

TRUSAN SUGUT (PROTECTION) FOREST RESERVE



FOREST MANAGEMENT PLAN 2016 – 2026

SABAH FORESTRY DEPARTMENT
(Revised April 2017)

Trusan Sugut Forest Reserve

10-Year Forest Management Plan

(1st July 2016–30th June 2026)

Approved by:

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Date:



SUMMARY

The Trusan Sugut Forest Reserve is located in the north-eastern part of Sabah and extends over 8,680 *ha*. It was formerly a Class II (Production) Forest Reserve (FR) that formed part of the larger Sugut FR. In November 2014, it was reclassified as a Class I (Protection) FR. The current management focus in the reserve is to protect ecosystem functions, and prohibit all major forms of destructive human activities (including commercial logging). The management of Trusan Sugut FR comes under the jurisdiction of the Beluran Forestry District.

A key feature of Trusan Sugut FR is the diversity of forest types occurring within a relatively small area. The reserve contains endangered lowland forest types such as lowland mixed *Dipterocarp* forest, a variant of which is the *Kapur* forest, lowland Kerangas forest, lowland peat swamp forest, and lowland freshwater swamp forest. Surveys have shown that this reserve is rich in plant endemics, some of which are endangered now.

Additionally, the orang-utan and proboscis monkey, both of which are Borneo endemics and endangered species, occur commonly within Trusan Sugut FR. Ten out of 20 terrestrial mammal species detected in the reserve are considered in the IUCN Red List as critically endangered, endangered, or vulnerable. Ten out of 230 bird species recorded in Trusan Sugut FR are classified in the IUCN Red List as critically endangered, endangered, or vulnerable. Seven bird species endemic to Borneo have also been observed to occur here.

High conservation values (HCV) of all types (HCV 1 to 6) are present in Trusan Sugut FR. The biodiversity values (HCV 1 to 3) are highly significant and diverse, with many threatened plant and animal species, and species endemic to Sabah and Borneo occurring in the reserve. On the whole, the overlapping extent of HCVs over the entire area of Trusan Sugut point to the great importance of the reserve as a HCV area, and underline the utmost need for managing the reserve effectively.

Due to its high conservation value, efforts to bring Trusan Sugut FR under effective management and protection were initiated by the Sabah Forestry Department in 2011. As part of this effort, formulation of this forest management plan (FMP) was initiated in June 2014. This FMP defines the scope and prescribes activities for the management of the Trusan Sugut FR for a 10-year period, beginning from 1st July, 2016 to 30th June, 2026. This is to ensure that all management activities are carried out in a systematic and efficient manner.

This FMP broadly consists of:

- Documentation of important components of biodiversity found in the forest reserve;
- Assessment of threats to the biodiversity and identification of the management needs;
- Activities and inputs needed to achieve the management goals and objectives (protection, conservation and enhancement of the biological diversity of the project area, including forest restoration); and
- A plan for monitoring the implementation and achievements of the goals and objectives laid down in the FMP.

Trusan Sugut FR is part of a larger area being established for long-term conservation called “Sugut Conservation Area (SCA)”. Along with Trusan Sugut FR, the adjacent Sugut Wildlife Corridor FR, Kuala Bonggaya and Kuala Labuk mangrove FR, Sg. Sugut, Sg. Paitan and Jembongan mangrove FR, and the conservation zone of Sugut FR (Class II, production) form the larger conservation area, the SCA. This FMP covers only the Trusan Sugut FR, while it keeps the larger SCA in view while planning the management activities.

The primary management goal of Trusan Sugut FR is long-term conservation of various forest types and other ecosystems present in the reserve, the wildlife inhabiting the area, and the ecological functions of forests, and through which to ensure long-term sustenance and enhancement of the environmental services the reserve provides.

This includes the following specific 5 – 10 year management goals:

- i) Protection and restoration of various forest types in the reserve, such as lowland *Dipterocarp* forest, freshwater swamp forest and mangroves, and the riparian areas;
- ii) Conservation of the rare, threatened and endangered mammal, bird and tree species such as orang-utan, proboscis monkey, helmeted hornbill and the various *Dipterocarp* tree species;
- iii) Enhancing the forest structure and tree species diversity by facilitating natural regeneration and through enrichment planting;
- iv) Reversing forest degradation caused by past logging activities and fire damages through reforestation type of planting;
- v) Restoring connectivity between Trusan Sugut FR and the nearby forest reserves for expanding habitat for long ranging wildlife species such as the banteng, clouded leopard and Malayan sun bear;
- vi) Management of the identified High Conservation Values in the reserve; and
- vii) Protecting and enhancing the environmental services provided by the reserve.

These goals will be achieved largely by reducing threats to the forests and wildlife and by speedy and effective forest restoration efforts.

The specific threat reduction objectives (1 – 2 years scale) include:

- i) Reducing the threats to forests and tree species by surveillance and enforcement against encroachment and illegal logging;
- ii) Reducing the threats to wildlife species by patrolling and enforcement against poaching and illegal fishing activities;
- iii) Preventing and controlling fire, particularly by being prepared during El Nino drought years;
- iv) Monitoring and protecting rivers and streams from upstream pollution sources;
- v) Engaging communities to regulate traditional use of forest resources, to provide benefits of environmental services, and to elicit support for protection of the reserve; and
- vi) Promoting regulated recreation and low-impact tourism in the reserve.

Therefore, the main activities for this 10-year planning period focus on protection, forest restoration and wildlife conservation, HCV management and monitoring, and developing opportunities for recreation and low-impact nature tourism. An action plan and implementation schedule drawn up in this FMP will guide development of annual work plans. The estimated budget for implementing this FMP for 10 years, from 2016 to 2026, is RM 20 million, with an average annual budget of RM 2 million.

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ABBREVIATIONS USED

a.s.l. – above mean sea level
AWP – Annual Work Plan
dbh – diameter at breast height
DFO – District Forest Officer
FIRMS – Fire Information for Resource Management System
FMP – Forest Management Plan
FR – Forest Reserve
FRC - Forest Research Centre (research wing of the SFD)
FSC – Forest Stewardship Council
HCV – High Conservation Values
IPS - Institut Perhutanan Sabah
IUCN – International Union for Conservation of Nature and Natural Resources
Kg. – Kampung (village)
NASA – National Aeronautics and Space Administration
PES – Payments for environmental services
PFR – Permanent Forest Reserve
SCA – Sugut Conservation Area
SFD – Sabah Forestry Department
SFM – Sustainable Forest Management
Sg. – Sungai (river)
SMART – Spatial Monitoring and Reporting Tool
TSFR – Trusan Sugut Forest Reserve
WCE – Wildlife Conservation Enactment
WWF – Worldwide Fund for Nature

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ACKNOWLEDGEMENTS

In an attempt to revisit some of the IPPA (Identification of Potential Protected Areas project) sites of 1998 and to revive conservation advocacy on them, WWF-Malaysia's Sabah terrestrial conservation programme turned its focus on Lower Sugut FR in 2013. It then approached Sabah Forestry Department to explore the possibility of re-classifying the area as a protection forest.

Sabah Forestry Department welcomed the idea and asked for assistance in conducting biodiversity surveys and in coming up with a management plan for the area, from the point of view of a protection forest reserve (Class I or Class VII). As the programme leader for WWF in Sabah at that time, I wanted to use the opportunity to produce a management plan that can serve as a model for other upcoming protection forest reserves in Sabah.

WWF-Malaysia covered the time I spent in the initial stages of preparation of this FMP, specifically during the field surveys that laid the foundation for this FMP. Even after I left WWF, Sabah Forestry Department was kind to extend me the opportunity to continue on and complete the FMP as an independent collaborator, with its research wing, the Forest Research Centre.

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*K. Yoganand
September 2016*

1 INTRODUCTION

1.1 Background

The Trusan Sugut Forest Reserve is located in the north-eastern part of Sabah and extends over 8,680 ha (Figure 1.1). It was formerly a Class II (Production) Forest Reserve (FR) that formed part of the larger Sugut Forest Reserve. In November 2014, it was reclassified as a Class I (Protection) FR through an amendment made to the Forests Enactment 1984 (Constitution of Forest Reserves and Amendment). This reclassification meant that the management of the reserve would focus on protection of ecosystem functions, and prohibit all major forms of destructive human activities (including commercial logging and mining). The management of Trusan Sugut FR comes under the jurisdiction of Beluran Forestry District of the Sabah Forestry Department.

Trusan Sugut FR contains certain endangered lowland forest types such as lowland mixed *Dipterocarp* forest, a variant of which is the *Kapur* forest, lowland Kerangas forest, lowland peat swamp forest, lowland freshwater swamp forest and mangroves. As reported in the Sabah Biodiversity Conservation Project (Identification of Potential Protected Areas; Payne and Siambun 1998), one of the most important features of Trusan Sugut (then called Lower Sugut) in relation to biodiversity is the diversity of forest types within a relatively small area.

Past surveys have shown that this area is rich in plant endemics, some of which are endangered now (PAMOL 1998; Reza 1998). A 1998 Environmental Impact Assessment of Lower Sugut area (the area adjacent to Trusan Sugut FR on the southwest side) listed 365 butterfly species, 57 amphibian species, 103 reptile species, 335 bird species and 168 mammal species, including 40 species of medium-sized and large mammals as potentially occurring in the area (PAMOL 1998). Additionally, two Borneo endemics and endangered species, the orang-utan and proboscis monkey, occur commonly in Trusan Sugut FR.

Due to its high conservation value, efforts to bring Trusan Sugut FR under effective management and protection were begun by the Sabah Forestry Department in 2011. For this, a special initial allocation of RM 2 million from Sabah's Community Forestry Development Fund was made. As part of this effort, the formulation of a forest management plan (FMP) was initiated by the Forestry Department in June 2014.

This FMP broadly consists of:

- Documentation of important components of biodiversity found in the forest reserve;
- Assessment of threats to the biodiversity and identification of the management needs;
- Activities and inputs needed to achieve the management goals and objectives (protection, conservation and enhancement of the biological diversity of the project area, including forest restoration); and
- A plan for monitoring the implementation and achievements of the goals and objectives laid down in the FMP.

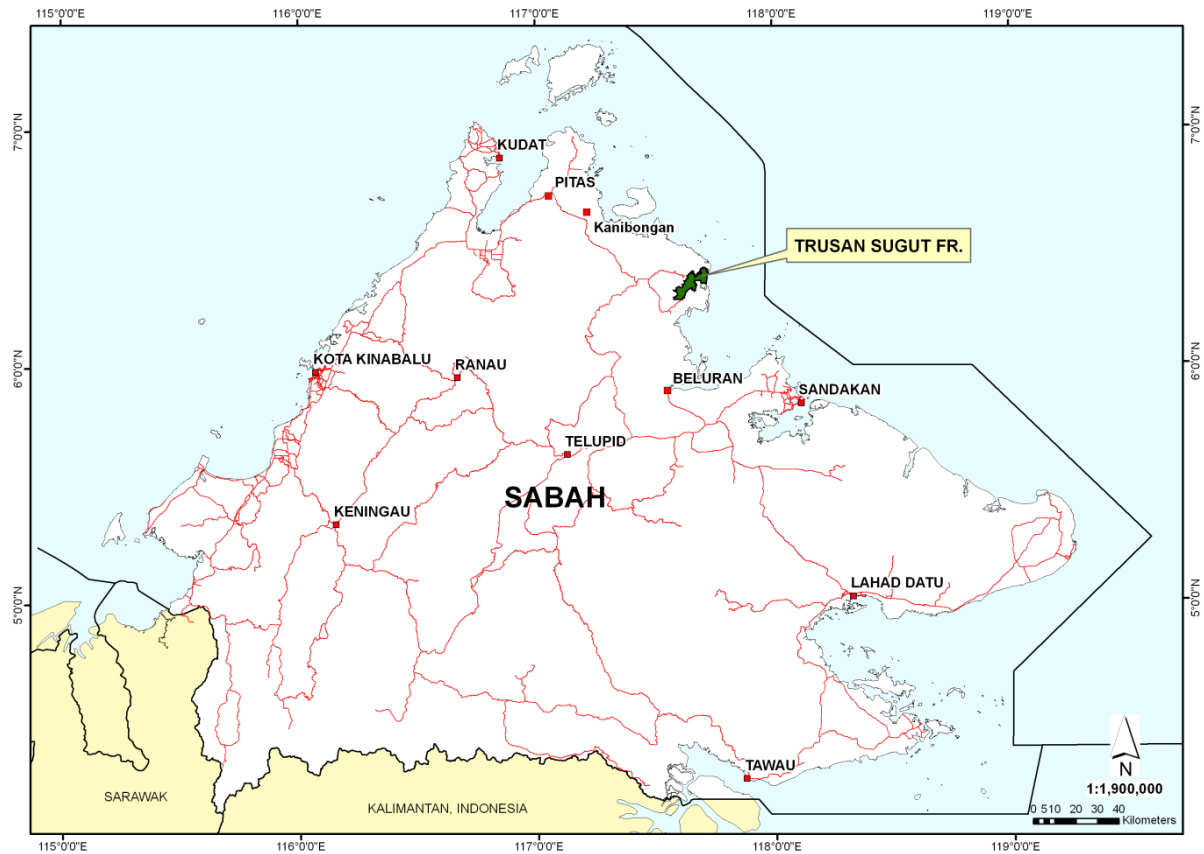


Figure 1.1. Location of the Trusan Sugut Forest Reserve in Sabah, Malaysian Borneo

1.2 Purpose and scope of the FMP

This forest management plan (FMP) defines the scope and prescribes activities for the management of the Trusan Sugut Forest Reserve for a 10-year period, beginning from 1st July, 2016 to 30th June, 2026. This is to ensure that all management activities are carried out in a systematic and efficient manner. The main activities for this 10-year planning period (2016-2026) focus on protection, forest restoration and wildlife conservation, and developing opportunities for recreation and low-impact tourism.

