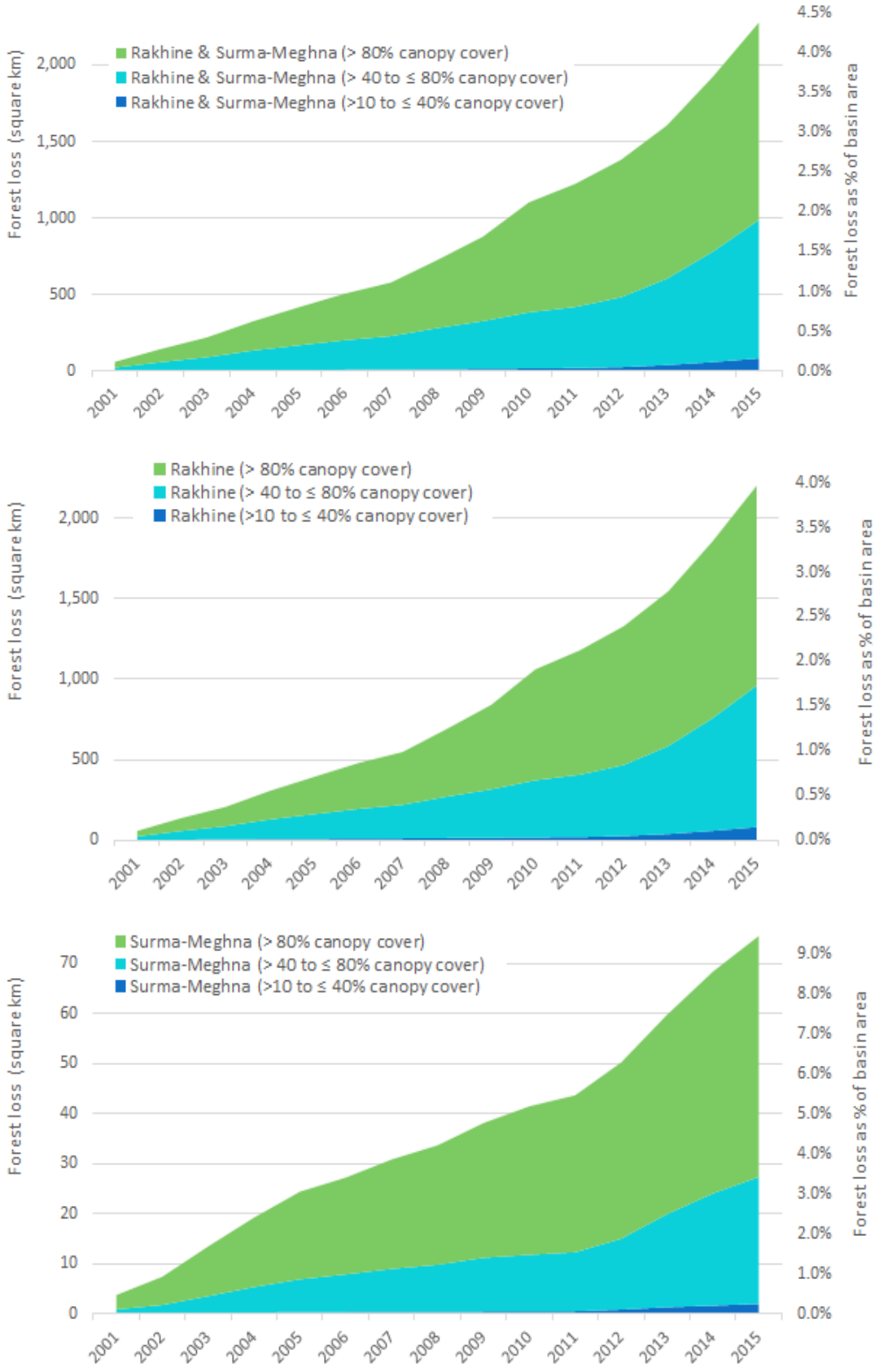
Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 11.2: Forest cover in the Rakhine Coastal/Surma-Meghna Basins in 2014



Source: ICEM analysis of data from Myanmar Forest Cover Change 2002-2014 (2016) study

Figure 11.3: Loss of forest in the Rakhine Coastal/Surma-Meghna basins from 2000 to 2015



Source: ICEM analysis of data from Hansen et al. 2013

11.3 Trends in summary

In summary:

(i) *The presence of large mammal species, including tiger, leopard, and Asian elephant make the remaining biodiversity areas within this basin a high priority for conservation.*
(ii) *Protected areas cover only 8% of the identified KBAs within the basin.*
(iii) *Illegal logging and the wildlife trade are ongoing pressures on biodiversity.*
(iv) *Agriculture, aquaculture and fuelwood collection pose threats to coastal and inland rainforest ecosystems.*

12. SUB-BASIN ASSESSMENT

12.1 Ranking process

Each of the eight basins assessed in the previous sections of this chapter were further divided into 58 sub-basins for more detailed analysis, with each sub-basin ranked according to biodiversity values. Biodiversity values were calculated based on the percentage area of each basin covered by KBAs and intact forest (greater than 80% canopy cover). A score of 1 to 5 was applied to each sub-basin for both KBA and intact forest coverage and the total divided by 2. The final terrestrial biodivesity ranking of each sub-basin is a value from 1 (very low value) to 5 (very high value) (Table 12.1). Table 12.2 lists the twelve sub-basins identified with the highest biodiversity values of 4 or 5 and Table 12.3 details the inputs to the ranking process.

Table 12.1: Scores applied to percentage cover of both KBA and intact forest by sub-basin

Scoring	Percentage cover
1	0-20%
2	21-40%
3	41-60%
4	61-80%
5	80-100%

Some sub-basins might not have a high ranking when considering just KBA and intact forest coverage. But they may be associated with critical/endangered ecoregions. In those situations, as for the highly ranked sub-basins, development must proceed with the upmost caution in case pockets of the ecoregion persist or rehabilitation is feasible. The critical/endangered ecoregions in Myanmar are listed in Table 12.4. Sub-basins with critical/endangered ecoregions are identified along with any existing protected areas they might support (Table 12.2).

