

Mainstreaming of Biodiversity Conservation into River Management

Landscape Analyses and the Identification of Riparian Conservation Priority Areas

Overview

To better understand the landscape of the Segama River catchment and the issues surrounding riparian forests and biodiversity conservation within this region, we undertook a number of landscape studies. These are preliminary described below and include: (1) a land use and land cover study for the catchment accompanied by developing a land title ownership spatial layer; (2) a detailed riparian study; (3) we then used these to hone into identifying potential sites for the project to focus on, and (4) we then selected four sites to focus on and undertook initial ground-truthing surveys in these sites (See Appendix Five) to better understand the main issues and opportunities.

1. Land Use and Land Cover Analysis and Land Title Ownership

Land use and land cover data were developed for the Segama catchment to better understand the varying land use types and conservation opportunities present within the landscape. This was a first port of call in enabling us to identify conservation priority areas. To do this, we used high resolution true colour imagery (i.e. SPOT 5 & 6 at 1.5 meter resolution) from the years 2014 and 2015 and supplemented by extracting and georeferencing more recent imagery from [GoogleEarth](#) where available. Using such high resolution imagery enabled us to develop a detailed and comprehensive land use and land cover map of various categories, which we present here in **Figure 1** and **Table 1**.

Furthermore, to enable us to understand the corporate stakeholders within the Segama catchment we used available cadastral data that was ascertained from the Land and Survey Departments online platform (<http://www.ituwma.net/>) in January 2017. Through online searches for company information and reports, and by using the GeoRSPO online platform (<https://rspo.org/members/georspo>) we collated company and concession level data and incorporated these information into the cadastral layer thereby enabling us to start to understand the key stakeholders within the catchment. This database will be continuously improved as new information becomes available.

The total area of the Segama catchment is 467,950 hectares, making up 6.32% of Sabah's land mass. Within this catchment, we identified that a significant proportion is under forest cover estimated at around 334,181 hectares or 71.4% of the catchment (**Table 1**). Of this total forest extent almost all (i.e. 97.4%) is within the various protected areas. These protected areas are, however, located to the far eastern and western regions of the catchment (**Figure 1**). To the east these protected areas include: Class I Protection Forest Reserves (Kuala Segama & Kuala Meruap, Mount Hatton, Sungai Maruap, and Sungai Segama Forest Reserves), Class VI Virgin Jungle Reserves (Dagat, Kretam and Tabin Forest Reserves), Class VII Wildlife Reserves (Kulamba and Tabin Wildlife Reserves), as well as Wildlife Conservation Areas. To the west the protected areas include many Class I Protection Forest Reserves (i.e. Danum Valley, Bukit Piton, Malua, Mount Louisa, Mount Magdalena, Northern Gunung Rara, Northern Kuamut, Sapagaya, Sungai Taliwas and Ulu Segama Forest Reserves), as well as Class VI Virgin Jungle Reserves (Kawag Gibong, Merisuli and Sepagaya Forest Reserves).

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

Outside of these protected areas, however, there is very little forest remaining. We identified in the region of 8,399 ha of unprotected forest, of varying forest types and forest quality and that includes riparian forest also (regardless of size/width) (**Table 1**). However, it is likely that there is less forest today given that this estimate corresponds to satellite imagery, largely, for the years 2014 and 2015. Updating of these analyses will be done as and when new imagery comes online. Securing these remaining forests under some kind of protection is paramount to maintaining biodiversity conservation values in this landscape.

The rest of the region is heavily dominated by oil palm which comprises around 128,535 ha or 27.47% of the catchment (**Table 1**). Of this extent, the majority (i.e. 121,530 ha or 94.55% of the total extent of oil palm) is within large commercial estates. To date, we have identified 21 oil palm companies who are land holders within the Segama catchment, which amounts to around 58% of the oil palm extent identified within large commercial estates (see **Table 2**). The main oil palm companies identified are RSPO members and include Hap Seng Plantations Holdings Bhd, Wilmar (PPB Oil palms Bhd) and IOI Corporation Bhd that collectively total 34% of the oil palm identified within large commercial estates in the Segama catchment (**Table 2**); thus these three corporations alone manage a significant area of the oil palm landscape in the Segama.

Apart from the large commercial oil palm estates, there were also medium sized growers and smallholdings. These, however, only comprise around 5.45% of the oil palm landscape demonstrating the dominance of large oil palm corporations in the catchment. In many cases it was difficult to understand whether the oil palm identified was under a medium sized grower or under smallholdings. Nevertheless, we estimated that in the region of 485 ha is under medium sized growers, 2,142 ha is under either medium sized growers or smallholdings, and a further 4,377 ha is under smallholdings (**Table 1**).

A key finding for this project is that we identified over 2,600 ha of underproductive or failed oil palm, mostly within the large commercial estates (**Table 2**). These areas are associated with seasonal flooding and low lying swamps. Oil palm is intolerant of prolonged flooding and waterlogged areas that cause root rot that can lead to the palms producing small low yielding fruits or in many cases cause the palms to die. These underproductive or failed oil palm areas were likely once seasonal freshwater swamp forest, freshwater swamp forest or mangrove forest and unless land holders invest significant flood prevention systems, these areas have little commercial value to companies or smallholders. This means that crucial riparian and freshwater swamp forests have, in the past, been converted to oil palm for no significant economic gain but have likely caused biodiversity loss.

In addition to smallholdings, there are ten villages within the Mid-Segama catchment, and we have endeavoured to identify the extent of these community areas within the landscape; along with other land use types identified such as agroforestry, large/buildings and factories, a potential golf course and mining (**Table 1**).