Although the stated planning horizon is 10 years, the FMP seeks to optimize socio-economic and environmental benefits to the State, and other key stakeholders, over and beyond the current planning period. This FMP is scheduled to be reviewed in year 5 (2021). Major revisions to the FMP will need to be approved by the Director of Forestry. The Beluran District Forestry Officer is responsible for the implementation of this FMP.

Trusan Sugut FR is part of a larger area being established for long-term conservation called “Sugut Conservation Area (SCA)”. Along with Trusan Sugut FR, the adjacent Sugut Wildlife Corridor FR, Kuala Bonggaya and Kuala Labuk mangrove FR, Sg. Sugut, Sg. Paitan and Jembongan mangrove FR, and the conservation zone of Sugut FR (Class II, production) form the larger conservation area, the SCA. This FMP covers only the Trusan Sugut FR, while it keeps the larger SCA in view while planning the management activities.

1.3 Policies and management guidelines

The Sabah Forestry Department is a state government agency entrusted with the sustainable management of Sabah's forest resources, mainly on lands legally classified as forest reserves. As such, the Department is committed to managing Trusan Sugut FR in accordance with the principles of sustainable and responsible management as prescribed by the Forest Stewardship Council (FSC) and the Malaysian Criteria and Indicators (MC&I) of the Malaysian Timber Certification Council (MTCC), and in conformity with all existing State forest policies, environmental policies, legislations and regulations. The Sabah Forestry Department will also ensure the protection of Trusan Sugut FR from fire, illegal felling, encroachments and poaching, and safeguard the forest resources under responsible management.

The Trusan Sugut FR will be managed as a Class I (Protection) FR where commercial logging is prohibited. The primary long-term goal of forest management places emphasis on the non-destructive use of forest resources, focusing largely on the conservation of wild flora and fauna. Given this focus, direct financial benefits is not an important factor in the management of this forest reserve. The public is becoming increasingly aware of the importance of forest conservation. Therefore, it is important that the management of public lands like forest reserves is seen as serving the demands of today's society.

In achieving the stated management goals and objectives, the Sabah Forestry Department subscribes to the following policies and strategies:

- Management of the area ensures the sustainable management of forest resources over the long-term in such a way as to optimize socio-economic benefits to the state;
- All field operations give due consideration to environmental protection so as to minimize any negative impact on the natural environment;
- High conservation values (HCV) are maintained and enhanced;
- Third party certification of forest management under an accredited scheme would be aimed for;
- Research and educational opportunities aimed at improving the management of the forest reserve are given due attention; and
- Preferences in employment and service contracts are given to local/rural communities wherever possible.

1.4 Legal framework

Forest management activities of Sabah Forestry Department are governed and regulated by various laws and regulations. The following are Sabah's legal instruments and guidelines as they relate to the management of the Trusan Sugut FR:

- State Forest Policy;
- Forest Enactment, 1968;
- Forest Rules, 1969;
- Environmental Protection Enactment, 2002;
- Environmental Protection Enactment (Prescribed Activities), 2005;
- Wildlife Conservation Enactment, 1997;

- Land Ordinance, 1930;
- Water Resources Enactment, 1998;
- Cultural Heritage (Conservation) Enactment, 1997;
- Biodiversity Enactment, 2000;
- Environmental Quality Act, 1985;
- Sabah Labour Ordinance;
- Occupational Safety and Health Act, 1994;
- International Agreements:
 - Convention on Wetlands of International Importance, 1971;
 - Convention on the International Trade in Endangered Species of Wild Flora and Fauna, 1973;
 - Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000;
 - International Tropical Timber Agreement, 1994;
 - United Nations Convention on Biological Diversity, 1992;
 - United Nations Framework Convention on Climate Change, 1992;
 - United Nations Declaration of the Rights of Indigenous Peoples, 2007;
 - The Kyoto Protocol to the Convention on Climate Change, 1997

1.5 Management goals and objectives

The primary management goal of Trusan Sugut FR is long-term conservation of various forest types and other ecosystems present in the reserve, the wildlife inhabiting the area, and the ecological functions of forests, and through which to ensure long-term sustenance and enhancement of the environmental services the reserve provides.

This includes the following specific 5 – 10 year management goals:

- i) Protection and restoration of various forest types in the reserve, such as lowland *Dipterocarp* forest, freshwater swamp forest and mangroves, and the riparian areas;
- ii) Conservation of the rare, threatened and endangered mammal, bird and tree species such as orang-utan, proboscis monkey, helmeted hornbill and the various *Dipterocarp* tree species;
- iii) Enhancing the forest structure and tree species diversity by facilitating natural regeneration and through enrichment planting;
- iv) Reversing forest degradation caused by past logging activities and fire damages through reforestation type of planting;
- v) Restoring connectivity between Trusan Sugut FR and the nearby forest reserves for expanding habitat for long ranging wildlife species such as the banteng, clouded leopard and Malayan sun bear;
- vi) Management of the identified High Conservation Values in the reserve; and
- vii) Protecting and enhancing the environmental services provided by the reserve.

These goals will be achieved largely by reducing threats to the forests and wildlife and by speedy and effective forest restoration efforts.

The specific threat reduction objectives (1 – 2 years scale) include:

- i) Reducing the threats to forests and tree species by surveillance and enforcement against encroachment and illegal logging;
- ii) Reducing the threats to wildlife species by patrolling and enforcement against poaching and illegal fishing activities;
- iii) Preventing and controlling fire, particularly by being prepared during El Nino drought years;
- iv) Monitoring and protecting rivers and streams from upstream pollution sources;
- v) Engaging local communities to regulate traditional use of forest resources, to provide benefits of environmental services, and to elicit support for protection of the reserve; and
- vi) Promoting regulated recreation and low-impact tourism in the reserve.

Additional management activities such as identifying and sourcing finances, building infrastructure, boundary demarcation, and staff capacity building are support activities for achieving the goals and objectives as stated above. Other activities related to monitoring progress on achieving the goals and objectives, making adaptive changes to the management, and monitoring implementation of the FMP through forest certification, independent auditing and periodic reviews are also covered in this FMP.



Mangroves are largely intact and extend over a third of the Trusan Sugut Forest Reserve.

2 AREA DESCRIPTION OF TRUSAN SUGUT FR

2.1 Location and Access

The Trusan Sugut FR is located in the north-eastern part of Sabah, just south of the downstream part of the Sugut river, and covers an area of 8,680 ha (geographical coordinates: 6.28 – 6.41 N; 117.58 – 117.73 E). It is bordered by the Sulu Sea to the east, Sg. Sugut, Sg. Paitan and Jembongan FR to the north, Sugut River and Sugut Class II production FR to the west (although separated from it by about 1 – 1.5 km wide strip of state land and alienated land running along the length of the river), oil palm plantations to the south-west, and the Kuala Bonggaya and Kuala Labuk Class V Mangrove FR to the south (Figure 2.1).

The quickest access to Trusan Sugut is by boat from the town of Beluran; the drop-off point is a jetty operated by IJM Plantations in its Sabang Estate. Otherwise, access is also possible by road, a 150 km drive that takes about 4 hours from Sandakan by car. Access to the field operations base is via the Sabang Estate, an oil palm plantation belonging to IJM Plantations. Beluran is the nearest rural town where key government administrative offices are located. Boundary demarcation on the ground is yet to be carried out for the Trusan Sugut FR. Much of Trusan Sugut FR borders mangrove forest reserve, namely the Kuala Bonggaya and Kuala Labuk forest reserve.

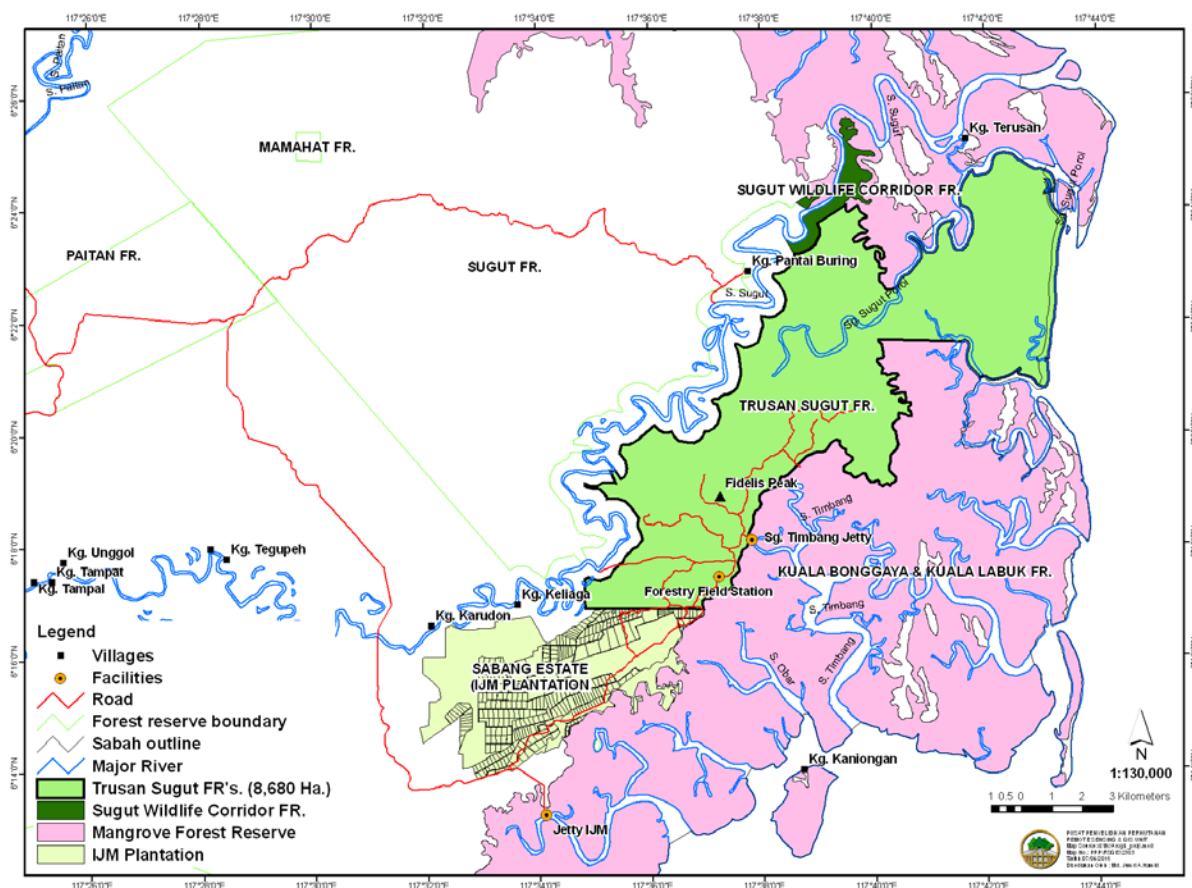


Figure 2.1. The extent of Trusan Sugut Forest Reserve, the adjacent land-uses, and the access road to the IJM jetty and the field station are shown here. The newly gazetted Sugut Wildlife Corridor FR and other adjacent forest reserves, along with Trusan Sugut FR, forms the larger Sugut Conservation Area.