A map of the 58 sub-basin boundaries together with intact forests, KBAs, existing Protected Areas and critical/endangered ecoregions appears as Figure 12.1. The 21 sub-basins containing any coverage of critical/endangered ecoregions are listed in Table 12.5. Of those, 16 have biodiversity rankings of 3 or less.

Table 12.2: Sub-basins with biodiversity values of 4 or 5 and associated protected areas and critical/endangered ecoregions

No.	Basin	Sub basin	Biodiversity value	PA (km^2)	% PA	Critical/endangered ecoregion (km^2)	% ecoregion
1	Chindwin	Chindwin Headwater 1	5	5568	93	0	0
2	Chindwin	Chindwin Headwater 2	5	5687	73	0	0
3	Headwater Ayeyarwady	Nmae Hka	5	4795	27	3543	20
4	Headwater Ayeyarwady	Mali Hka	5	5177	22	0	0
5	Tanintharyi	Tanintharyi	5	455	3	0	0
6	Headwater Ayeyarwady	Naw Chang Hka	5	0	0	934	39
7	Rakhine/Surma-Meghna	Kyein Ta Li HPP	4	746	70	14	1
8	Rakhine/Surma-Meghna	Than Dwe HPP	4	428	31	42	3

No.	Basin	Sub basin	Biodiversity value	PA (km^2)	% PA	Critical/endangered ecoregion (km^2)	% ecoregion
9	Chindwin	Upper Chindwin	4	6951	30	0	0
10	Rakhine/Surma-Meghna	Thatay	4	273	21	14	1
11	Chindwin	Uyu	4	127	1	0	0
12	Tanintharyi	Glohong Kra HPP	4	0	0	0	0

Table 12.3: KBA and intact forest inputs to calculation of sub-basin rankings

No.	Basins	Sub basins	Basin area (km^2)	KBAs (km^2)	% KBAs	KBAs Score	Intact forest	% Intact forest	Intact forests score	Biodiversity value
1	Chindwin	Chindwin Headwater 1	5977	5977	100	**5**	5069	85	**5**	**5**
2	Chindwin	Chindwin Headwater 2	7813	7701	99	**5**	5624	72	**4**	**5**
3	Headwater Ayeyarwady	Nmae Hka	17501	16037	92	**5**	12268	70	**4**	**5**
4	Headwater Ayeyarwady	Mali Hka	23287	21098	91	**5**	16181	69	**4**	**5**
5	Tanintharyi	Tanintharyi	17865	15954	89	**5**	11439	64	**4**	**5**
6	Headwater Ayeyarwady	Naw Chang Hka	2401	2380	99	**5**	1486	62	**4**	**5**
7	Rakhine	Kyein Ta Li HPP	1061	893	84	**5**	344	32	**2**	**4**
8	Rakhine	Than Dwe HPP	1359	991	73	**4**	593	44	**3**	**4**
9	Chindwin	Upper Chindwin	23314	17122	73	**4**	17071	73	**4**	**4**
10	Rakhine	Thatay	1289	1158	90	**5**	482	37	**2**	**4**
11	Chindwin	Uyu	11440	6893	60	**4**	6697	59	**3**	**4**
12	Tanintharyi	Glohong Kra HPP	992	666	67	**4**	614	62	**4**	**4**

Table 12.4: Critical/endangered ecoregions in Myanmar

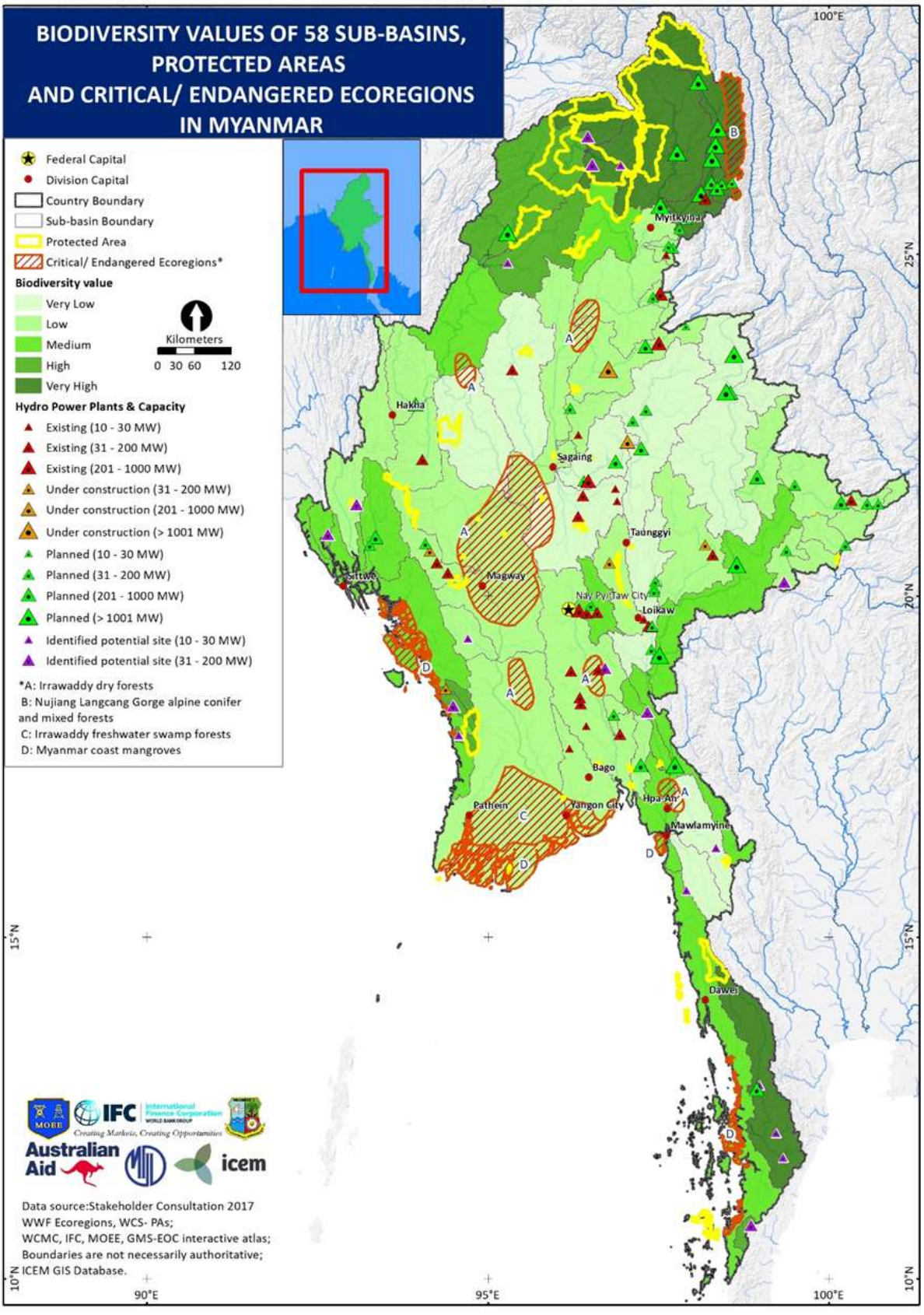
Ecoregion name	Area (km^2)	National area coverage (%)
Irrawaddy dry forests	35,023	5.2
Nujiang Langcang Gorge alpine conifer and mixed forests	4,495	0.7
Irrawaddy freshwater swamp forests	15,101	2.3
Myanmar Coast mangroves	15,863	2.4