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

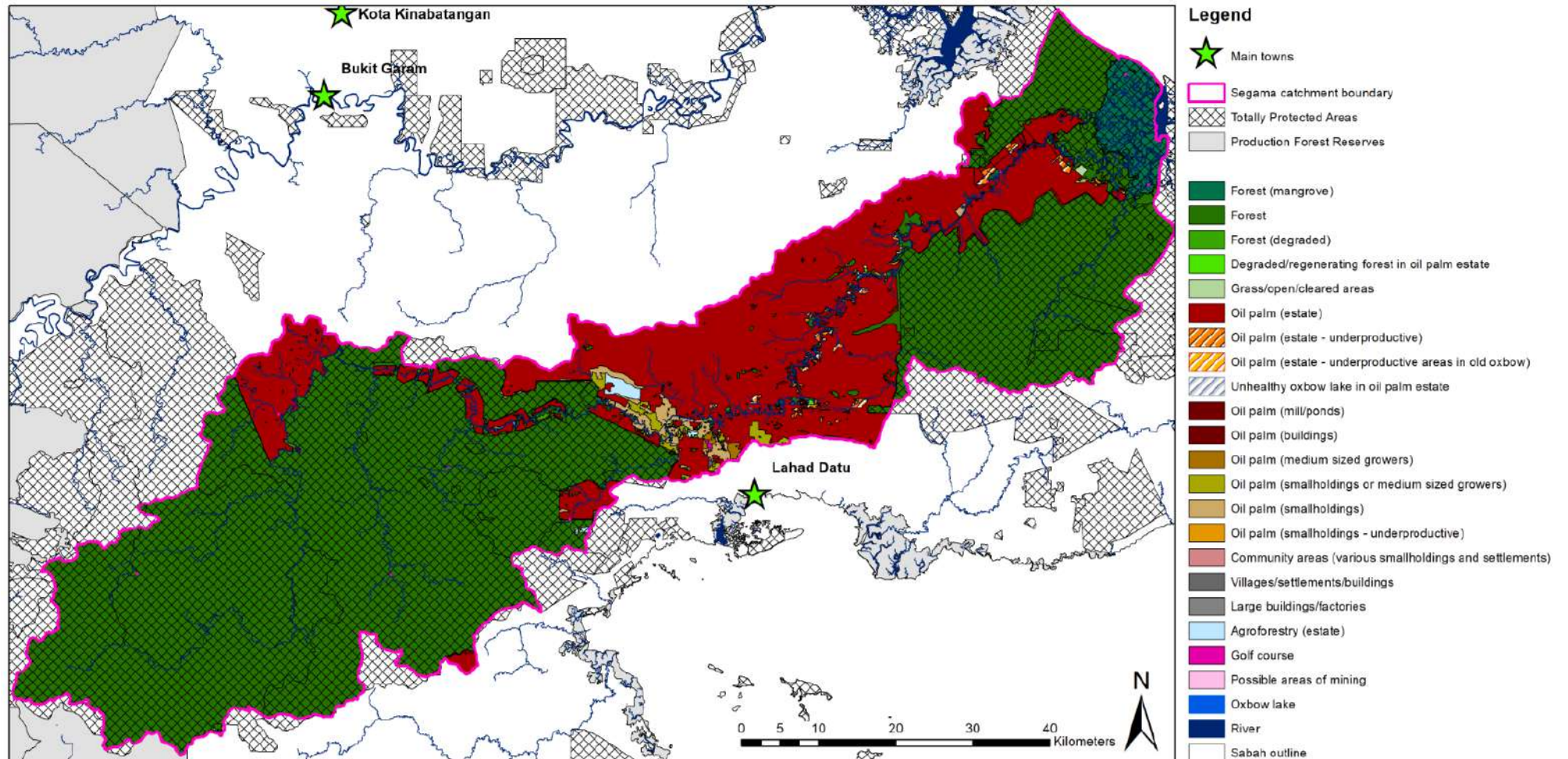


Figure 1 (Appendix Two): Map showing the results of the land use and land cover analysis undertaken within the Segama catchment boundary (pink line) with the majority (71.4%) of the region being under forest cover (green) largely within various protected areas (cross hatch), with the extent outside of protected areas being dominated by oil palm (27.5%) that is mostly within commercial oil palm estates.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

Table 1 (Appendix Two): Summary table of the land use and land cover analysis undertaken within the Segama catchment boundary.

Land Use Land Cover Type	Hectares	Proportion (%) per type	Proportion (%) in wider category
Forest (mangrove) within TPA	9,705	2.07	
Forest (generic)/degraded forest within TPA	316,078	67.55	
Forest (mangrove) outside of TPA	499	0.11	71.41
Forest (generic)/degraded forest outside of TPA	7,727	1.65	
Forest (degraded/regenerating in oil palm estate)	173	0.04	
Grass/open/cleared areas	393	0.08	0.08
Oil palm (estate)	118,740	25.37	
Oil palm (estate – underproductive/failed)	2,608	0.56	
Unhealthy oxbow lake in oil palm estate	28	0.01	
Oil palm (mill/ponds and other buildings)	155	0.03	27.47
Oil palm (medium sized growers)	485	0.10	
Oil palm (smallholdings or medium sized growers)	2,142	0.46	
Oil palm (smallholdings)	4,330	0.93	
Oil palm (smallholdings – underproductive/failed)	47	0.01	
Community areas (various smallholdings and settlements)	53	0.01	0.01
Village/settlement/buildings	154	0.03	
Large buildings/factories	82	0.02	
Agroforestry (estate)	1,021	0.22	0.28
Golf course	55	0.01	
Mining	9	0.00	
River and healthy oxbow lakes	3,466	0.74	0.74
TOTAL AREA	467,950	100.00	100.00

Note: TPA = Totally Protected Areas

Table 2 (Appendix Two): Findings from our land title ownership study to identify corporate stakeholders within the Segama catchment.

RSPO certified	Company name	Number of hectares within Segama catchment	Number of hectares with planted oil palm within Segama catchment
Certified	Hap Seng Plantations Holdings Bhd	22,466	22,148
Certified	Wilmar (PPB Oil Palms Bhd)	10,477	10,011
Certified	IOI Corporation Bhd	8,761	8,707
Uncertified/certified	Boustead Plantations Bhd	6,951	6,822
Uncertified	Sawit Kinabalu Sdn Bhd	6,898	6,829
Unknown	Tradewinds Plantation Bhd	5,100	4,999
Unknown	TAMACO Plantations	3,605	3,601
Uncertified	Kwantas Corporation Berhad	2,236	2,195
Uncertified	FELDA Global Ventures Holdings Bhd	2,177	2,176
Unknown	Atlantic Plantations Sdn Bhd	1,985	1,966
Uncertified	Teck Guan Holdings Sdn Bhd	1,277	1,253
Certified	Kuala Lumpur Kepong Berhad	940	940
Certified	Lam Soon Plantations Sdn Bhd	693	693
Unknown	Khoo Ching Hung	432	165
Unknown	KHL Plantation Sdn Bhd	331	327
Uncertified	Kretam Holdings Berhad	283	283
Unknown	Kak Plantation (Sabah) Sdn Bhd	192	46
Unknown	Pertasa Plantation Sdn Bhd	72	72

Uncertified	N.Y Hiew (Holdings) Sdn Bhd	19	19
Certified	Carotino/ JC Chang Group	12	12
Certified	Genting Plantations Bhd	8	8
TOTAL AREA		74,916	73,273

2. Riparian Analysis of the Segama River

To better understand the landscape within the mid to lower Segama River that is dominated by oil palm estates, as well as communities, we undertook a nuanced riparian study along 288 km of the main Segama River (see **Figure 2**). To do this, we measured (in kilometres) the length of riparian forest of differing widths (measured in width categories in meters) to better understand where and how much riparian is present along the main river. When riparian forest was absent the main land use type within 20 meters from the river bank was taken and recorded.

Along the circa 288.5 km length analysis of the mid to lower Segama, we identified 107.6km (or 37%) of the riparian analysis length on the north bank and around 67km (or 23%) on the south bank that had no riparian forest zone at all. In fact, within these areas oil palm were planted up until the river bank with most of these areas occurring in oil palm estates, as well as next to smallholdings (**Table 3**). For areas that did have riparian zones, these riparian forests ranged in width, with most being the legally required 20m, however, riparian widths of 40m, 60m, and over 100m were commonly identified along the north and south banks (**Table 3**). In many cases, these wider riparian forests were observed when land titles were tens of meters away from the river edge. Meaning, this is a key lesson for issuing land titles. To ensure good riparian forests do not alienate land titles near to rivers.

One key observation from these land use and land cover and riparian analyses is that while three quarters (71.4%) of the Segama catchment is under forest less than one third (32.8%) of the riparian falls within such forests (**Table 1** and **Table 3**). This is because the fertile floodplain soils that once supported mega-diverse lowland forests in the Mid-Segama have now been allocated to oil palm and the large and world class Protected Areas in the catchment lie mostly in the hills of the Ulu Segama headwaters and in the Lower Segama mangrove delta, or at any rate away from the river. Importantly, however, we found that there is still unprotected forest along some sections of the Mid-Segama riparian. While only 2.64% of the forest remaining in Segama Catchment as a whole is outside of the Totally Protected Areas, one third (32.4%) of the riparian that is within forests lies within unprotected forest (**Table 3**).