2.2 Management history

The Trusan Sugut FR was first gazetted as a forest reserve in December 1961, forming part of the larger Sugut FR. In the 1960s-70s, it was administered under the the DFO Sandakan North, which later became known as the Beluran District Forest Office. In 1984, it was reclassified as part of the larger Sugut Forest Reserve (Class II Production FR). The area had been subjected to timber extraction since the 1960s. According to the Sabah Forestry Department records, Trusan Sugut area was last logged in 1996. However, illegal logging seems to have continued at least along the riverside of Sugut until 1998 (Reza 1998). Over 20 timber licensees have operated in the area over the years (Appendix 1). The volume of timber extracted could not be estimated from available records. The area has all along been managed for commercial timber extraction. In November 2014, it was reclassified as a Class I Protection FR (Gazette details - Date: 24th December 2014; Gazette no.: 9/2014; Map FD: 18/174).

2.3 Compartment Delineation

For the purpose of management planning, the Trusan Sugut FMU was divided into 15 compartments (Figure 2.2), ranging in size from 189 ha to 1,385 ha. Compartment boundaries generally followed natural features such as rivers and ridges, as well as roads.

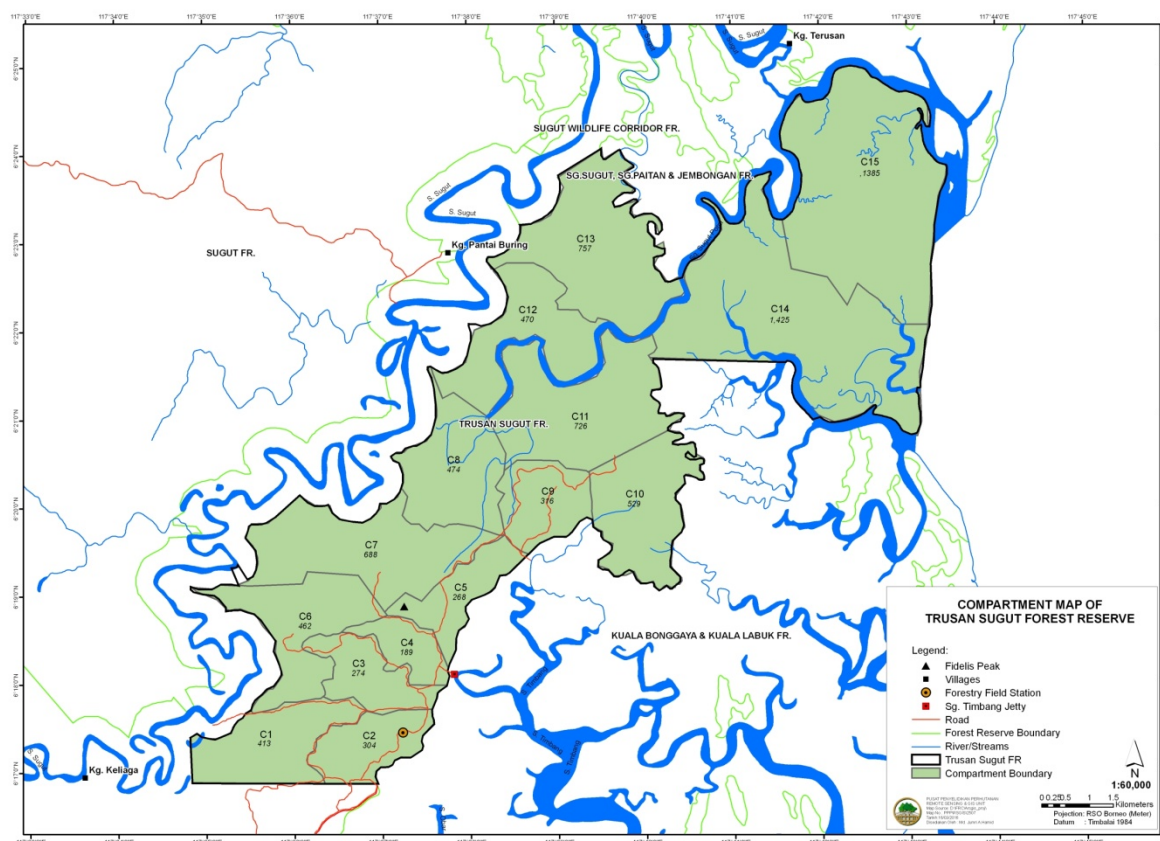


Figure 2.2. Compartment map of Trusan Sugut FR

2.4 Field Amenities & Infrastructure

2.4.1 Buildings and other structures

The main field outpost is located in Compartment 2 (Photo 1). Apart from buildings occupied by the Forestry Department, no other buildings exist within the Trusan Sugut FR. Major buildings include a rest house, office space, and the staff quarters (Table 2.1). At present, electricity supply for these buildings is from diesel powered generators. To provide access by boat, a jetty is located in Compartment #4, along Sg. Timbang (Photo 2). A helipad is located about 200 m from the Sg. Timbang Jetty.

Table 2.1. Components of the field complex in the Trusan Sugut FR.

Components
1 rest house
1 visitor reception building
1 storage building
1 fire equipment storage building
1 staff quarters (4 rooms)
1 fuel storage building
2 generator buildings



Photo 1. Field outpost complex located in Compartment #2.

2.4.2 Telecommunication

Fixed line telecommunication is not available within the Trusan Sugut FR. Hand phone signal is only available using the Celcom and Maxis networks at the highest points. Fidelis Peak is usually used for making calls due to its accessibility by road and being close to the field outpost. Plans are afoot to construct a Communications Tower within the next 2 years, as funding becomes available.

2.4.3 Water supply

Water supply for domestic use is drawn from both captured rainwater and a stream in compartment #2 called Sg. Rose. Since field staff numbers are low, water supply is sufficient presently.



Photo 2:
(left) Sg. Timbang Jetty in Compartment #4. The helicopter landing pad can be seen in the upper right corner.



Photo 3: The fire tower located close to the Fidelis Peak in Compartment #5.

2.4.4 Roads

The road network density within the Trusan Sugut is extremely low, largely owing to the swampy and low-lying nature of the area. There is only about 7.4 km of roads within the FMU, of which 5.2 km is graveled. In the current planning period, about 10 km of additional access roads are planned, 5 km within Compartments #1&2 (leading to Bukit Kambawon), and 5 km within Compartments 9 & 10 (leading to Bukit Malukap). Apart from roads, there are 14 km of foot trails within the FMU.

2.5 Physical environment

2.5.1 Climate (rainfall & temperature)

Mean annual rainfall over a 10-year period, from 2006 – 2015, recorded at the IJM Sabang Estate adjacent to Trusan Sugut FR was 3,633 mm. Most rainfall occurred annually between November and February coinciding with the northeast monsoon (Figure 2.3). May and October appear to be the driest months with monthly mean rainfall dropping below 200 mm. The area gets an average of 173 days of rain per year and between 12 and 20 days of rain in any month (Figure 2.4). Detailed rainfall data are given in Appendix 2. The mean daily temperature is about 27°C, with a mean daily minimum of 23°C and a maximum of 32°C.

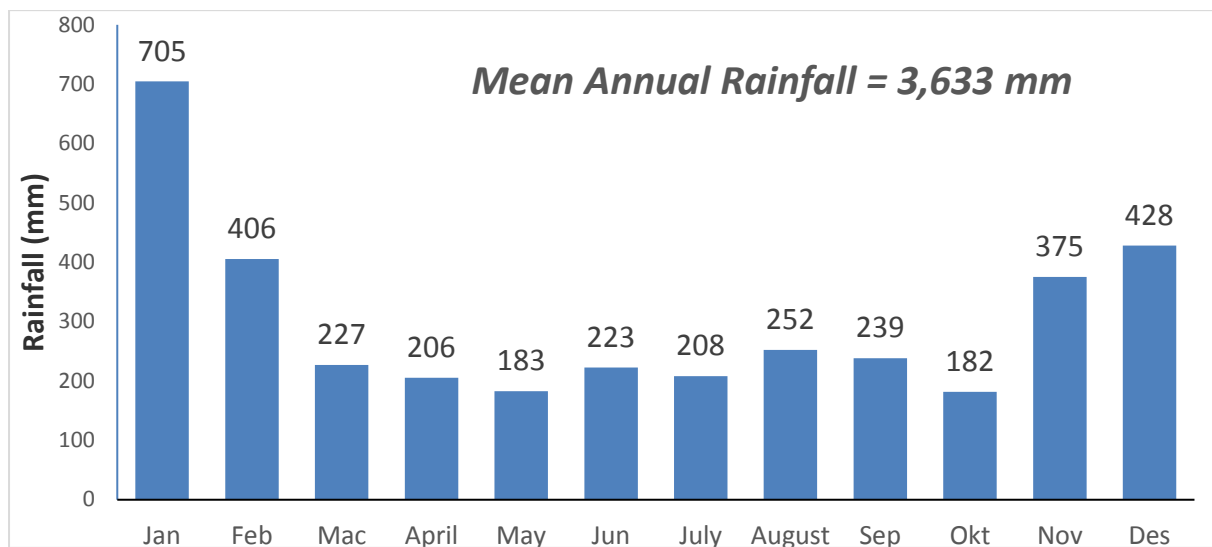


Figure 2.3. Mean monthly rainfall over a 10-year period from 2006 to 2015. (Source: IJM Plantations Sdn. Bhd.)

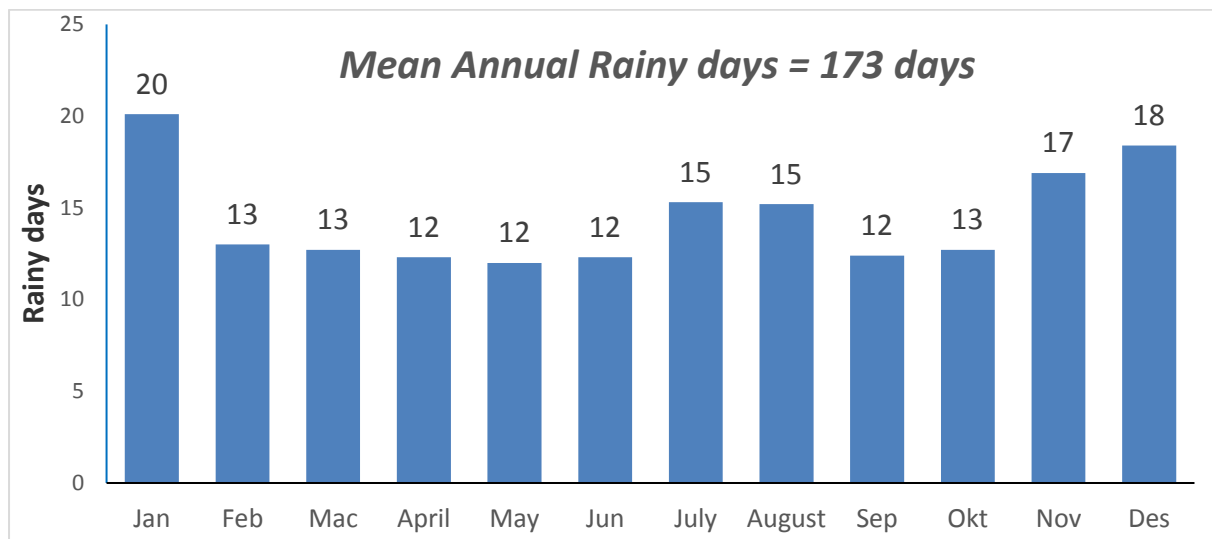


Figure 2.4. Mean monthly number of rainy days over a 10-year period from 2006 to 2015 (Source: IJM Plantations Sdn. Bhd.)