No.	Basins	Sub basins	Biodiversity values	PA (km^2)	% PA	Critical ecoregion (km^2)	% ecoregion

1.	Headwater Ayeyarwady	Nmae Hka	5	4795.1	27.4	3542.5	20.2
2.	Headwater Ayeyarwady	Naw Chang Hka	5	0.0	0.0	934.4	38.9
3.	Rakhine	Than Dwe HPP	4	427.6	31.5	41.8	3.1
4.	Rakhine	Kyein Ta Li HPP	4	746.1	70.3	13.9	1.3
5.	Rakhine	Thatay	4	273.0	21.2	13.9	1.1
6.	Rakhine	Other Rakhine Coastal Basins	3	254.8	1.0	4002.8	15.5
7.	Tanintharyi	Other Tanintharyi Coastal Basins	3	1437.6	5.5	1269.2	4.9
8.	Thanlwin	Lower Thanlwin	3	45.5	0.3	1227.3	8.8
9.	Chindwin	Middle Chindwin	3	0.0	0.0	516.0	3.6
10.	Lower Ayeyarwady to Delta	Delta	2	136.5	0.3	24825.6	46.8
11.	Lower Ayeyarwady to Delta	Lower Ayeyarwady	2	919.0	2.5	19037.6	51.3
12.	Middle Ayeyarwady 2	Middle Ayeyarwady mainstem	2	127.4	0.7	3933.0	21.9
13.	Bago	Bago	2	9.1	0.1	2384.9	23.2
14.	Sittaung	Other Sittaung	2	209.3	0.7	1520.2	5.3
15.	Middle Ayeyarwady 1	Upper Ayeyarwady mainstem	2	91.0	0.5	962.3	5.4
16.	Middle Ayeyarwady 2	Shweli	2	182.0	1.4	725.2	5.5
17.	Lower Ayeyarwady to Delta	Mone Chaung	2	445.8	7.5	195.3	3.3
18.	Middle Ayeyarwady 2	Zawgyi/ Myogyi	1	373.1	2.3	3040.4	18.6
19.	Chindwin	Lower Chindwin	1	1419.4	8.5	1366.8	8.2
20.	Thanlwin	Lam Pha HPP	1	209.3	2.3	571.8	6.4
21.	Middle Ayeyarwady 2	Mu	1	263.9	1.3	69.7	0.4

Table 12.5: Sub-basins containing critical/endangered ecoregions.

Figure 12.1: Intact forests, Key Biodiversity Areas, existing Protected Areas and critical/endangered ecoregions in the 58 sub-basins



12.2 Summary

(i) *Twelve of 58 sub-basins were assigned the highest biodiversity values of 4 or 5 – only five of those include critical/endangered ecoregions.*
(ii) *Sixteen additional sub-basins of the 58 with scores of 3 or less have potential to retain pockets of critical/endangered ecoregions*
(iii) *Sub-basins of the northern Ayeyarwady and Chindwin basins, and Tanintharyi basin, dominate the highest rankings (value of 5).*
(iv) *The biodiversity significance of the Rakhine/Surma-Meghna basin is highlighted by three of its sub-basins being assigned a biodiversity value of 4, all including Protected Areas and critical/endangered ecoregions. Sub-basins of the Chindwin and Tanintharyi were similarly ranked with a value of 4.*
(v) *Critical ecosystems are poorly representated in the protected areas network.*

13. CONCLUSIONS

This chapter focusing on terrestrial biodivesty compliments the chapter on Fisheries and Aquatic Ecology. The objective was to draw on existing infromation and fresh analysis to establish an evidence base for defining areas of the country with biodiversity of international importance requiring due consideration in the project site selection process and special management and safeguards.

The assessment has identified specific areas within sub-basins and larger scale corridors which are of special significance. These high priority areas are based on an analysis of ecoregion status, protected area location and importance, Key Biodiversity Area location and importance, and the ecosystem services these areas provide. This assessment will benefit from ongoing refinement of biodivesrity areas through consultation with government agencies and NGOs working in the field, as part of the ongoing SEA process.

There is no doubt that some regions are of such outstanding significance that development decisions affecting them must be made with the upmost care and caution. Those areas inlcude the upper Chindwin and Ayeyarwady basins and forest complex, the Tanintharyi Forest Corridor, and the Salween Forest Corridor.