This finding highlights the potency of this riparian project: (1) how riparian (especially oil palm) lands are treated has an outsize impact, and, (2) there is still time to make significant conservation impacts by protecting and connecting forest patches with restored riparian zones.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

Table 3 (Appendix Two): Summary table for the riparian analysis 288.6km of the Segama River.

Categories	Calculation for the North Bank			Calculation for the South Bank		
	km	%	%/km	km	%	%/km
Riparian forest within TPA	58.84	20.39	-	84.13	29.15	-
Riparian within larger unprotected forest	22.06	7.64		24.26	8.41	
Riparian (40m) next to TPA	-	-		0.91	0.32	
Riparian (60m) next to TPA	-	-		0.77	0.27	
Riparian (100m) next to TPA	-	-		0.01	0.00	
Riparian (+100m) next to TPA	-	-		0.27	0.09	
Riparian (10m) next to OPE	3.44	1.19		1.33	0.46	
Riparian (20m) next to OPE	34.28	11.88		17.78	6.16	
Riparian (40m) next to OPE	9.74	3.37		34.67	12.01	
Riparian (60m) next to OPE	15.86	5.50	38.48%	22.30	7.73	43.05%
Riparian (80m) next to OPE	3.54	1.23	or	9.46	3.28	or
Riparian (100m) next to OPE	4.80	1.66	111 km	3.31	1.15	124 km
Riparian (+100m) next to OPE	7.90	2.74		5.14	1.78	
Riparian (10m) next to OPS	0.24	0.08		0.54	0.19	
Riparian (20m) next to OPS	3.06	1.06		2.41	0.84	
Riparian (40m) next to OPS	4.85	1.68		0.56	0.20	
Riparian (60m) next to OPS	0.71	0.25		0.18	0.06	
Riparian (80m) next to OPS	-	-		0.05	0.02	
Riparian (100m) next to OPS	0.01	0.00		0.00	0.00	
Riparian (+100m) next to OPS	0.55	0.19		0.06	0.02	
Riparian (20m) next to OPSM	-	-		0.21	0.07	
Grass/open/cleared areas	7.70	2.67	3.63% or 10.49km	9.25	3.20	4.12% or 11.9km
Grass/open/cleared areas next to OPE	2.78	0.96		2.65	0.92	
Oil palm (estate)	86.71	30.05	37.28%	44.25	15.33	23.18%
Oil palm (estate - underproductive)	2.56	0.89	or	0.67	0.23	or
Oil palm (smallholdings & medium sized)	2.35	0.82	107.6km	0.72	0.25	66.9km
Oil palm (smallholdings)	15.96	5.53		21.26	7.37	
Mining	0.19	0.06	-	0.80	0.28	-
River	0.42	0.14	-	0.62	0.22	-
TOTAL LENGTH	288.54	100	-	288.60	100	-

Note: TPA = Totally Protected Areas; OPE = Oil palm estate; OPS = Oil palm smallholdings; OPSM = Oil palm smallholdings and medium sized growers

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

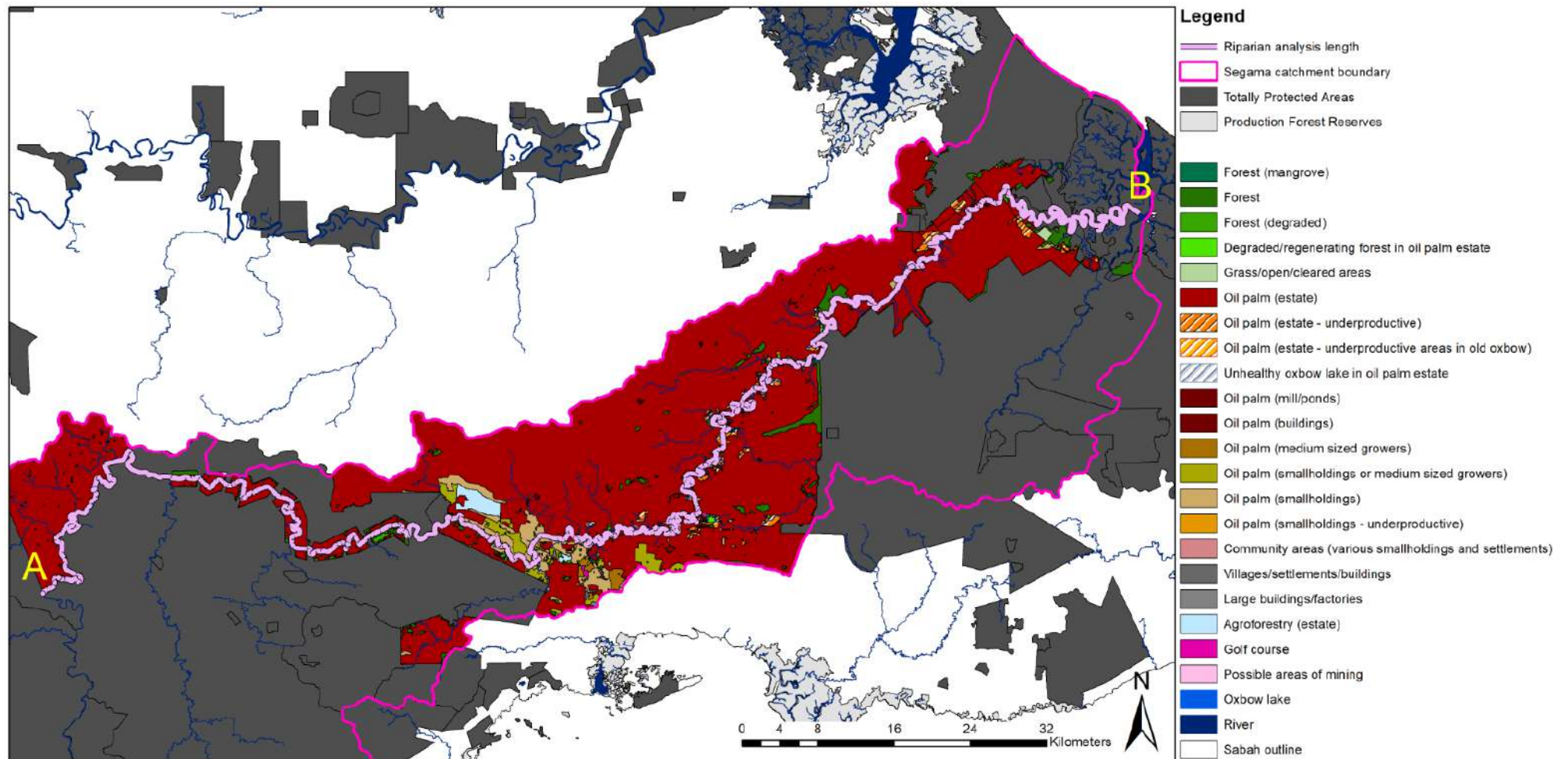


Figure 2 (Appendix Two): Land use land cover data within the Segama catchment overlaid with protected areas. The light purple line from point 'A' to 'B' shows the section of the Segama River (measuring circa 288 kilometres) where the riparian analysis was undertaken (using the land use and land cover data and the Totally Protected Area data) for the north bank and the south bank.

3. Preliminary Identification of Riparian Conservation Priority Areas

Through the development of the land use and land cover data and the riparian analyses, we initially identified ten sites that exemplified key issues and opportunities prevalent within the landscape. These ten sites are described in **Table 4** and shown in **Figure 3**.

Table 4 (Appendix Two): Summary table outlining the key issues, potential sites and the potential conservation opportunities and actions needed to facilitate biodiversity conservation within the Segama catchment.