2.5.2 Geology and Soils

The geology of the area consists basically of two main types of parent materials – the oldest rocks consist of large to well-bedded sandstone and shale of the Crocker Formation of the Eocene age, while the other type is sandstone and shale with small coal seams of the Bonggaya Formation of Miocene age. Riverine alluvia are found along the Sungai Sugut and other major streams. In the eastern parts of the area, mangrove swamps with marine alluvia are found.

There are seven major soil associations that underlie Trusan Sugut FR (Figure 2.5). Due to its location, about 69% of the FR has a high water table. About 30% of soil under tidal influence is categorised as Weston association; 39% of those under freshwater influence are categorised as Sapi, Kinabatangan and Klias soil associations. The other soil associations that are considered as dryland are Maliau and Tanjung Aru, although Tanjung Aru association can be slightly swampy during wet season. Both types of dryland soil associations are considered to be of intermediate fertility with respect to plant nutrients (Acres et al. 1975, cited in Nilus and Sugau 2015).

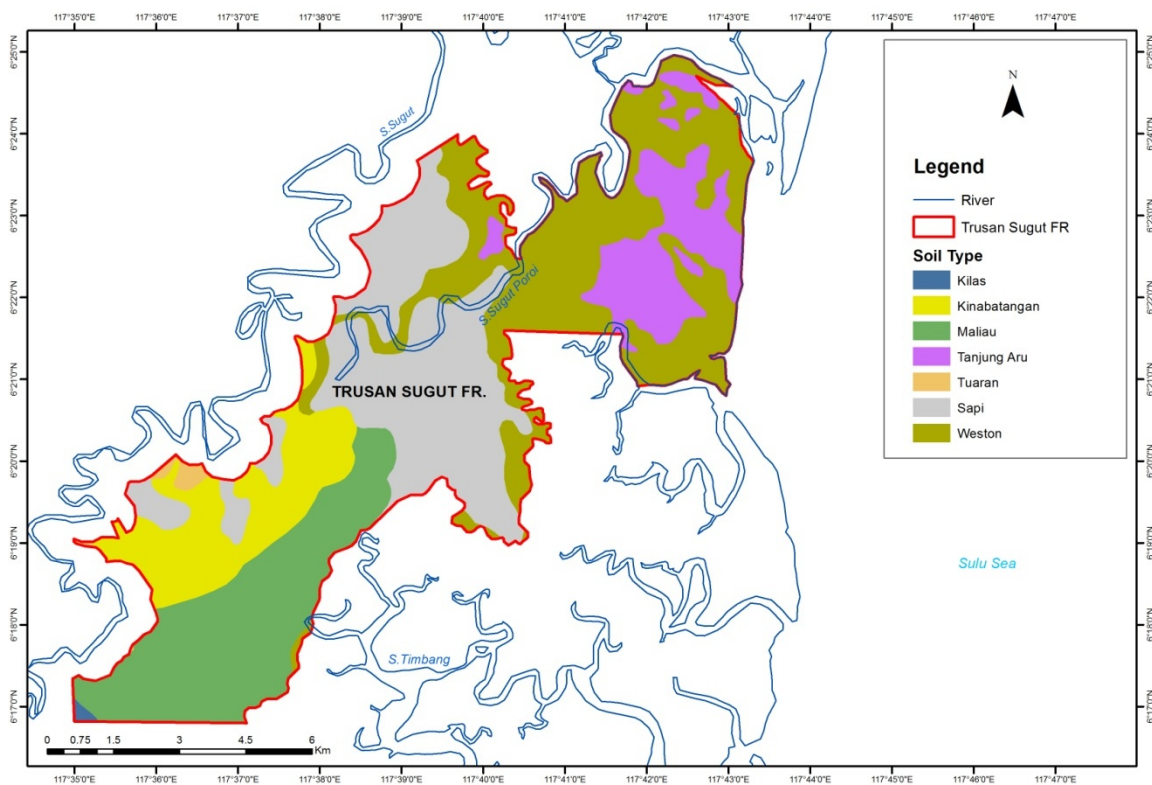


Figure 2.5. Soil types and their distribution in Trusan Sugut Forest Reserve.

2.5.3 Topography and drainage

Most of Trusan Sugut FR is comprised of flat or slightly undulating land below 30-m in elevation (Figure 2.6). A topographic contour map is given in Appendix 3. The northern end of a sandstone hill ridge running from Bonggaya hills in the south-west forms the southern and south-eastern parts of the Trusan Sugut FR. This ridge forms a steep escarpment on the western side dropping vertically down 30 – 100 m along its length, and a more gentle dip slope on the eastern side. The highest point within the reserve is about 135 m a.s.l.

Although the Sugut river technically falls outside the western boundary of Trusan Sugut FR, it is key to the ecology of the FR and is part of the larger Sugut Conservation Area. This perennial river keeps a large part of the Trusan Sugut FR as freshwater swamp forest and seasonally floods an even larger area. A small river named Sg. Sugut Parai runs through the Trusan Sugut FR, somewhat parallel to the main Sugut river and forms the northern boundary of the FR (Figure 2.6). This river remains as fresh water for about a third of its length and then turns brackish due to tidal influence. The tidal influence extends to the north-eastern parts of Trusan Sugut FR through coastal creeks. In all, the high water table and tidal influence keeps over two-thirds of Trusan Sugut FR poorly drained and swampy.

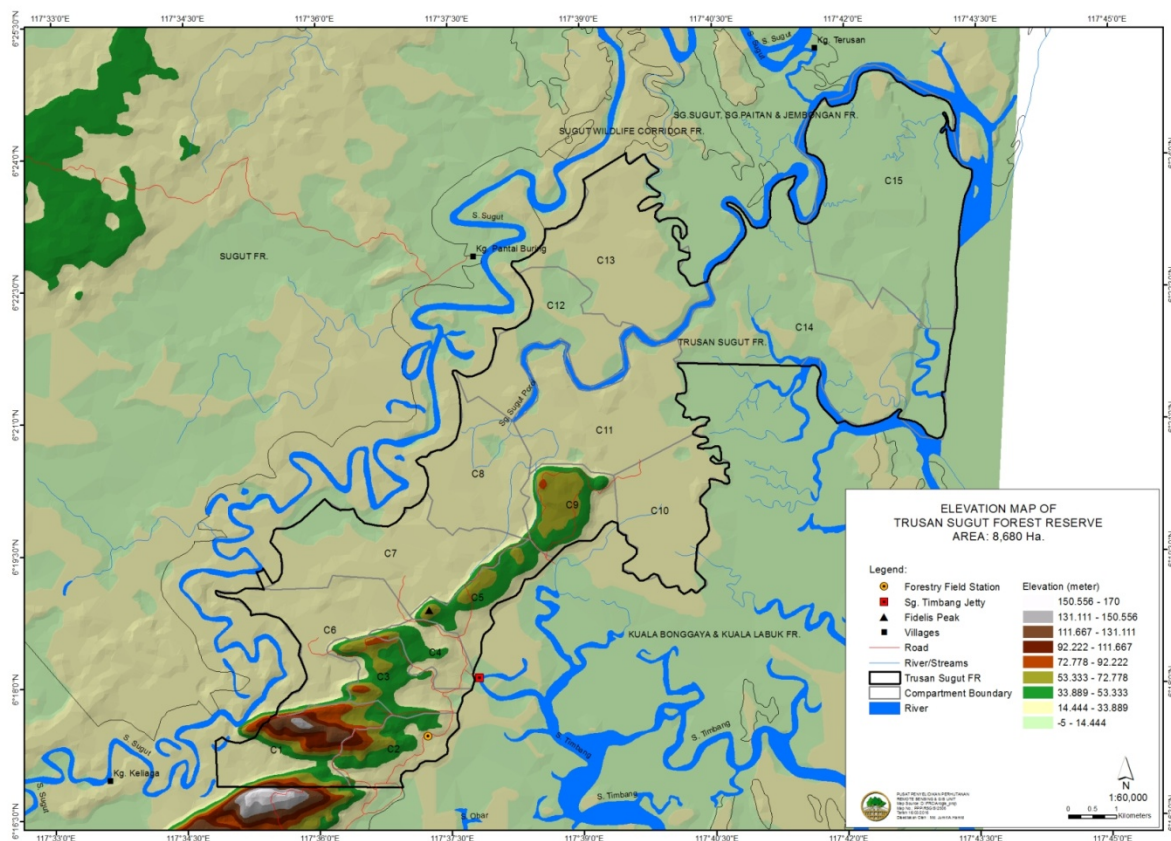


Figure 2.6 Topography and drainage of the Trusan Sugut FR

2.5.4 Physical environment: management implications

The Trusan Sugut FR receives high annual rainfall and experiences a seasonal peak in rainfall between November and February (Figure 2.3 and Figure 2.4). This would mean an inherent high risk of erosion and soil loss. Therefore the management needs to be mindful of not creating additional conditions for increased soil loss (during planting, constructions, etc) particularly in the dryland parts of the reserve, and include mitigation measures to minimize such soil loss where such activities are unavoidable.

A dominant natural character of the reserve is the high water table and seasonal flooding which creates freshwater swamp forests. Drought related lowering of the water table and pollution of the Sugut river will have significant implications on the ecology of these swamp forests. This requires

regular monitoring of river pollution level, occasional monitoring of the forest condition during drought periods and making suitable interventions when necessary. Such periodical flooding and occasional droughts would also impact the survival of plants from forest restoration efforts and will need to be factored in while planning for restoration.



The sandstone ridges overlooking the low-lying floodplain formed by the river Sg. Sugut in Trusan Sugut FR. The relatively closed tree cover of the steep ridges contrast with the more open canopy of the flat areas heavily degraded by past logging, illegal felling and fire.

2.6 Human environment

2.6.1 Local communities and socioeconomics

The main ethnic group of the local communities surrounding Trusan Sugut FR is *Orang Sungai*, followed by *Bajau* and *Suluk* (Symbiosis Consulting, 2015). The main occupation of the villagers is fishing. Four major settlements are within vicinity of Trusan Sugut FR, namely Kg. Kaliaga, Kg. Pantai Boring¹, Kg. Terusan Sugut and Kg. Kaniogan (Figure 2.7).

¹ It is also spelt *Pantai Buring* in some documents. Both refer to the same place.

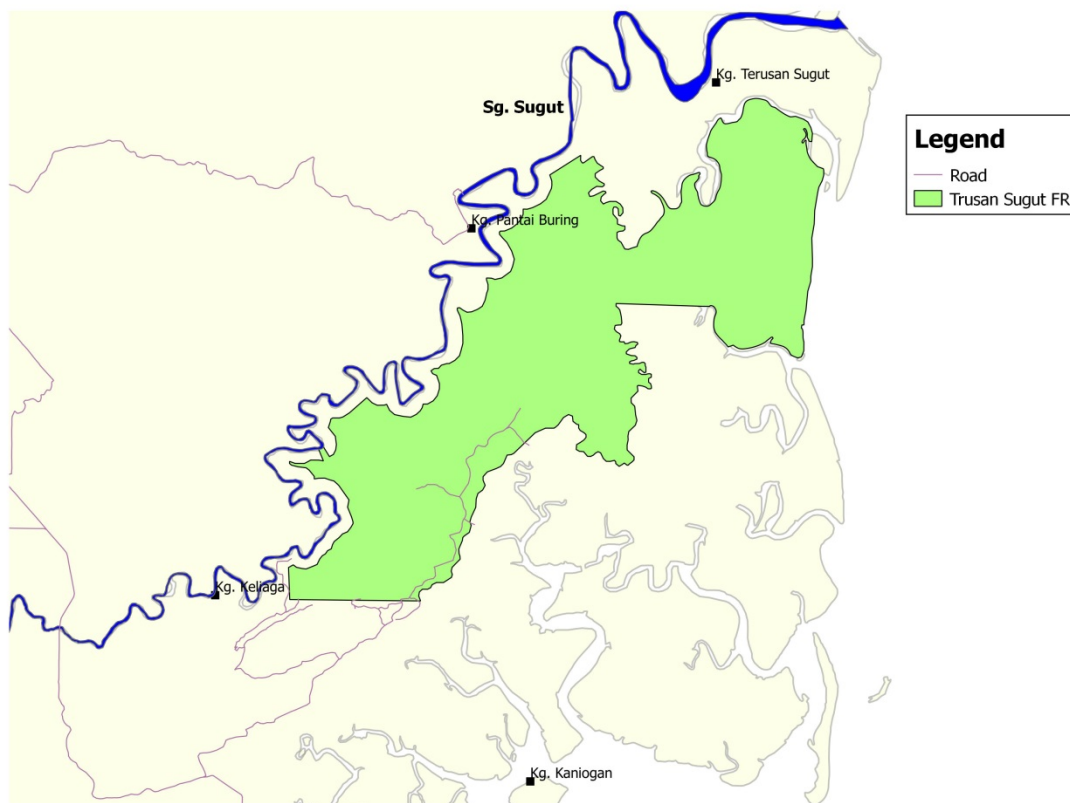


Figure 2.7. Locations of villages and human settlements near Trusan Sugut Forest Reserve.