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ANNEX 1: CATEGORIES USED FOR FOREST COVER MAPS AND GRAPHS

A1.1 Forest cover maps

The forest cover maps in this chapter were derived from data used in the *Myanmar Forest Cover Change (2002-2014)* study (2016)[56], using the three main categories as follows (also refer to Figures A1.1 and A1.2 for more details):

(i) "Intact forest (>80% canopy cover)" which corresponds to "Intact Forest" in Table A1.1.

(ii) "Degraded forest (10-80% canopy)" which corresponds to the two categories - 'Degraded Forest', and "New Degraded Forest' in Table A1.1.

(iii)"Plantations and non-forest (<10%)' is an aggregation of data from "Non-Forest", "New Non-Forest", "Plantations", "New Plantations" from Table A1.1.

Table A1.1: The 'Final Land Cover Classification' table from the Myanmar Forest Cover Change (2002-2014) report (p. 8).

Category	Description
Intact Forest	>80% canopy cover in evergreen & mixed deciduous forests; >60% canopy cover in dry deciduous forests*
Degraded Forest	10-80% canopy cover in evergreen & mixed deciduous forests; 10-60% canopy cover in dry deciduous forests
New Degraded Forest	Intact Forest in 2002 to degraded forest in 2014
Non-Forest	<10% canopy cover
New Non-forest	Intact Forest in 2002 to <10% canopy cover in 2014
Plantations	All types of tree plantations
New Plantations	Intact Forest in 2002 to plantation in 2014
Oil Palm Plantations	Oil palm plantation (Tanintharyi Region only)
New Oil Palm Plantations	Intact Forest in 2002 to oil palm plantation in 2014 (Tanintharyi Region only)
Mining	Mining Areas (Kachin State and Sagain Region only)
New Mining	Intact Forest in 2002 to mining in 2014 (Kachin State and Sagaing Region only)
Water	Rivers, Flooded river beds, flooded rice paddies, lakes & reservoirs
New Water	Reservoirs, changes in rivers, and hydro-electric projects
Snow or ice	Snow or ice at high elevation
**Dry deciduous forests are a rare and endangered forest type in Southeast Asia and are characterized by open companies. To ensure inclusion of these forests in the intact forest category, canopy cover cut-off was decreased to 60% for some areas covering southern Sagaing region and western-central Shan State where dry deciduous forests are common*	

A1.2 Graphs of forest cover in 2014

The categories used in these plots are the same as for the forest cover maps described above.

A1.3 Graphs of forest cover change from 2002 to 2014

The categories aggregated were as follows (refer to Figures A1.1 and A1.2 for more details):

(i) 'Changed forest' represents the loss of 'intact forest' which is the aggregation of 'new plantations', new degraded forest', 'new non-forest', and 'new water'.

(ii) 'Degraded regions': 'degraded forest', 'plantations' and 'non-forest'.

[56] Myanmar Forest Cover Change: 2002-2014. This report is based on a manuscript and data prepared by: Tejas Bhagwat, Andrea Hess, Ned Horning, Thiri Khaing, Zaw Min Thein, Kyaw Moe Aung, Kyaw Htet Aung, Paing Phyo, Ye Lin Tun, Aung Htat Oo, Anthony Neil, Win Myo Thu, Melissa Songer, Katherine LaJeunesse Connette, Asja Bernd, Grant Connette, and Peter Leimgruber. Entitled: "Losing a Jewel-Rapid Declines in Myanmar's Intact Forests from 2002-2014. " In review, submitted February 2016

Figure A1.1: Schematic diagram of categories of forest and other land use categories in the Myanmar Forest Cover Change (2002-2014) report.

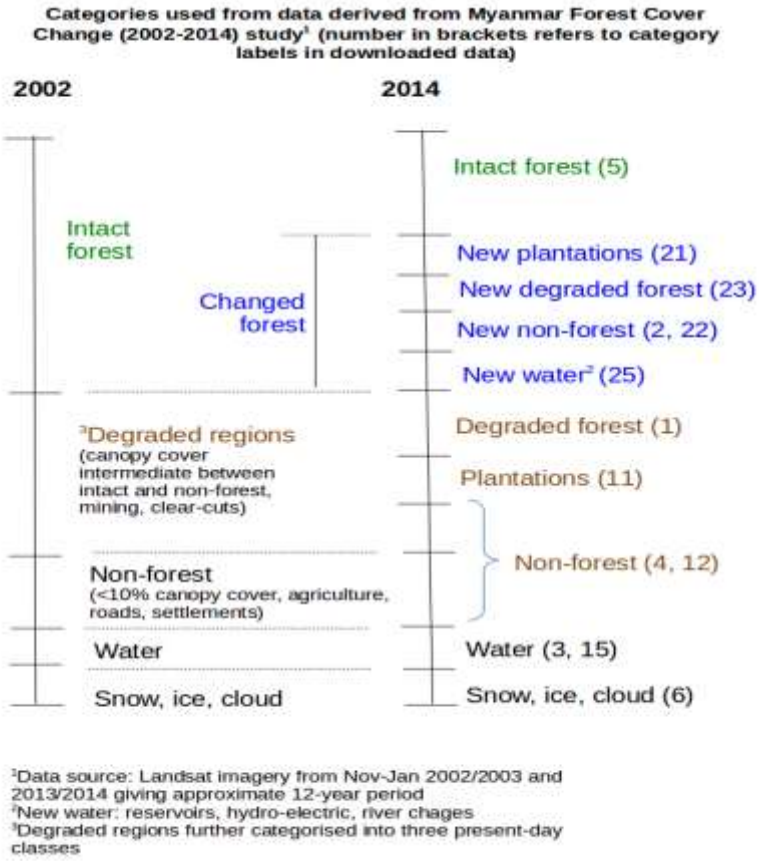

Figure A1.2: Assignment of data (see description of labels in Fig A1.1) to the analysis of forest cover

Data labels	Categories
5	Intact forest (>80% canopy)*
2,21,22,23,25	Changed forest cover**
1,11,4,12	Degraded regions
3,6,15	Other (eg. open water, urban)
	Categories
5	Intact forest (>80% canopy)*
2, 4, 11, 12, 21, 22	Plantation & non-forest (<10% canopy)
1, 23	Degraded forest (10-80% canopy)
3,6,15,25	Other (eg. open water, urban)