Issue	Potential Sites	Opportunities
Absence of Riparian Zones with Oil Palm.	Lower-Mid Segama (Site 3), Mid-Segama (Site 7) and Upper-Segama (Sites 9 & 10) with large (IOI, Hap Seng,) and mid-size producers.	Consider how to ensure legal compliance of 20m riparian zone (currently only about half the river front is in compliance)
Large Degraded Area & Lack of Riparian Zone.	Lower-Mid Segama (Site 4) - Next to Hap Seng Plantation.	Restore 111 ha of degraded lands that are partially converted to oil palm smallholdings back to forest. Ensure riparian zone provides connectivity for proboscis monkeys.
Unprotected valuable forest patches (HCV). Lack of Riparian Zones. Lack of connectivity. Many areas of underproductive/failed oil palm because of planting on unsuitable (swamp) lands.	Lower-Mid Segama (Site 1) - Kg. Tidung, Kg. Dagat & Sri Balung (Khoo Ching Hung) & Hap Seng Plantations	Protect remaining forest patches. Deploy silviculture in degraded areas. Restore swamp forest in areas of underproductive oil palm.
	Lower-Mid Segama (Site 2) - Next to Hap Seng Plantation.	Protect 91ha of quality forest with ox-bow lake (proboscis monkey habitat); restore swamp forest in 230ha of failed oil palm; potentially reconnect (via tributary) to Kulamba Wildlife Reserve.
	Mid-Segama (Site 5) - Kg. Litang/Hap Seng & Wilmar Plantations/Tabin Wildlife Reserve	Conserve 670ha of forest around Kg. Litang and other forest patches up-river (at least 80ha) to connect to Tabin Wildlife Reserve. Explore community conservation & ecotourism. Restore 162 ha failed oil palm on estates & smallholdings
	Mid-Segama (Site 6) - Near to Tamaco Estate (north bank) & Wilmar (south bank); and other unknown estates.	Protect 81ha forest patch; restore swamp forest in failed oil palm; restore missing riparian buffer zones
Lack of Riparian Zones within Community Lands and Smallholdings.	Upper-Mid Segama (Site 9) - Private land parcel within Ulu Segama Forest Reserve	Conserve 252ha of forest and 139ha of degraded forest in island of alienated land with healthy riparian areas; connecting river to Ulu Segama Forest Reserve
	Upper-Mid Segama (Site 8) - Villages & smallholdings between Kg. Upak & Kg Segama Lama.	Identify & support indigenous innovations in riparian management as prototypes for best practices (shifting river banks, enrichment planting, restoration of old oil palm, encouraging natural regeneration etc.) to tackle 30-40% No Riparian Zone.

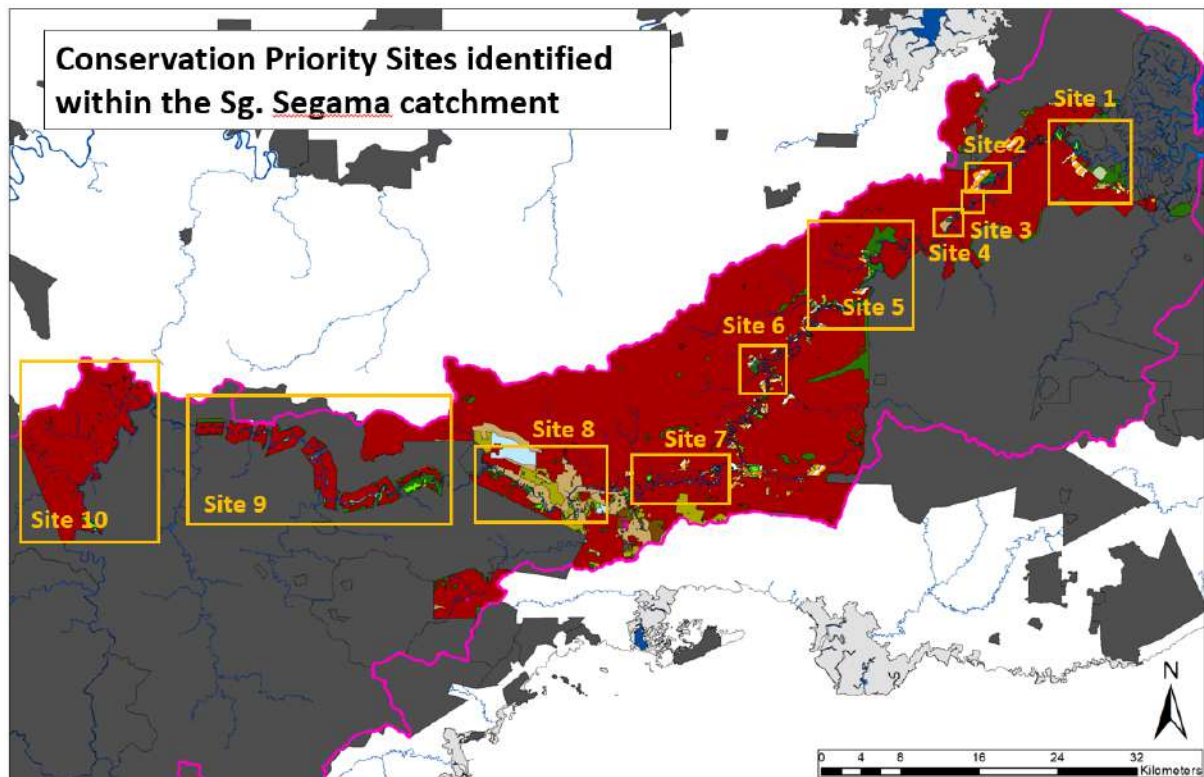


Figure 3 (Appendix Two): Ten initial sites identified through the use of the land use and land cover, as well as riparian analyses.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

4. Final Selection of Riparian Conservation Priority Areas & Initial Ground-Truthing

After internal discussions within the Forever Sabah team and then with Sabah's Drainage and Irrigation Department, four sites were selected for initial focus of this project. These sites include one or more of the key issues outlined in **Table 4** in order to allow us to start to proceed towards a series of strategic interventions to mainstream biodiversity in riparian management in the Mid-Segama. See **Table 5** and **Figure 4** for the final site descriptions and locations, as well as **Figure 5** through to **Figure 16** that show close up maps of the sites and some initial ground-truthing faunal data provided by the teams expedition from September 6th to 18th 2020.

Table 5 (Appendix Two): Summary table outlining the key issues present in the four selected sites and the conservation opportunities to facilitate biodiversity conservation within the Segama catchment.

Issues	Selected Sites	Opportunities
Unprotected valuable forest patches (HCV). Lack of Riparian Zones. Lack of connectivity. Many areas of underproductive/failed oil palm because of planting on unsuitable (swamp) lands	Lower-Mid Segama (Site 2) - Next to Hap Seng Plantation.	Protect 91ha of quality forest with ox-bow lake (proboscis monkey habitat); restore swamp forest in 230ha of failed oil palm; potentially reconnect (via tributary) to Kulamba Wildlife Reserve.
	Mid-Segama (Site 5) - Kg. Litang/Hap Seng & Wilmar Plantations/Tabin Wildlife Reserve	Conserve 670ha of forest around Kg. Litang and other forest patches up-river (at least 80ha) to connect to Tabin Wildlife Reserve. Explore community conservation & ecotourism. Restore 162 ha failed oil palm on estates & smallholdings
Absence of Riparian Zones within Oil Palm Estate	Lower-Mid Segama (Site 3) with large IOI.	Consider how to ensure legal compliance of 20m riparian zone (currently 6.6 km with no observed riparian).
Degraded Areas & Lack of Riparian Zones	Lower-Mid Segama (Site 2 & Site 3) Next to Hap Seng Plantation.	Identify areas that seem to have smallholdings to understand if areas being degraded/planted with oil palm are plantation workers or local communities. Possibly restore these areas back to forest/riparian to provide connectivity for proboscis monkeys.
Inadequate Riparian Zones within Community Lands and Smallholdings	Upper-Mid Segama (Site 8) - Villages & smallholdings between Kg. Upak & Kg Segama Lama.	Identify & support indigenous innovations in riparian management as prototypes for best practices (shifting river banks, enrichment planting, restoration of old oil palm, encouraging natural regeneration etc.) to tackle 30-40% No Riparian Zone.