2.6.2 Local community use of forest

The social baseline survey found (albeit with varying degrees) that the local communities surrounding Trusan Sugut FR relied on the forest reserves² to fulfil their basic needs, in terms of food sources, building materials, fuel sources, traditional medicines and cash income. The survey also found that amongst the four villages interviewed, the community of Kg. Pantai Boring is the most dependent on the forest produce, due to its proximity to the forests (Symbiosis Consulting 2015). Among the forest produce obtained for basic needs, wood appears to be the most important forest produce for house and boat building, followed by rattan and herbs (Table 2.2).

The local communities do not rely significantly on forest products for their protein sources as they have access to other forms of protein such as fish, prawns, crabs (both freshwater and saltwater), supplemented by the small-scale rearing of livestock such as chicken and cows, and the occasional purchase of eggs, chicken and beef. It was mentioned in the survey report (Symbiosis Consulting 2015: p.60) that the quantification of hunting activities by local communities can be particularly sensitive and a separate, more specific qualitative approach would be more beneficial. However, during informal interviews, it was revealed that hunting (of wildlife) was done on a seasonal basis and mainly for personal consumption; hence it can be deduced that hunting is occasional and may not be a serious threat to wildlife presently. Further investigation revealed that

² During the survey, it is not stated which forest reserve (Sugut FR /FMU2 or Trusan Sugut FR) was being utilized for basic needs. In this case, it is treated as if Trusan Sugut FR is being utilized by the local communities unless stated explicitly otherwise or ruled out.

awareness regarding laws and procedures on hunting was considered generally poor among those interviewed.

Table 2.2. Resources obtained from forests by local communities around Trusan Sugut FR. Adapted from Symbiosis Consulting (2015)

	Categories	Description	Dependency on forest (% from total households interviewed)
1	FOOD SOURCE		
1.1	Protein	Bush-meat	2
1.2	Fruit and Vegetables	These would include ferns, <i>kangkung</i> , <i>salak</i> , <i>rambutan</i> , <i>nipah</i> fruit and mango	12
1.3	Carbohydrate	None taken from forest as all source of carbohydrate are either purchased or home grown	0
1.4	Others	Honey and Birds' Nest	1
2	BUILDING MATERIALS		
2.1	Wood	Boat building: Species utilised would include <i>Seraya</i> , <i>Kapur</i> , <i>Rasak Batu</i> , <i>Acacia</i> , <i>Adat</i> , <i>Geriting</i> , <i>Obar</i> , <i>Bayu</i> ,	64
		House building: Species utilized would include <i>Kapur</i> , <i>Seraya</i> , <i>Geriting</i> , <i>Rasak Batu</i> , <i>Nibung</i> , <i>Tengar</i> , <i>Keruing</i> , <i>Santing</i> , <i>Merbau</i> , <i>Nyatoh</i> , <i>Selangan Batu</i> and <i>Belian</i>	93
		Furniture	2
2.2	Rattan	Mainly used for making prawn traps (<i>Bubu</i>); in a lesser extent for making handicraft, furniture, rattan mats (<i>Bidai</i>) and food cover (<i>Tudung Saji</i>)	19
2.3	Bamboo	Used to construct rafts, houses, prawn traps and handicraft	8
2.4	Nipah	Roofing material	<1
3	COOKING FUEL	Firewood is used as a supplementary fuel when gas supplies run short or during large preparation of food for festivities in the village	16
4	TRADITIONAL MEDICINES	Various forest produce are used to treat various ailments, such as: 1. <i>Tongkat Ali</i> – Malaria, dengue, back pain, injuries and high blood pressure 2. <i>Pegaga</i> – Fever, minor injuries and high blood pressure 3. <i>Misai Kucing</i> – High blood pressure and diabetes 4. <i>Akar Tebilang</i> – Coughs 5. <i>Tagimali</i> - Fever	18
5	FRESHWATER SOURCE	Due to the location of villages, none of them are dependent on Trusan Sugut FR for freshwater source (see Figure 2.7)	0
6	CASH INCOMES	Collected bamboo to be sold as cash income	<1

2.6.3 Human use: management implications

- Over-extraction of minor forest products and wood for household use can result in forest degradation and decline of rare and threatened species of plants. These activities would need to be regulated and monitored.

- Extraction of minor forest products and wood for household use and hunting by local communities would require creating awareness about the conservation needs of endangered and protected species, and the hunting (Wildlife Conservation Enactment 1997) and tree felling (Forest Enactment 1968) laws.
- Fishing activities in the river Sg. Sugut Parai and other mangrove creeks would require monitoring and the over-fishing concerns need to be addressed through the existing '*tagal sungai*' system.
- Hunting and other forest and wildlife legal offences will need constant monitoring and law enforcement. Training local community members as honorary forest rangers and wildlife wardens and using their assistance in intelligence gathering, education and law enforcement efforts would strengthen efforts and increase effectiveness of the reserve management.

2.7 Adjacent land-uses

On the seaward side, Trusan Sugut FR is bordered to the south and north by mangroves (Figure 2.1), legally classified as Class V (Mangrove) Forest Reserves under the Forest Enactment 1984. The southern boundary of the reserve is shared with Sabang Estate, an oil palm plantation belonging to IJM Plantations. The south-western border is shared with a smaller oil palm plantation company, Sayongmas, and some smallholder plantations and croplands along the banks of Sg. Sugut. Further to the southwest, a few tens of thousands of hectares land is covered by oil palm plantations, mostly that of big companies including PPB Oil Palms and IJM Plantations.

The western boundary of Trusan Sugut FR is shared with a strip of state land along the river Sg. Sugut, much of which has been applied for alienation by members of local community. Some of these plots of riverbank land have already been cleared for agriculture, mainly for the cultivation of oil palm. Further to the west, across Sg. Sugut, lies the larger Sugut (Class II production) forest reserve, but which currently has little commercial forestry activities. The southern part of the larger Sugut FR is a peat-swamp land and it has been zoned for conservation purposes in its FMP; the northern areas of which is devoid of tree cover, caused by repeated fires and is partly encroached and planted with oil palm. The main human settlements close to Trusan Sugut FR are Kg. Pantai Buring, Kg. Terusan Sugut, and Kg. Kaliaga (Figure 2.7).

2.7.1 Adjacent land-uses: management implications

The proximity of human settlements close to Trusan Sugut FR, particularly Kg. Pantai Boring, lends itself to encroachment, particularly along the western boundary. Fire can pose a risk during land clearing. Poaching and illegal tree felling, particularly from nearby villagers and from the large worker population in adjacent oil palm plantations, are likely threats. Stronger monitoring and enforcement are needed to manage these threats.

Human-wildlife conflict could become an issue if human settlements and agricultural crops become established on the western boundary along the river Sg. Sugut. Runoff from upstream oil palm plantations and effluents from palm oil mills would pollute the river and the freshwater swamp forests of the reserve, requiring periodical water quality monitoring.

The peat-swamp forest land zoned for conservation in the adjacent Sugut production FR provides additional habitat for the long-ranging animals occurring in Trusan Sugut FR – the reserve management will need to consider securing forest connectivity between the two areas through the intervening state land and alienated land.



Oil palm plantations developed abutting the boundary of Trusan Sugut FR. The flat ridge tops and floodplains, except the areas under constant flooding, have been converted for agriculture use entirely.

2.8 Environmental services provided by Trusan Sugut FR

- Mangroves act as spawning habitats for fishes, crustaceans (shrimps, crabs) and other aquatic food and commercial species.
- The swamp forests and mangroves have high soil carbon content and accumulate soil and carbon over time. Further, the regenerating forests sequester carbon in the growing trees.
- The forests act as watershed for the Sg. Sugut and Sg. Sugut Parai rivers and provide clean water to downstream users.
- The reserve provides fish, bush-meat (animals entering croplands can be legally hunted with license), timber for household use, and other non-timber forest produce.



Mangroves in the north-eastern part of Trusan Sugut FR, providing environmental services to the fishing communities, fisheries and seafood industry.

3 FORESTS, WILDLIFE and HIGH CONSERVATION VALUES

3.1 Forests

The varied features of geology, topography, hydrology and the geographical location of Trusan Sugut FR has interacted to create conditions for formation of a variety of forest types within the FR. Seven forest types cover different extents of the reserve of which five occur over substantial areas (Figure 3.1). A relatively small strip of beach forest is found along the sandy coastal area (not shown in Figure 3.1). The various forest types are described below.

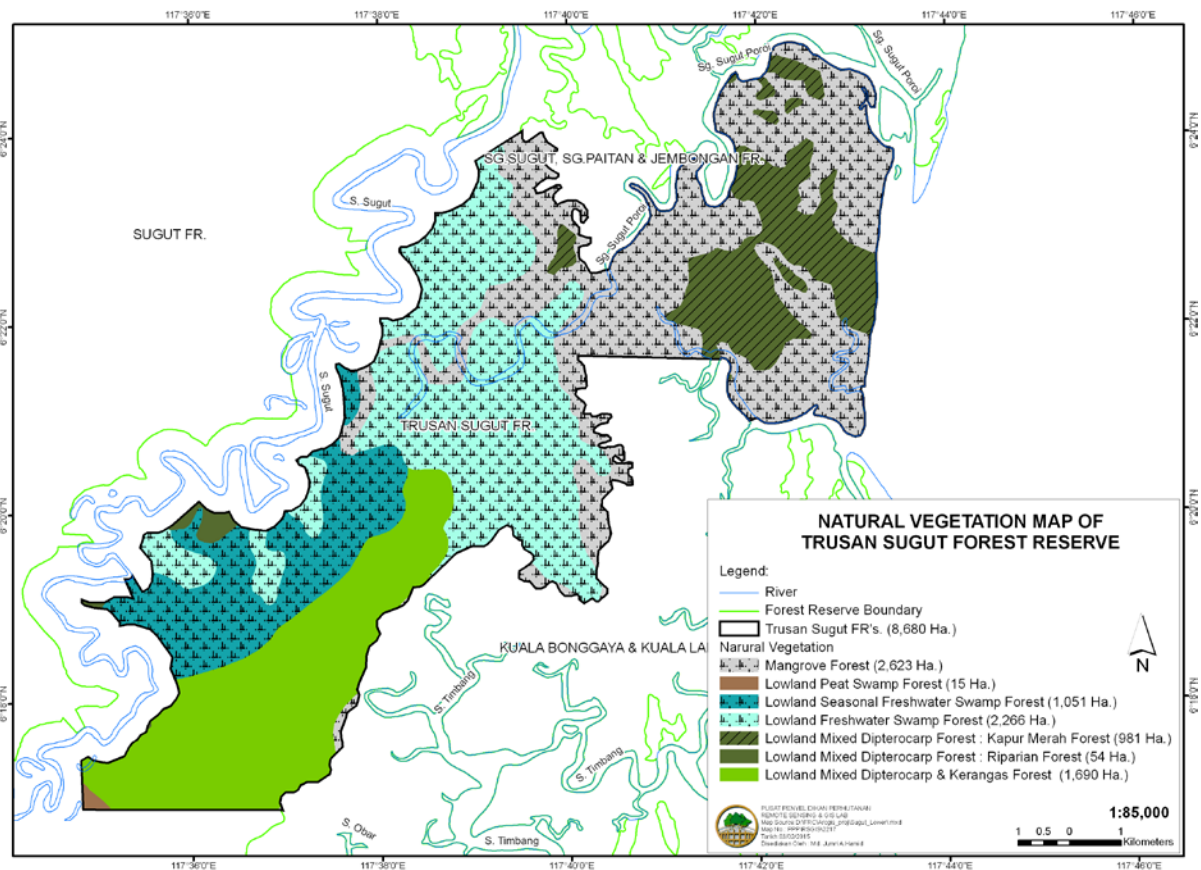


Figure 3.1. Extent of natural forest types in Trusan Sugut Forest Reserve.