A1.4 Graphs of annual cumulative forest loss

For each basin, a line plot of cumulative forest loss from 2000 to 2014 is included. Plots of annual cumulative loss of forest by basin, where forest loss is determined for open canopy, and medium-

closed canopy cover, and intact forest, were derived from data created by Hansen et al. (2013).[57] The canopy cover metrics adopted for these plots are based on those from the Myanmar Global Forest Resources Assessment 2015,[58] and Myanmar Forest Cover Change (2002-2014) report.[59,60] In this study, the term 'open forest' refers to forest with greater than 10% and less than or equal to 40% canopy cover; 'medium-closed forest' has a canopy cover of more than 40% and less than or equal to 80%; and 'intact forest' has greater than 80% canopy cover. The term 'medium-closed' canopy cover is used rather than 'closed' canopy cover (as defined in the Myanmar Forest Resources Assessment) as this helps better describe the three categories of canopy cover presented in this study: open, medium-closed, and intact forest.

[57] Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

[58] FAO (2015) Global forest resources assessment 2015, Country report, Myanmar. URL: http://www.fao.org/3/a-az283e.pdf

[59] The Myanmar Forest Cover Change (2002-2014) report comes from a manuscript and data prepared by: "Tejas Bhagwat, Andrea Hess, Ned Horning, Thiri Khaing, Zaw Min Thein, Kyaw Moe Aung, Kyaw HtetAung, Paing Phyo, Ye Lin Tun, Aung Htat Oo, Anthony Neil, Win Myo Thu, Melissa Songer, Katherine LaJeunesse Connette, Asja Bernd, Grant Connette, and Peter Leimgruber. Entitled: 'Losing a Jewel—Rapid Declines in Myanmar's Intact Forests from 2002-2014.' In review, submitted February 2016".

[60] Data from Myanmar Forest Cover Change (2002-2014) study are accessible at ftp://glcf.umd.edu/glcf/Myanmar_ForestChange/

ANNEX 2: PROTECTED AREAS IN MYANMAR

Figure A2.1: Protected Areas in Myanmar (refer to Table A2.1 for PA details)