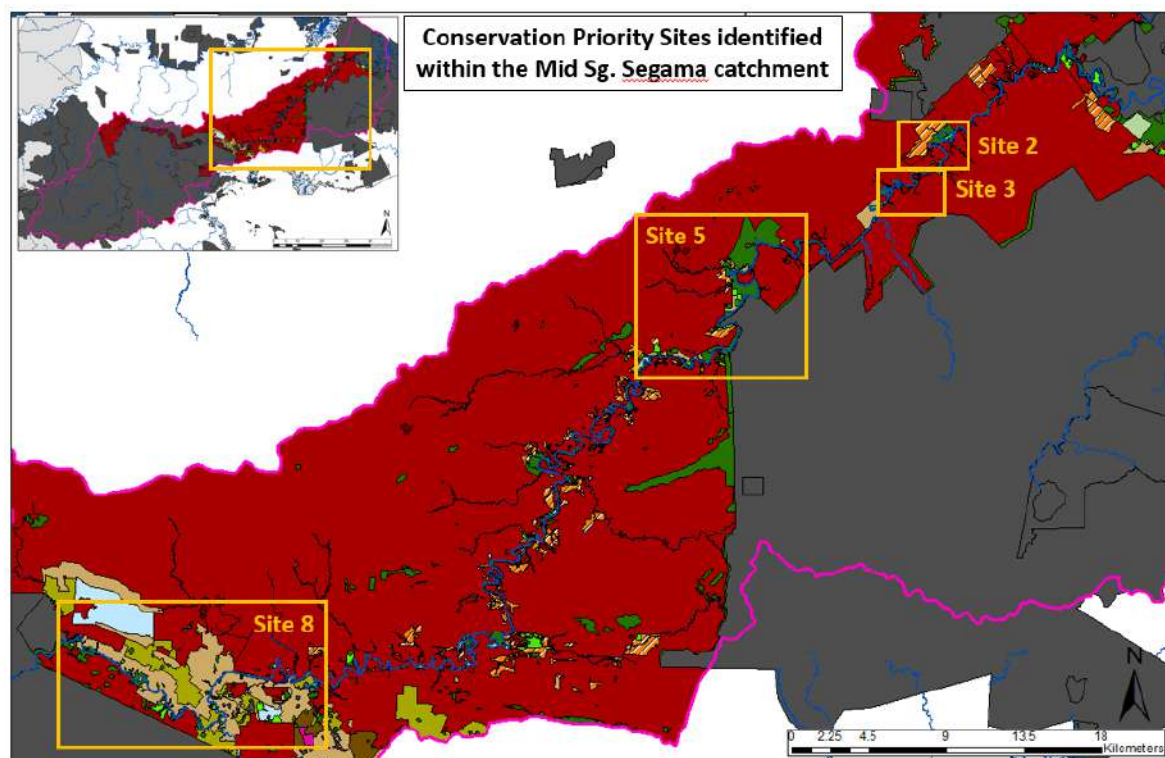


Figure 4 (Appendix Two): Location of the four sites selected for project implementation.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

Site 2: Aim to protect riparian forest of significant size (91 ha) and investigate reforestation of oil palm areas that are underproductive and that connect to protected areas

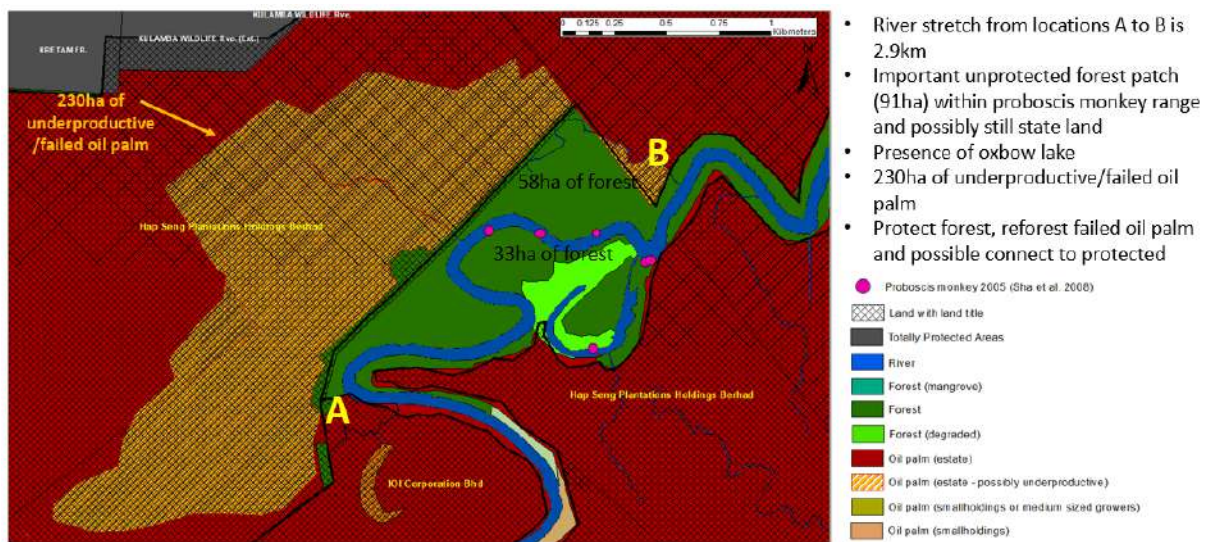


Figure 5 (Appendix Two): Map of site 2 accompanied by some key observations on riparian length, forest patch size and areas of underproductive/failed oil palm extent.