The descriptions of forest structure and species composition in this FMP are based on ten 0.13 ha field plots established in February, 2015 (Nilus and Sugau, 2015). A total of 674 trees with dbh above 10 cm were enumerated in the plots. Of these, 168 species and lower taxa and 96 genera from 44 known families were recorded. Pooled data from these plots show that the *Dipterocarpaceae* is the most species-rich family, followed by *Myristicaceae* (Figure 3.2). The common tree species representing the main canopy, mid-storey and under-storey layers for each forest type are listed in Appendix 4.

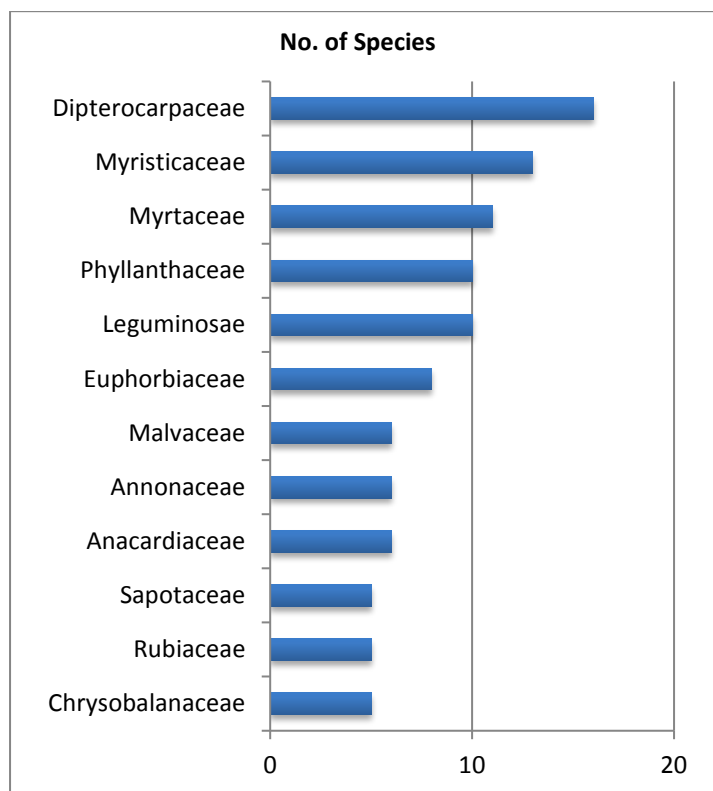


Figure 3.2. The 12 most species-rich families (trees ≥ 10 cm dbh) derived from pooled data of 10 sampling plots in Trusan Sugut Forest Reserve.

3.1.1 Forest types

Lowland mixed Dipterocarp and kerangas forest (LMDKF)

This forest type extends over 1,690 ha or 19% of Trusan Sugut FR (Figure 3.1). The dominant group of trees are Dipterocarps, representing up to 14–33 % and 25–48 % of the total density and basal area of the forest, respectively. Other important tree families are Anacardiaceae and Myrtaceae.

The main canopy consists of trees >50 cm DBH, and which attain heights of about 40–50 m (Appendix 4). Typical main canopy species recorded are *Shorea kudatensis*, *Shorea multiflora* and *Shorea parvifolia* from the tree family Dipterocarpaceae, and *Gluta oba* (Anacardiaceae). The middle storey consists of trees with a diameter range of 20–40 cm, and rarely exceeding 40 m in height. It is partly represented by the main canopy species, as well as other medium-sized trees, such as, *Anisoptera marginata*, *Cotylelobium melanoxydon*, *Dryobalanops beccarii*, *Hopea beccariana*, *Shorea rubra* from the tree family Dipterocarpaceae; and *Syzygium attenuata*, *Syzygium sp.*, *Tristaniopsis obovata* from the tree family Myrtaceae. Common trees in this understory layer are *Mangifera griffithii*, *Mangifera macrocarpa*, *Mangifera swintonioides* from the tree family Anacardiaceae; and *Rhodamnia cinerea*, *Syzygium spp.* from the family Myrtaceae.



Lowland mixed Dipterocarp and kerangas forest occuring on the sandstone ridges of Trusan Sugut FR.

Lowland mixed Dipterocarp (Kapur Merah) forest (LMDF)

The lowland mixed *Dipterocarp* forest occupies about 981 ha or 11% of Trusan Sugut FR (Figure 3.1). In its pristine form, this particular type of forest is dominated by kapur merah (*Dryobalanops beccarii*) in the main canopy, with the species accounting for up to 85 % of basal area in some patches. Similar forest composition is also found in the Sg Kapur Virgin Jungle Reserve. The tree family Ixonanthaceae forms another important group of trees.

The main canopy layer consists of mature trees with diameter of >50 cm and they can attain heights to about 50 – 60 m (Appendix 4). The common trees found in this canopy layer are *Dryobalanops beccarii* (Dipterocarpaceae). The mid-storey layer consists of trees with a diameter range of 20–50 cm but rarely exceed 40 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as, *Chaetocarpus castanocarpus* (Peraceae) and *Syzygium* sp. (Myrtaceae). The understorey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside understorey treelets with diameter of <20 cm. Common trees in this understorey are *Garcinia gaudichaudi*, *Garcinia parvifolia*, *Garcinia* sp. from the tree family Clusiaceae; *Syzygium* cf. *acuminatissima*, *Syzygium clavatum*, *Syzygium confertum* from the family Myrtaceae; *Gardenia elata*, *Timonius luzonensis* from the family Rubiaceae; and *Vatica umbonata* (Dipterocarpaceae).



Lowland mixed Dipterocarp (Kapur Merah) forest found in the north-eastern part of Trusan Sugut FR.

Lowland seasonal freshwater swamp forest (LSFWSE)

The lowland seasonal freshwater swamp forest covers an estimated area of 1,051 ha or 12% of Trusan Sugut FR (Figure 3.1). This forest is seasonally inundated and much of its composition is a mixture of freshwater swamp and low lying mixed *Dipterocarp* forest tree species. The forest is co-

dominated by the Dipterocarpaceae and Leguminosae tree families. The Dipterocarpaceae represents about 8–20 % and 20–23 % of the total density and basal area of the forest, respectively. The trees from Leguminosae family represent about 10–13 % and 18–25 % of the total density and basal area of the forest, respectively. Other important tree families are Rubiaceae and Moraceae.

The main canopy consists of mature trees with diameter of >30 cm, attaining heights of 20–30 m (Appendix 4). It is dominated by the typical upland species, namely *Hopea sangal* and *Vatica umbonata* from the tree family Dipterocarpaceae; *Cassia nodosa*, *Crudia* sp. and *Sindora cf. coriacea* from the tree family Leguminosae; and *Neolamarckia cadamba* (Rubiaceae). The middle storey layer consists of trees with a diameter range of 20–30 cm but rarely exceed 20 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as *Dipterocarpus validus* and *Shorea gibbosa* from the tree family Dipterocarpaceae; and *Crudia reticulata* and *Sindora* sp. from the tree family Leguminosae. The under-storey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside under-storey treelets with diameter of < 20 cm. Common trees in the under-storey are *Hopea nervosa* and *Parashorea malaanonan* from the tree family Dipterocarpaceae; *Baccaurea lanceolata*, *Baccaurea tetrandra*, *Cleistanthus myrianthus* and *Glochidion rubrum* from the family Phyllanthaceae; and *Pleiocarpidia sandakanica* (Rubiaceae).

Lowland freshwater swamp forest (LFWSF)

The lowland freshwater swamp forest was not assessed for forest structure and composition due to inaccessibility at the time of field work. It is estimated that about 2,266 ha or 26% of Trusan Sugut FR is covered by this forest type.



Lowland freshwater swamp forest, which extends over a quarter of the Trusan Sugut FR.

Lowland kerangas Forest (LKF)

This forest occurs in patches within the lowland mixed dipterocarp and kernagas forest growing on the Maliau soil association (these patches are not shown in Figure 3.1). This type of forest is dominated by trees of the family Myrtaceae that contribute about 21 % and 27 % of the density and basal area of the forest, respectively. Other important associates in the forest are from the families Annonaceae and Sapotaceae.

The main canopy layer consists of trees with diameter of > 30 cm, attaining heights about 20–30 m (Appendix 4). The main canopy is dominated by the typical kerangas species, namely *Tristaniopsis obovata* (Myrtaceae). The middle storey consists of trees with a diameter range of 20–30 cm but rarely exceed 20 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as *Mezzetia sp.* and *Xylopia ferruginea* from the tree family Annonaceae. The understorey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside understorey treelets with diameter of < 20 cm. Common trees in this understorey canopy are *Syzygium incarnatum* and *Syzygium biabas* from the tree family Myrtaceae; and *Palaquium pseudorostratum* and *Palaquium sp.* from the family Sapotaceae.

Mangroves and beach forest

The mangroves are areas under tidal influence and occupy about 2,624 ha or 30% of Trusan Sugut FR (Figure 3.1). Based on preliminary observations, mangroves appeared largely undisturbed and most of the mangrove zonation, such as seaward fringe, main mangrove, back mangrove and transitional forest were well represented in the reserve. This forest type was not assessed for forest structure and composition due to limited time.

A narrow strand of beach forest grows on raised sandy beach on the seaward side of the reserve. This forest is mainly dominated by Aru trees (*Casuarina equisetifolia*, Casuarinaceae) and associated with other coastal species, such as, *Heritiera littorale* (Malvaceae), *Barringtonia asiatica* (Lecythidaceae), *Calophyllum inophyllum* (Calophyllaceae), *Pongamia pinnata* (Leguminosae) and *Pouteria obovata* (Sapotaceae).

Secondary forests

The natural landscape of Trusan Sugut FR has been degraded into secondary vegetation consisting of various successional stages. The scale, intensity and age of the past logging operations and encroachments have resulted in residual forests of varying levels of forest quality. Considerable area mapped as historically containing LMDF and LMDKF currently occur as secondary growth vegetation that is poor in forest structure and diversity. The recovery of such disturbed areas is largely compounded by the severity of soil degradation in relation to soil moisture and fertility. The recovery rate is slow in areas where the topsoil has been removed. Furthermore, the soils that are compacted as a result of passage of heavy machinery are often devoid of high vegetation structure and can be considered to be low in forest productivity.