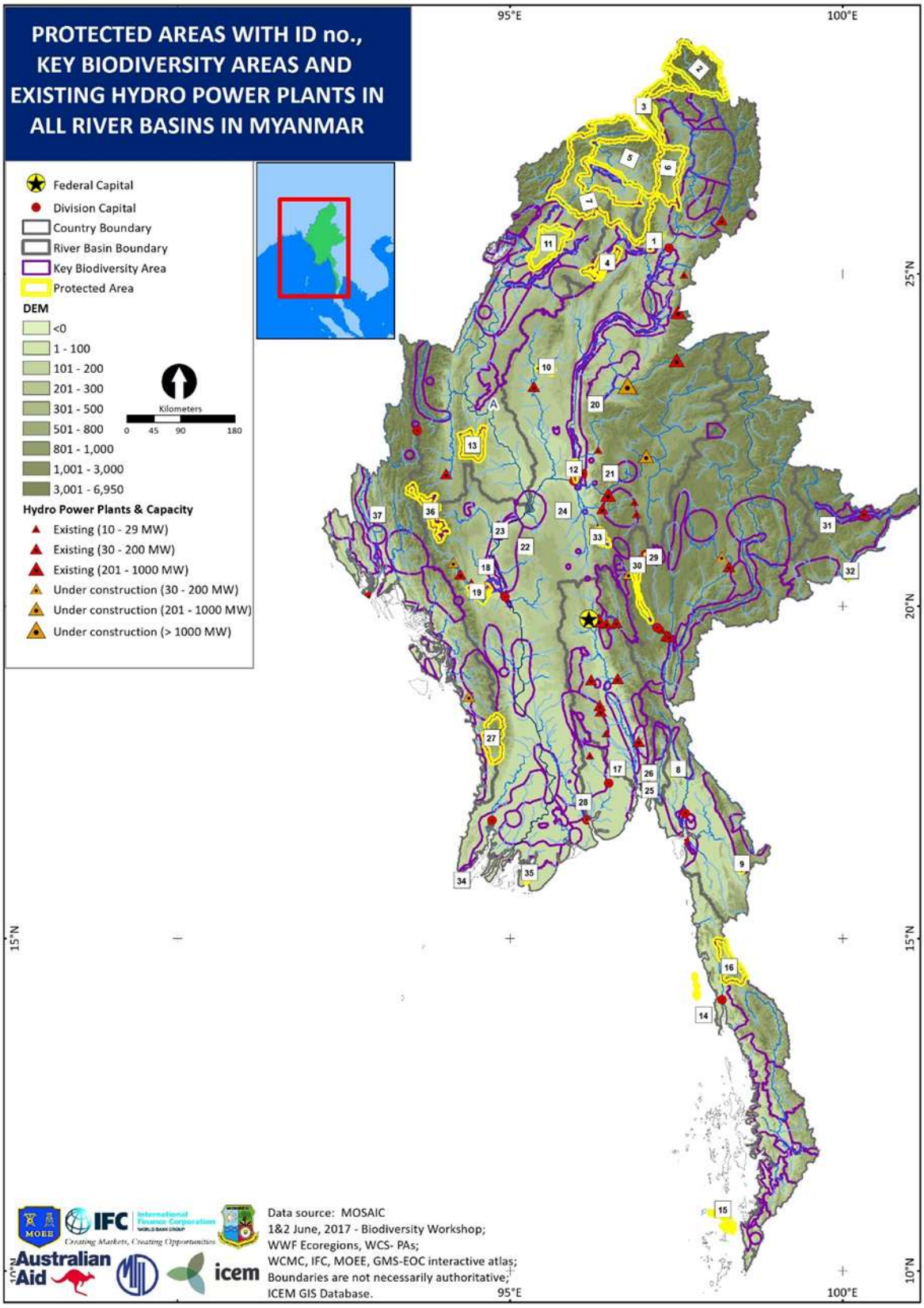

Table A2.1: Protected Areas in Myanmar

ID	Name	Level	Est-year	Location	Managed by	Mgt_status	Con_Value	Area (km^2)	Staff_no	Status
1	Pidaung W.S	Wildlife Sanctuary	1927	Kachin State	NWCD	Staffed	13%	150	9	Notified
2	Hkakaborazi N.P	National Park	1996	Kachin State	NWCD	Staffed	25%	4,313	12	Notified
3	Hponkanrazi W.S	Wildlife Sanctuary	2003	Kachin State	FD			2,804	0	Notified
4	Indawgyi W.S	Wildlife Sanctuary	2004	Kachin State	NWCD	Staffed	27%	737	11	Notified
5	Hukaung Valley W.S	Wildlife Sanctuary	2004	Kachin State	NWCD	Staffed		6,484	16	Notified
6	Bumhpabum W.S	Wildlife Sanctuary	2004	Kachin State	FD			2,940	0	Notified
7	Hukaung Valley W.S(Extension)	Wildlife Sanctuary	2010	Kachin State/Sagaing Division	NWCD	Staffed		11,351	0	Notified
8	Kahilu W.S	Wildlife Sanctuary	1928	Kayin State	FD			127	0	Notified
9	Mulayit W.S	Wildlife Sanctuary	1939	Kayin State	FD			214	0	Notified
10	Chatthin W.S	Wildlife Sanctuary	1941	Sagaing Division	NWCD	Staffed		284	34	Notified
11	Htamanthi W.S	Wildlife Sanctuary	1974	Sagaing Division	NWCD	Staffed	14%	2,186	21	Notified
12	Minwuntaung W.S	Wildlife Sanctuary	1972	Sagaing Division	FD		24%	125	0	Notified
13	Alaungdaw Kathapa N.P	National Park	1989	Sagaing Division	NWCD	Staffed	66%	1,433	76	Notified
14	Moscos Kyun W.S	Wildlife Sanctuary	1927	Taninthayi Division	FD			57	0	Notified
15	Lampi Island Marine N.P	National Park	1996	Taninthayi Division	FD		15%	274	10	Notified
16	Taninthayi N.R	Nature Reserve	2005	Taninthayi Division	NWCD	Staffed		1,619	60	Notified
17	Moyungyi Wetland W.S	Wildlife Sanctuary	1988	Bago Division	NWCD	Staffed	32%	103	1	Notified
18	Wetthikan B.S	Bird Sanctuary	1939	Magwe Division	FD		18%	4	0	Notified
19	Shwesettaw W.S	Wildlife Sanctuary	1940	Magwe Division	NWCD	Staffed	61%	497	50	Notified
20	Shwe U Daung W.S	Wildlife Sanctuary	1929	Mandalay Division/Shan State	NWCD	Staffed	16%	183	13	Notified
21	Pyin Oo Lwin B.S	Bird Sanctuary	1927	Mandalay Division	FD		7%	77	0	Notified
22	Popa Mountain Park	Mountain Park	1989	Mandalay Division	NWCD	Staffed	52%	98	95	Notified
23	Lawkananda W.S	Wildlife Sanctuary	1995	Mandalay Division	NWCD	Staffed	35%	0	13	Notified

ID	Name	Level	Est-year	Location	Managed by	Mgt_status	Con_Value	Area (km^2)	Staff_no	Status
24	Minzontaung W.S	Wildlife Sanctuary	2001	Mandalay Division	NWCD	Staffed	24%	17	10	Notified
25	Kelatha W.S	Wildlife Sanctuary	1942	Mon State	FD			25	0	Notified
26	Kyaikhtiyoe W.S	Wildlife Sanctuary	2001	Mon State	NWCD	Staffed	36%	137	14	Notified
27	Rakhine Yoma Elephant Range	Elephant Range	2002	Rakhine State	NWCD	Staffed	35%	1,714	22	Notified
28	Hlawga Park	Wildlife Park	1989	Yangon Division	NWCD	Staffed	56%	6	0	Notified
29	Taunggyi B.S	Bird Sanctuary	1920	Shan State	FD		12%	70	0	Notified
30	Inlay Wetland W.S	Wildlife Sanctuary	1985	Shan State	NWCD	Staffed	42%	554	17	Notified
31	Loimwe P.A	Protected Area	1996	Shan State	FD		6%	43	0	Notified
32	Parsar P.A	Protected Area	1996	Shan State	FD		14%	117	0	Notified
33	Panlaung Pyadalin Cave W.S	Wildlife Sanctuary	2002	Shan State	NWCD	Staffed		349	13	Notified
34	Thamihla Kyun W.S	Wildlife Sanctuary	1970	Ayeyarwady Division	FD		24%	2	0	Notified
35	Mainmahla Kyun W.S	Wildlife Sanctuary	1993	Ayeyarwady Division	NWCD	Staffed	41%	145	17	Notified
36	Natmataung N.P	National Park	2010	Chin State	NWCD	Staffed	37%	1,100	24	Proposed
37	Kyaukpantaung W.S	Wildlife Sanctuary	2001	Chin State	FD			129	0	Notified

ANNEX 3: KEY BIODIVERSITY AREAS IN MYANMAR

Figure A3.1: Key Biodiversity Areas in Myanmar (refer to Table A3.1 for KBA names and areas)