Maps of initial ground-truth data

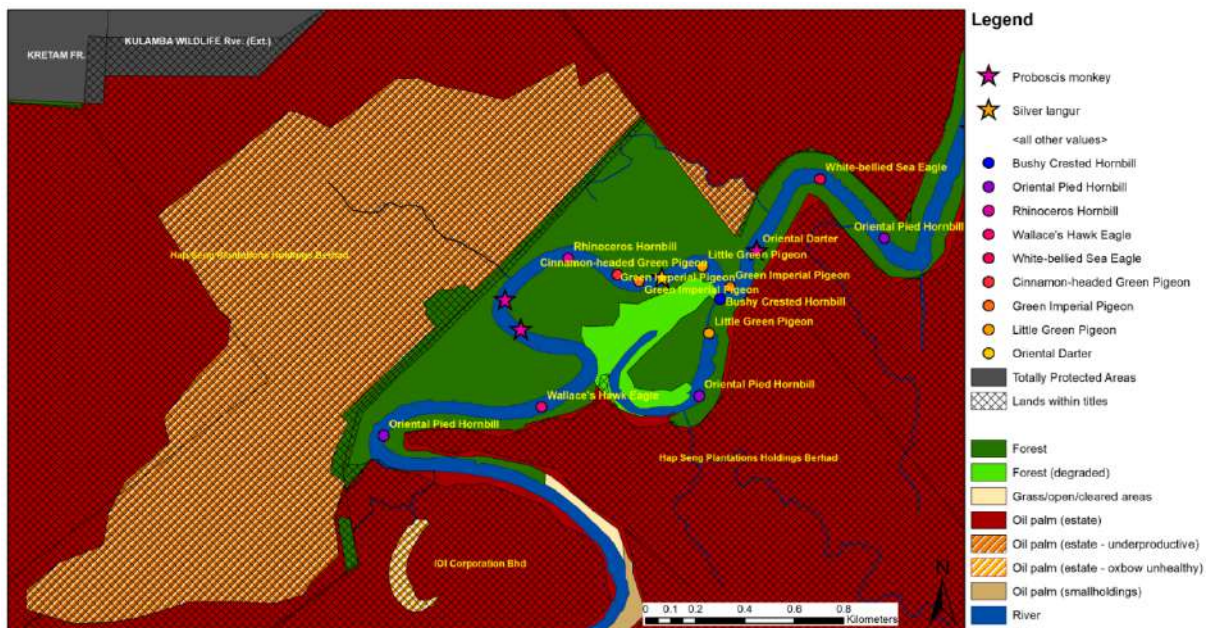


Figure 6 (Appendix Two): Map of site 2 with ground-truth data of mammals and birds of importance observed within the September expedition. A total of 12 bird species were observed in this site in the expedition.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

Site 3: Aim to work with stakeholders to establish long-term riparian corridors that are legally compliant and that serve proboscis monkey movements (connect populations)

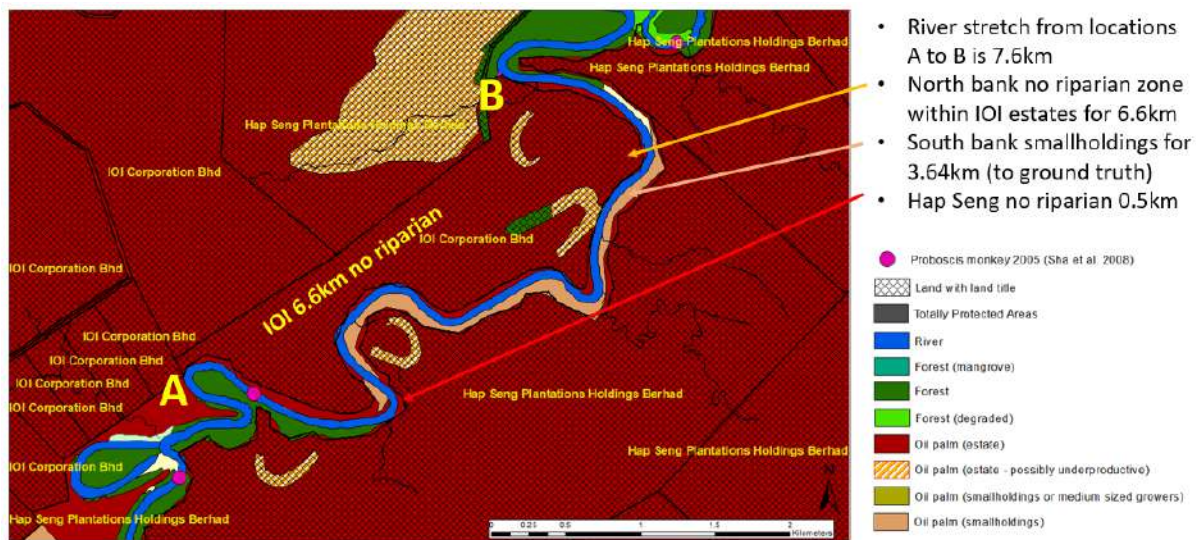


Figure 7 (Appendix Two): Map of site 3 accompanied by observations of the lack of riparian forest along some 6.6km of river bank within an IOI Corporation Bhd estate; along with initial observations of smallholdings in state land next to Hap Seng Plantations Holdings Bhd estate (thought to be workers from the RSPO certified estate).

Maps of initial ground-truth data

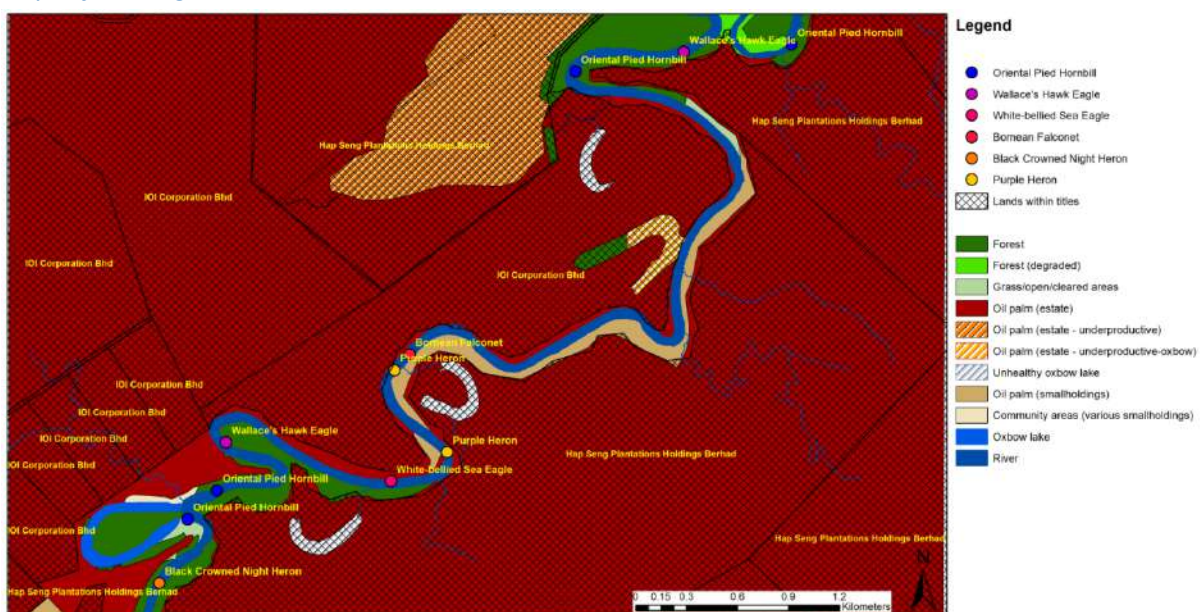


Figure 8 (Appendix Two): Map showing the birds of importance sighted in the September expedition. Fewer birds and no mammals of importance were observed in this site, likely due to the lack of forest and riparian areas. Nine bird species were observed in the September expedition. This site is a key bottleneck for proboscis monkey and other wildlife and is a site that require restoration of riparian forest to connect wildlife populations.