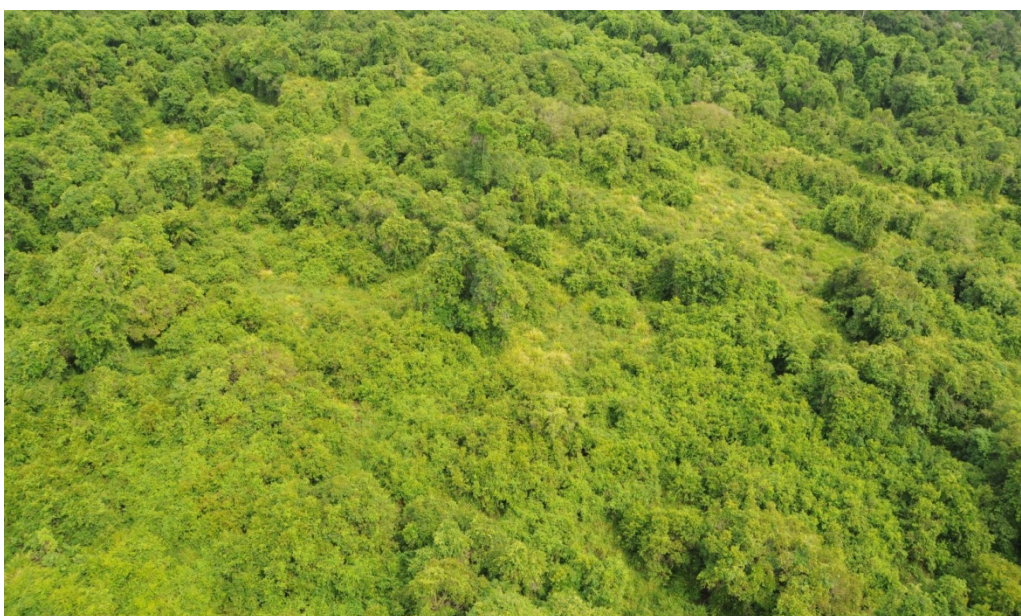
The common trees found in this heavily disturbed, secondary growth area are *Macaranga pearsonii*, *Macaranga gigantea*, *Macaranga tanarius*, *Macaranga hypoleuca* and *Macaranga beccariana* from the family Euphorbiaceae; *Neolamarckia cadamba* and *Neonauclea gigantea* from the family Rubiaceae; *Alstonia angustiloba* (Apocynaceae); *Trema orientalis* (Ulmaceae); *Alphitonia*

excelsa (Rhamnaceae); *Homalium foetidum* (Flacourtiaceae); *Artocarpus elasticus* (Moraceae); *Vitex pinnata* (Verbenaceae); *Litsea garciea* (Lauraceae); and *Bruinsmia styracoides* (Styracaceae). A number of secondary treelet species, namely, *Fagraea cuspidata* (Loganiaceae), *Ficus septic* (Moraceae), *Leea indica* (Leeaceae), *Melicope luna-ankenda* (Rutaceae), *Dillenia borneensis* (Dilleniaceae), *Callicarpa longifolia* (Verbenaceae), *Pternandra sp.* (Melastomataceae), *Homalanthus populneus* and *Glochidion sp.* from the family Euphorbiaceae, are categorized as common treelets that establish in the matrix of secondary vegetation. In more open areas, climbing bamboo (*Dinochloa scabrida*, Poacea), vines and woody climbers, such as, *Croton cordata* (Euphorbiaceae), *Merremia sp.* (Convulvulaceae), *Smilax borneensis* (Melastomataceae), and *Uncaria sp.* (Rubiaceae), scramble on the ground or smother other plants. In more open and nutrient poor sites, the ground layer is occupied by lalang grass (mainly *Imperata cylindrica*), ferns (mainly *Pteridium esculentum* and associated with *Dicranopteris linearis*) and shrubs (*Melastoma malabaricum*).

3.1.2 Forest cover and condition

Except the mangroves, other forests have been heavily logged in the past, resulting in forests presently found in various stages of recovery. A forest cover map of Trusan Sugut FR was prepared by classifying tree canopy cover into various cover classes using the moderately high resolution satellite data from Rapid Eye (5-m spatial resolution; acquisition dates: three scenes from 2011 and 2012). Further, the nipah palm, mangrove and oil palm areas were digitized using high resolution satellite data available in Google Earth (1 m resolution Digital Globe; imagery date: 2014).

Leaving out the mangroves, which cover about 30% of the FR area, about 45% of the FR has fairly closed (>60% cover) tree canopy cover and the remaining 25% of the FR has sparse cover or occurs as grassland and shrubland (Figure 3.3). However, much of the closed tree cover area comprises of secondary forest with poor forest structure and biomass. This suggests a great need for forest restoration in the area. The tree cover map helps identify areas in need of forest restoration and the types and levels of restoration needed.



Areas with sparse tree cover extend over a quarter of Trusan sugut FR.

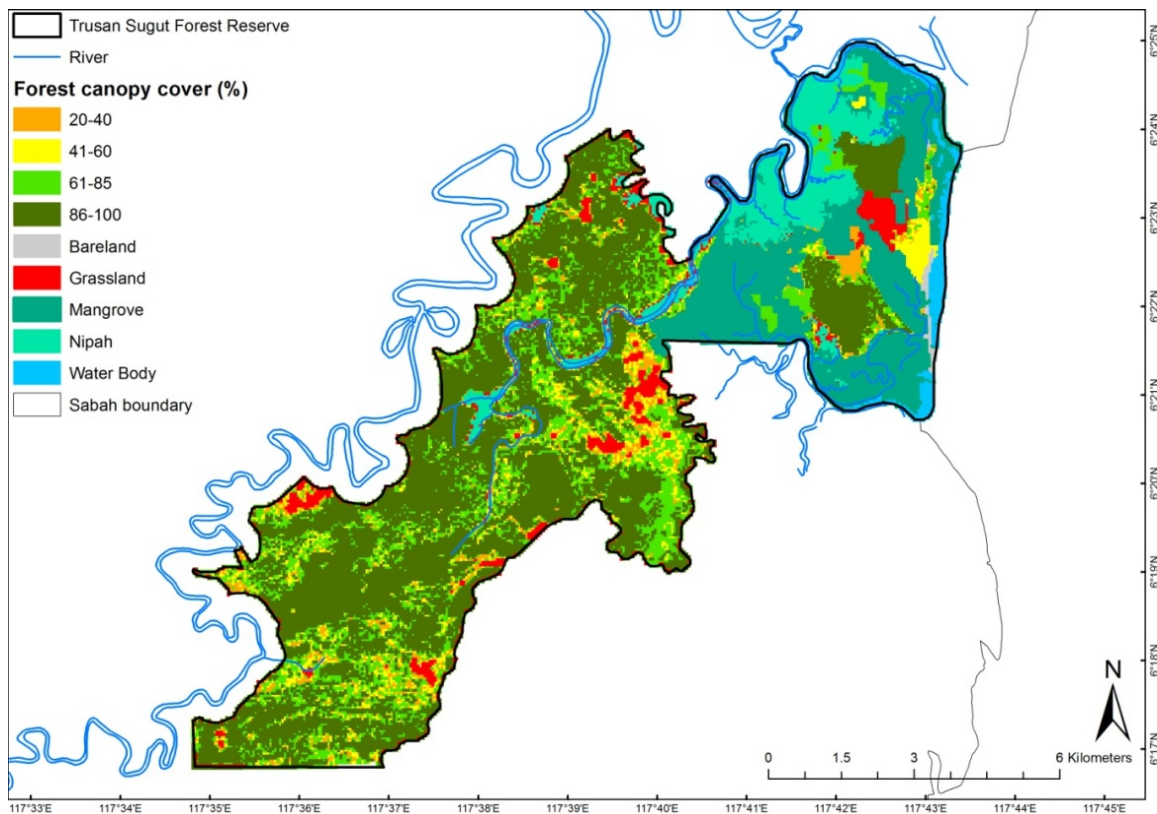


Figure 3.3. Forest cover map of Trusan Sugut Forest Reserve, as interpreted from satellite imagery of 2012. Mapping done by WWF-Malaysia.

3.1.3 Forest inventory (timber resource assessment)

The most comprehensive forest inventory of Trusan Sugut FR area was done in early 1970s. That work mapped the then (now, historical) forest timber stock of the area, based on tree crown size, as interpreted from aerial photographs taken in 1970 (Appendix 5). Although the map may not reveal much about tree species composition, it provides an indication of inherent/potential productivity of the land, with the large crown forest areas having the potential to support the best growth and so on. A large portion of the Trusan Sugut FR was classified in 1970s as ‘medium to mixed crown’ *Dipterocarp* forest with a gross standing volume of 280 – 390 m³/ha, whereas a relatively smaller area was classified as ‘large crown’ forest, with an estimated standing volume of 390 – 495 m³/ha.

3.1.4 Forests (type, cover, condition): management implications

The diversity of forest types is a key feature of Trusan Sugut FR. Since the diversity and structure of the various forest types (except mangroves) have been lost substantially and the forests have become simplified due to the impacts of past logging (Nilus and Sugau 2015), restoration efforts should focus on bringing back the natural character (diversity and structure) and functions of these various forest types.

The forest types found in the reserve, including the lowland freshwater swamp forest, lowland seasonal freshwater swamp forest, and the lowland *Dipterocarp* forest have become greatly reduced in extent across Sabah over the last few decades, and are now considered endangered in Sabah (WWF-Malaysia, unpublished report). Therefore, protection and restoration efforts should particularly focus on these forest types.

Secondary forests now cover a large part of the reserve, as a result of natural regeneration over the years since logging was ended. The natural regeneration process can be assisted by silviculture and enrichment planting to restore forest structure and diversity in the secondary forest areas. In all restoration planting efforts, a mix of species native to the area and to the particular forest type should be used. In areas where the top soil has been lost or severely damaged and hence natural regeneration has been poor, locally thriving and sun-tolerant (pioneer) species can be used for first stage of planting. Enrichment planting can be done at a later stage when tree cover and soil conditions improve over time.

Protecting the remaining forests from threats including illegal felling of trees, forest clearing due to encroachments and damages caused by fire are crucial to maintaining the current level of species diversity and ecological functions of the forests. Such protection will also help in natural regeneration and expansion of forest cover and plant diversity through seed dispersal and recruitment to other areas of the reserve.

3.2 Other ecosystems in the reserve and their management implications

3.2.1 Riparian forests and River systems

Trusan Sugut FR is largely drained by the rivers Sg. Sugut and Sg. Sugut Parai, the latter of which is brackish for most of its length and is lined by *Nipah* palm or mangrove forests along the banks. Sg. Sugut has riparian forest or secondary vegetation cover along its length adjacent to Trusan Sugut FR, where it has not already been cleared and planted with oil palm. These riparian areas are likely to be converted to agriculture over time, as the entire riparian stretch is outside the permanent forest reserve (PFR) and in state land or alienated land. It is in the best interest of the reserve and the ecology of the river to keep these areas under riparian forest cover.

Pollution of the river Sg. Sugut from upstream oil palm plantations (fertiliser and herbicide runoff and mill effluents) and forest clearance activities can have significant impact on the ecology of the river, and the permanent and seasonally flooded freshwater swamp forests of the Trusan Sugut FR. Therefore, periodically monitoring the river water quality and making appropriate interventions and remediation measures are crucial. Road construction activities in the reserve should be carefully planned such that it does not upset the current hydrology of the reserve. The swamp forests and the mangroves of the reserve depend critically on maintenance of the current hydrology.

3.3 Wildlife

Various field surveys were conducted in Trusan Sugut FR during 2014 and 2015 to support the preparation of this FMP, as listed below (Table 3.1).

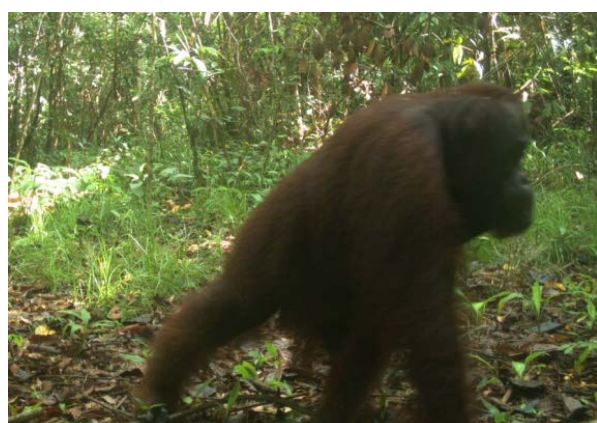
3.3.1 Orang-utan

Field surveys were carried out in Trusan Sugut FR to map the extent of occurrence and estimate the population size of orang-utans. Orang-utan nests were counted using a Bell 206B3 Jet Ranger helicopter, by flying along transects which were systematically laid out to get a representative sample of the reserve (a map of the helicopter transects and field survey locations are given in Appendix 6).

Orang-utans were common (as suggested by abundance of nests) in some parts of Trusan Sugut FR while being rare in others (Figure 3.4). Nests were detected in helicopter surveys in only about 44% (or 3,844 ha) of the total area of Trusan Sugut FR, most probably because the remaining area of the reserve consisted of mangroves, grassland and other sparse tree-covered areas that are unlikely to be suitable habitats (WWF-Malaysia, *unpublished report*). From the nest surveys, the orang-utan population density was estimated to be 2.08 / km² (95% CI: 1.01 – 3.15), and the population size to be around 80 individuals³ (mean = 79.94, 95% CI: 38.82 – 121.09).

Table 3.1. Forest cover mapping and wildlife surveys conducted to support preparation of this FMP.