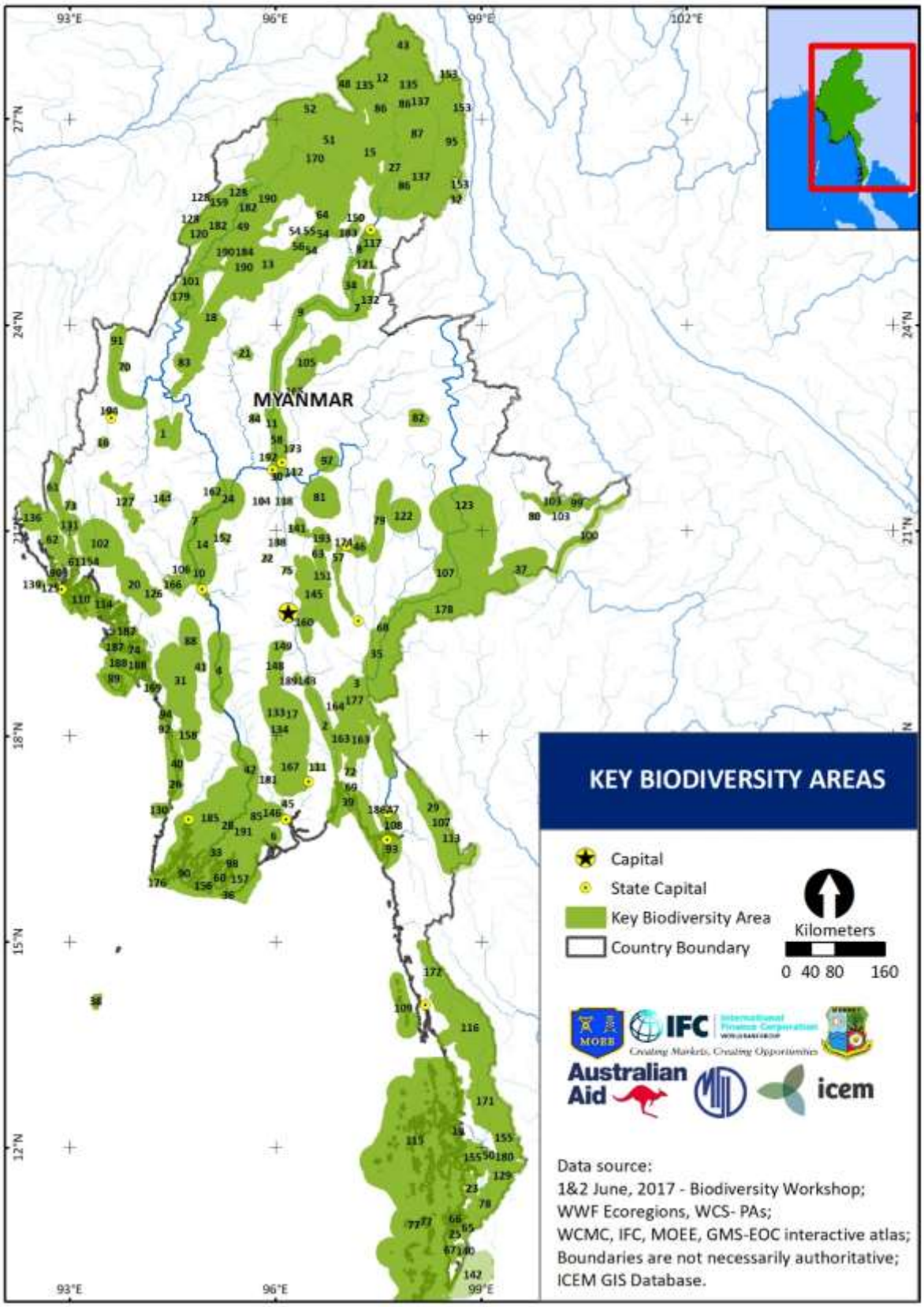

Table A3.1: Key Biodiversity Areas

No.	KBA Name	Area km^2	No.	KBA Name	Area km^2	No.	KBA Name	Area km^2	No.	KBA Name	Area km^2
1	Alaungdaw Kathapa	1426.2	50	Htaung Pru	288.6	99	Mekong Fish Migration Area	846.1	148	Phokya and North Zarmani Corridor	1213.5
2	Along Sittaung Valley	1831.6	51	Hukaung Valley	10212.8	100	Mekong freshwater KBA	2203.6	149	Phokyar Elephant Camp	100.4
3	Around Pan thi taung Area	364.5	52	Hukaung Valley extension	11306.5	101	Middle Chindwin and associated wetland area	3883.9	150	Pidaung	150.0
4	Around Pyay, Myit Twe bird	3248.6	53	Important area for Ayeyawady Dolphin protected area	5545.3	102	Min Byar KBA	3706.4	151	Pinglong (Limestone Hills)	336.0
5	Ashe myin Anauk myin	116.2	54	Indaw Gyi Basin	1331.3	103	Mine wa Dam watershed	763.0	152	Popa	97.9
6	Ayeyarwaddy Coastal Forest	415.4	55	Indawgyi Grassland and Indaw Chaung Wetland	253.2	104	Minzontaung	16.7	153	Proposed Imawbum National park	701.3
7	Ayeyarwady River: Bagan Section	574.8	56	Indawgyi Wildlife Sanctuary	737.6	105	Momeik-Mabein	2825.3	154	Pyaungbya River	152.3
8	Ayeyarwady River: Myitkyina to Sinbo Section	580.1	57	Inle Lake	555.5	106	Mone Chaung	14.2	155	Pyi Gyi Man Daing Corridor	3657.5
9	Ayeyarwady River: Shwegu Section	373.5	58	Irrawaddy Dolphin	333.5	107	Mongton	1911.9	156	Pyin-ah-lan	293.8
10	Ayeyarwady River: Sinbyugyun to Minbu Section	538.3	59	Kadongalay Island	10.2	108	Mont Zwekabin	194.7	157	Pyindaye	1320.7
11	Ayeyarwady River: Singu Section	62.6	60	Kadonkani	864.2	109	Moscos Kyun	2247.1	158	Rakhine Yoma Elephant Range	1706.1
12	Babulon Htan	1904.1	61	Kaladan River	1815.5	110	Mounth of Kaladan River KBA	2178.4	159	Saramati Taung	1062.2
13	Banmauk	2707.0	62	Kalatan Watershed KBA	1739.6	111	Moyingyi	103.5	160	Shan Yoma, Paung Laung NPT & Taunggu Watershed	974.3
14	Important area for birds	4441.6	63	Kalaw Limestone Hills	285.4	112	Myaleik Taung	37.1	161	Sheinmaga Tawyagyi	0.4
15	Bumphabum	2951.1	64	Kamaing	398.2	113	Myawaddy	543.8	162	Shinmataung	24.3
16	Bwe Pa	150.3	65	Kara River KBA	468.7	114	Myebon	685.6	163	Shwe kyin & Bawgada watershed	1709.2
17	Central Bago Yoma	3943.8	66	Karathuri	239.9	115	Myeik Archipelago	44267.2	164	Shwe kyin and Paung Laung corridor	681.6
18	Central Sagaing Forest	5563.5	67	Kawthaung District Lowlands	414.1	116	Myinmoletkhat	8209.6	165	Shwe U Daung	183.1
19	Central Tanintharyi Coast	1421.0	68	Kayah Limestone	363.0	117	Myitkyina-Nandebad-Talawgyi	556.3	166	Shwesettaw	493.9
20	Central Yakine Yoma KBA	2893.4	69	Kelatha	25.2	118	Myittha Lakes	37.2	167	South part Watershed of Bago Yoma range	4165.0
21	Chatthin	283.6	70	Kennedy Peak	107.5	119	Nadi Kan	37.4	168	Southern Mon Limestone Hills	50.7
22	Chaungmagyi Reservoir	37.4	71	Khaing Thaung Island	14.3	120	Nagaland	803.0	169	Spoon bill, PA	256.5
23	Chaungmon-Wachaung	511.7	72	Kyaikhtiyoe	137.7	121	Nam Sam Chaung	460.0	170	Tanai River	636.9
24	Chindwin-Ayeyarwaddy Myitsone	2245.3	73	Kyauk Pan Taung	127.8	122	Nam San Valley	2014.8	171	Taninthayi National Park	3702.8
25	Coastal and Mangrove protected area (PA)	355.6	74	Kyaukphyu (Wunbike)	2562.8	123	Namsam Mountain Region	7878.3	172	Taninthayi Nature Reserve	1631.6