Site 5: Aim to protect and restore good networks of riparian forests and Tabin Wildlife Reserve and explore ICCA and eco-tourism ventures with Kampung Litang and others in biodiversity hotspot

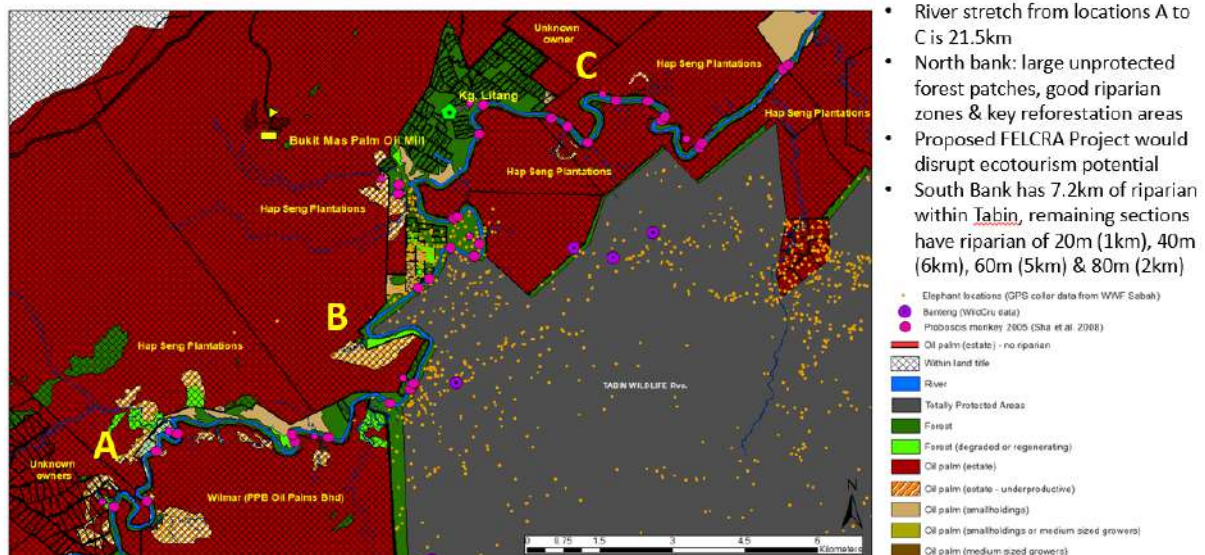


Figure 9 (Appendix Two): Zoomed out map of site 5 which is an important site as there is significant forest in this area on the north bank of the Segama River that harbours some of Sabah most threatened mammal species (Bornean elephant, Bornean orangutan and proboscis monkey). The forest is within community lands and has competing land uses imposed by government.

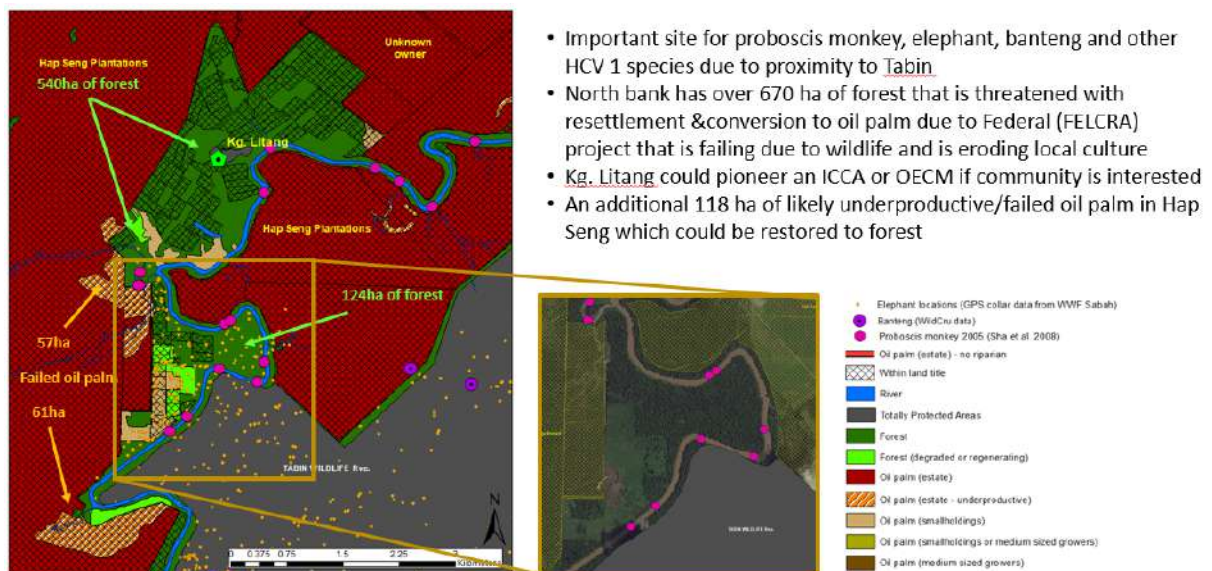


Figure 10 (Appendix Two): A zoomed in version of Figure 9 that shows some further details in the downstream section.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

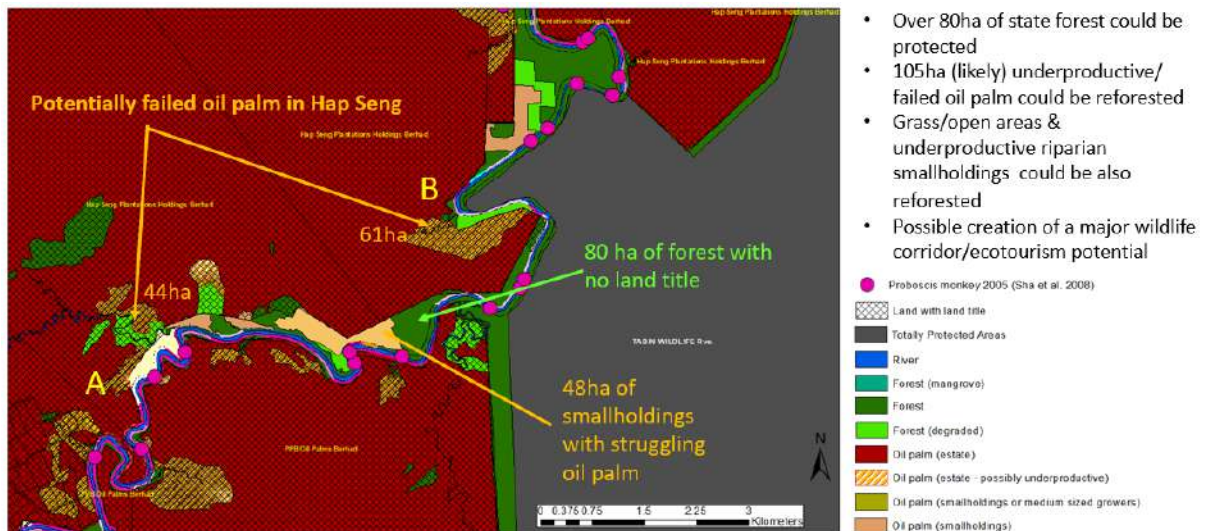


Figure 11 (Appendix Two): A zoomed in version of Figure 9 that shows some further details in the upstream section.

Maps of initial ground-truth data



Figure 12 (Appendix Two): Map of site 5 with ground-truth data from the teams September expedition of mammals of importance including orangutan nests, proboscis monkey and silver langur observed both north and south of the river.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management

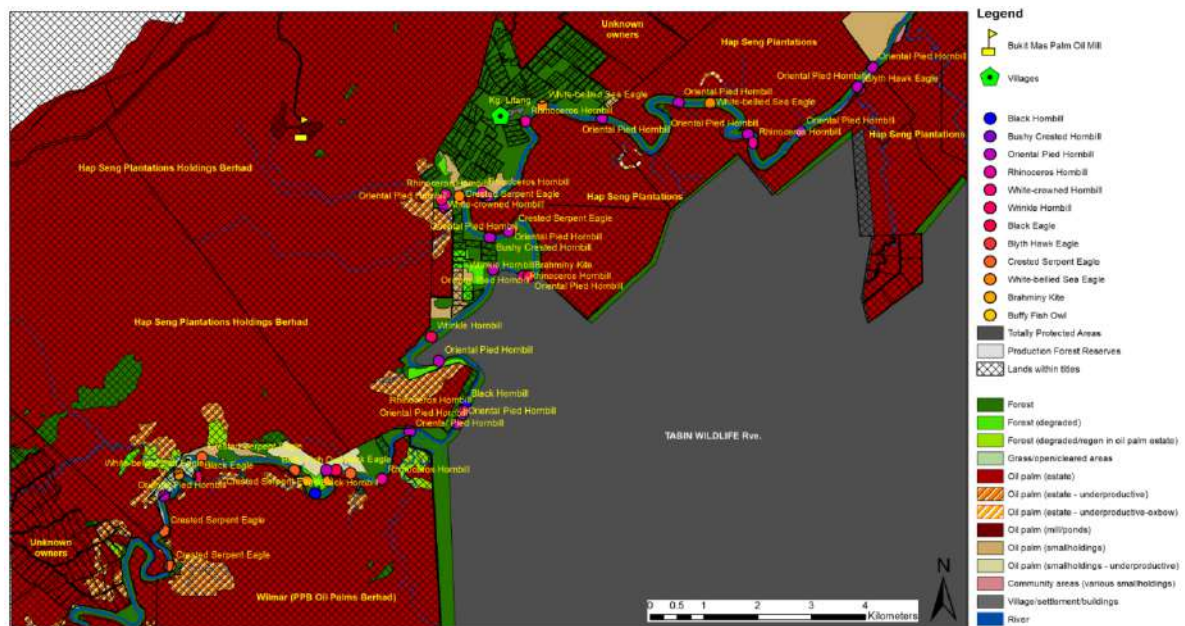


Figure 13 (Appendix Two): Map of site 5 with ground-truth data of hornbill and birds of prey species observed at this site in the September expedition. A total of 46 bird species were observed in this site in the expedition.

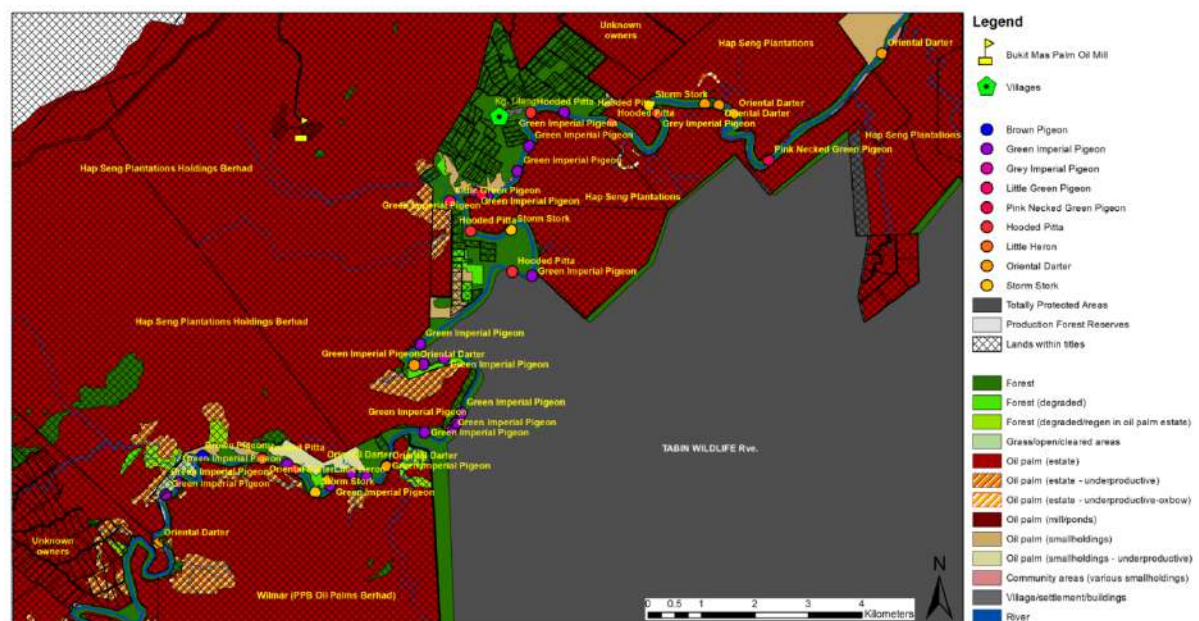


Figure 14 (Appendix Two): Map of site 5 with ground-truth data of pigeon, pitta, heron, darter and stork species observed at this site in the September expedition.

Site 8: Aim to work with communities to support innovations in riparian protection & establishment and indigenous management

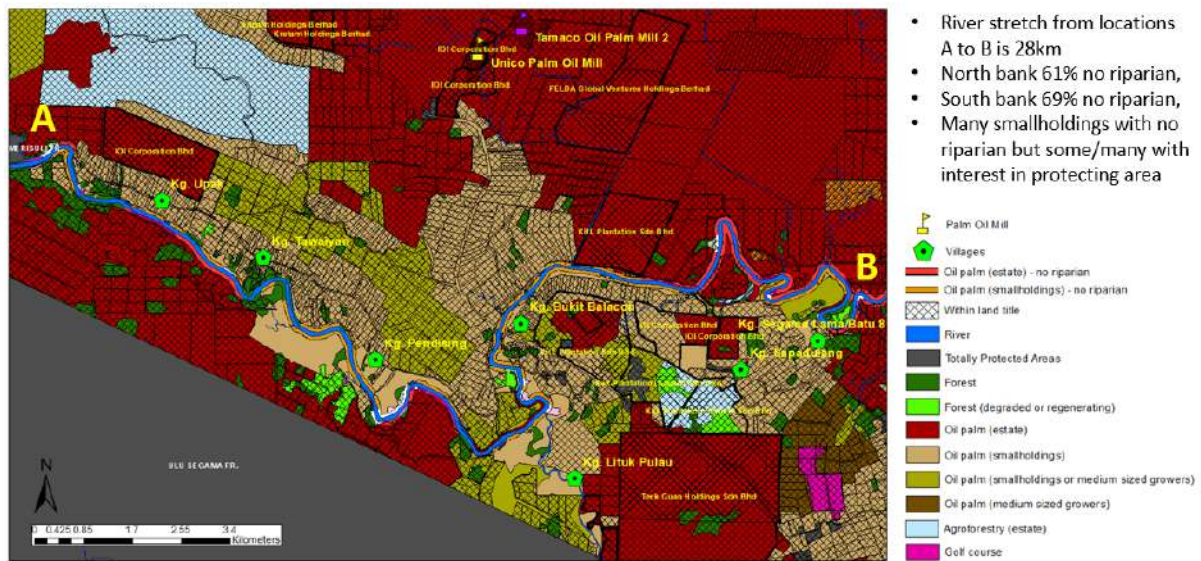


Figure 15 (Appendix Two): Map of site 8 accompanied with calculations of riparian forest lengths.

Maps of initial ground-truth data



Figure 16 (Appendix Two): Mapped observations of gibbon, proboscis monkey and silver langur in site 8 observed within the September expedition. Also included, are the locations of sand mining operations observed in the September expedition and the location of the company 'Borneo Marble' which is threatening gibbon habitat.

APPENDIX TWO: Mainstreaming of Biodiversity Conservation into River Management



Figure 16 (Appendix Two): Mapped 'birds of importance' observed in the September expedition. However, there were 29 species of birds observed in Site 8.