No.	KBA Name	Area km^2	No.	KBA Name	Area km^2	No.	KBA Name	Area km^2	No.	KBA Name	Area km^2
26	Coastal area between Gwa and Thandwe	1450.5	75	Kyee-ni Inn	37.5	124	Nan Thalet Chaung	129.2	173	Taung Kan at Sedawgyi	37.0
27	Confluence of May Kha and Maylikha Region,	4420.0	76	Kyunsu KBA	6.8	125	Nantha Island	96.6	174	Taunggyi	70.7
28	Crain protected area	5694.5	77	Lampi Island	276.1	127	Natmataung (Mount Victoria)	1092.0	175	Taungtaman Inn	6.5
29	Dawna Range	4750.1	78	Lenya	1879.8	126	Nat-yekan	159.1	176	Thamihla Kyun	85.3
30	Dry Zone wetlands of central Ayeyarwaddy	45.4	79	Loilen Ridge	1780.0	128	Ngaga mountain Range	885.7	177	Thanlwin Peace Park	5160.5
31	Eastern Rakhine Yoma KBA	4753.0	80	Loimwe	43.6	129	Ngawun (Lenya extension)	1873.1	178	Thanlwin Southern Forest	9792.6
32	Fen-shui-ling Valley	145.3	81	Lower Dokhtawaddy Watershed Forest	2588.3	130	Ngwe Saung	408.8	179	Thaungdut	323.6
33	Fish migratory project Area	10319.3	82	Lwoilin/Ginga Mountain	551.7	131	Ngwe Taung	725.8	180	Theinkhun Stream KBA	179.8
34	Freshwater KBA Sinbo Bhamo River section	719.0	83	Mahamyaing	1198.9	132	Ninety-six Inns	536.0	181	U-do	5.3
35	From Namsam to Wei Gyi	5836.2	84	Mahanandar Kan	77.9	133	North Zarmayi	99.1	182	Upper Chindwin River: Kaunghein to Padumone	603.7
36	Gayetgyi Island	13.2	85	Maletto Inn	386.1	134	North Zarmayi Elephant Range	710.4	183	Upper Mogaung Chaung Basin	188.3
37	Golden Triangle Area	3794.1	86	Mali Hka freshwater KBA	4326.5	135	Northern Mountain forest complex	2581.3	184	Uyu River	843.1
38	Great Coco Island	160.0	87	Mali Hka Area	5160.0	136	Northern Rakhine Yoma	1288.8	185	Warkalma	550.0
39	Gulf of Mottama	5098.8	88	Man Chaung	1794.7	137	NpMai Hka freshwater KBA	1324.8	186	Western part of Thanlwin River, limestone caves	152.0
40	GWA Island MPA	596.8	89	Manaung Kyun	1926.5	138	Nyaung Kan-Minhla Kan	37.4	187	Yan Byal Island	1592.6
41	Gyobin	160.3	90	Mangrove ecosystem protected area	3811.0	139	Oyster Island	78.9	188	Yanbywe Kyun KBA Extension	314.3
42	Hinthada	2044.0	91	Manipur River freshwater KBA	2463.7	140	Pachan	279.8	189	Yay Thoe Reservoir	104.4
43	Hkakaborazi	4360.9	92	Maw She	220.9	141	Panlaung Pyadalin Cave	349.6	190	Yebawmi	1719.5
44	Hlawga Park	6.0	93	Mawlamyine	90.6	142	Parchan River Transboundary PA	3290.1	191	Yelegale	82.9
45	Hlawga Reservior	23.2	94	Mawyone Extension KBA (Thabyuchyne)	221.5	143	Pathi Chaung	111.2	192	Yemyet Inn	41.6
46	Hopoung	469.9	95	May Hka Area	10068.6	144	Pauk Area	193.7	193	Ywangan Limestone Hills	581.0
47	Hpa-an	115.8	96	May Yu	307.1	145	Paung Laung Catchment Area	3703.6	194	Zeihmu Range	79.9
48	Hponkanrazi	2830.7	97	Mehon (Doke-hta Wady River)	882.9	146	Payagyi	709.6			
49	Htamanthi	5521.6	98	Meinmahla Kyun	136.2	147	Peleik Inn	37.1			

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