Surveys		Period	Parties involved
Forest cover and condition		2014- 2015	WWF-Malaysia
Forest connectivity		March, June 2014	FRC (SFD), WWF-Malaysia
Flora	Forest condition (for restoration)	16 – 22 August; 11-13 September 2014	WWF-Malaysia
	Vegetation	October 2014	FRC (SFD)
Fauna	Orang-utan	12 May; 13- 22 June; 16- 21 July 2014	WWF-Malaysia
	Terrestrial mammals	May – September 2014	WWF-Malaysia
	Fish	12- 18 June 2014	Universiti Malaysia Sabah (consultant hired by WWF)
	Bird	2 -6 Dec 2014, 11 -16 May 2015	John Bakar (consultant hired by SFD and WWF)
	Proboscis monkey	21- 25 Sept 2014	FRC (SFD)



Orang-utan and proboscis monkey, both endangered and endemic to Borneo, occur in Trusan Sugut FR

³ This estimate should be seen as preliminary, and indicative of a substantial population of orang-utan in Trusan Sugut FR. A more rigorous estimate should be made as part of the wildlife monitoring efforts.

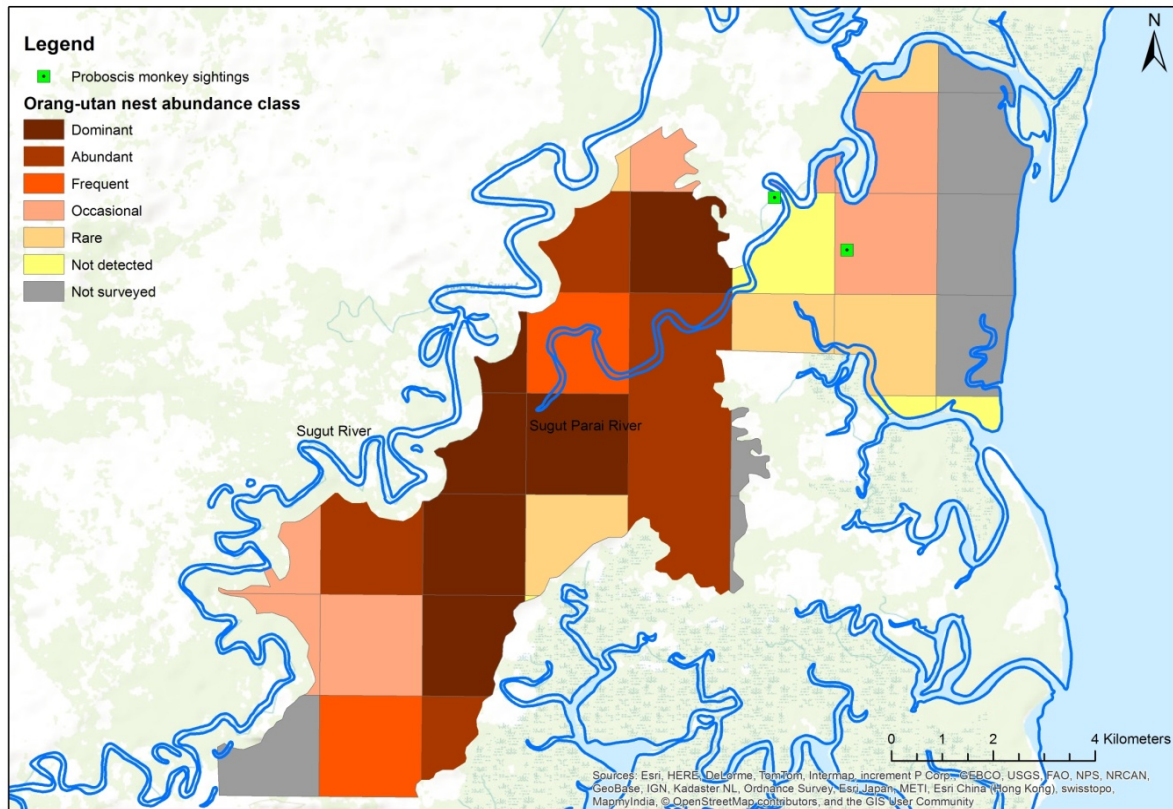


Figure 3.4. Estimated relative distribution of orang-utans and locations of proboscis monkey sightings in Trusan Sugut Forest Reserve.

3.3.2 Proboscis monkey

Proboscis monkey is a totally protected species under the Sabah Wildlife Conservation Enactment 1997, is endemic to Borneo, and is classified as endangered in the IUCN Red List (IUCN, 2015). A survey for proboscis monkey was carried out along Sg. Sugut Parai, and some associated mangrove creeks, which fall inside the Trusan Sugut FR. Observations were made from a boat and the sizes and composition of groups of monkeys were recorded. Approximately 25 individuals from two harems and a group consisting of all males were observed⁴ (FRC/SFD, unpublished report). A previous study estimated that the population of proboscis monkeys along the whole stretch of Sugut River (some length of which is located adjacent to Trusan Sugut FR) was 787 individuals in 58 groups (Sha *et al.*, 2008). The current population status of proboscis monkey in the Sugut River is unknown, although some were sighted in the river stretch adjacent to Trusan Sugut FR by WWF teams in 2014.

3.3.3 Other terrestrial mammals

Terrestrial wildlife were surveyed using camera-traps along forest trails, for which 28 camera-traps (Reconyx PC-900) were used. 2,706 trap-days of effort was made over a four-month period (Appendix 7 has a map of locations of camera-traps). Animals were identified using Payne and Francis (2007) and taxonomic nomenclature follows that of Wilson and Reeder (2005). The conservation status of species as in IUCN Red list of Threatened Species (IUCN, 2015) and Sabah Wildlife Conservation Enactment 1997 are listed below (Table 3.2).

⁴ This survey was conducted only along Sugut Parai river, over a short period of time.

Ten out of 20 terrestrial mammal species detected in Trusan Sugut FR are considered in the IUCN Red List as critically endangered, endangered, or vulnerable (Appendix 8 gives the full list of species detected). These species have been accorded with different levels of protection under the Sabah Wildlife Conservation Enactment 1997 (WCE 1997). Orang-utans were photo-captured at many locations across the reserve while other species which are either totally protected (Schedule 1) or listed as “endangered” in IUCN Red List were detected in just a few locations (Figure 3.5).

Table 3.2. Terrestrial mammal species detected in camera-trap surveys in Trusan Sugut FR that were considered critically endangered, endangered or vulnerable in IUCN Red List.

Common Name	Scientific name	Conservation / Legal Status	
		IUCN Red List	Sabah Wildlife Conservation Enactment 1997
Bornean orang-utan*	<i>Pongo pygmaeus</i>	Critically	Schedule 1
Banteng	<i>Bos javanicus</i>	Endangered	Schedule 1
Sunda clouded leopard	<i>Neofelis diardi</i>	Vulnerable	Schedule 1
Malayan sun bear	<i>Helarctos malayanus</i>	Vulnerable	Schedule 1
Bay cat*	<i>Catopuma badia</i>	Endangered	Schedule 2
Pig-tailed macaque	<i>Macaca nemestrina</i>	Vulnerable	Schedule 2
Oriental small-clawed otter	<i>Aonyx cinerea</i>	Vulnerable	Schedule 2
Banded palm civet	<i>Hemigalus derbyanus</i>	Vulnerable	Schedule 2
Bearded pig	<i>Sus barbatus</i>	Vulnerable	Schedule 3
Sambar deer	<i>Rusa unicolor</i>	Vulnerable	Schedule 3

* species endemic to Borneo. **Sabah Wildlife Conservation Enactment 1997**, Schedule 1 – Totally protected species; Schedule 2 – Protected species for which hunting license is required and collection is limited; Schedule 3 – Protected species for which hunting license is required.



Camera-trap photos of a bay cat and a yellow-throated marten in Trusan Sugut FR.

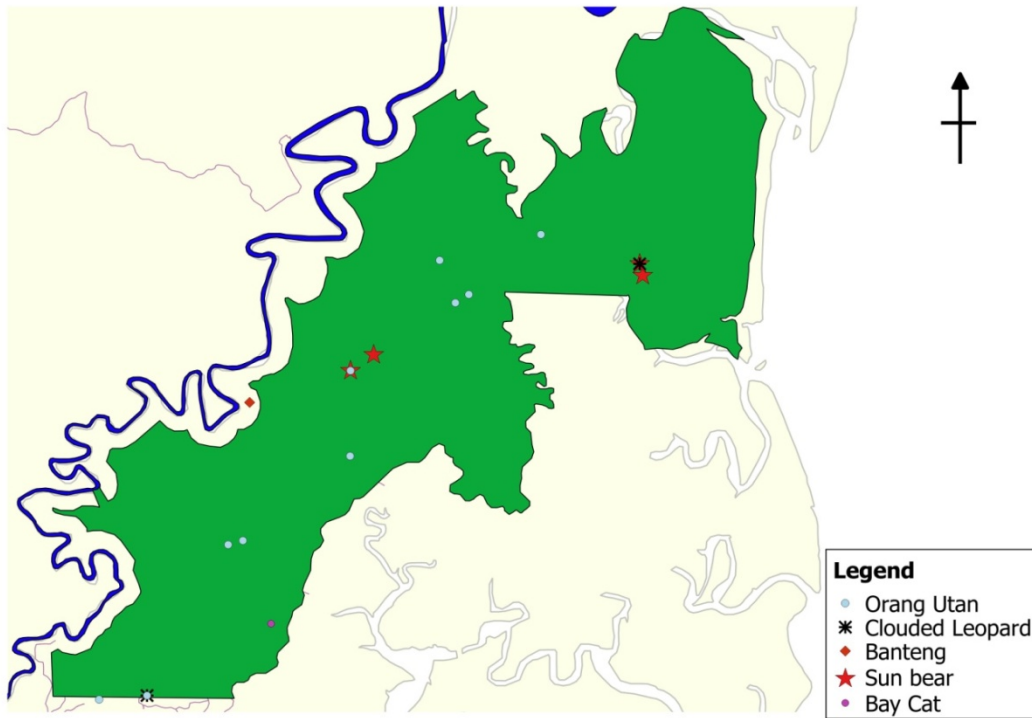


Figure 3.5. Locations where species either totally protected (Sabah WCE 1997: Schedule 1) or listed as "critically endangered" or "endangered" in IUCN Red List detected in camera-trap surveys in Trusan Sugut FR.

3.3.4 Birds

Bird diversity was documented by carrying out 10-minute point-counts at 69 pre-determined locations (Appendix 9 has a map of point-count locations). These locations were generated randomly, taking into account the different forest types but avoiding roads and water bodies. The aim was to cover all forest / habitat types as much as possible and for these points to serve as standard points for monitoring birds over time. Species detected (seen or heard) were recorded following a set of protocols and corresponding datasheets (Appendix 10). Bird species that were detected at other locations and times (not during point-counts) were also recorded separately.

Ten out of 230 bird species recorded in Trusan Sugut FR are classified as critically endangered, endangered, or vulnerable (Table 3.3; Appendix 11 for full list of bird species found in Trusan Sugut FR). Seven species endemic to Borneo have also been observed to occur here. Out of these, two are considered vulnerable in the IUCN Red List and also protected under the Sabah Wildlife Conservation Enactment (Table 3.3).

Table 3.3. Bird species found in Trusan Sugut FR which are considered as vulnerable and endangered in the IUCN Red List (2014). Adapted from John Bakar (unpublished report).

Common Name	Scientific name	Conservation/ Legal Status	
		IUCN	Sabah Wildlife Conservation Enactment (Schedule II)
Helmeted hornbill	<i>Rhinoplax vigil</i>	Critically	x

		endangered	
Chestnut-necklaced Partridge *	<i>Arborophila charltonii</i>	Vulnerable	x
Storm's Stork	<i>Ciconia stormi</i>	Endangered	x
Lesser Adjutant	<i>Leptoptilos javanicus</i>	Vulnerable	x
Chinese Egret	<i>Egretta eulophotes</i>	Vulnerable	x
Wallace's Hawk Eagle	<i>Nisaetus nanus</i>	Vulnerable	x
Far Eastern Curlew	<i>Numenius madagascariensis</i>	Vulnerable	x
Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	Vulnerable	
Blue-headed Pitta*	<i>Hydrornis baudii</i>	Vulnerable	x
Mangrove Pitta ⁵	<i>Pitta megarhyncha</i>	Near-threatened; Rare	

* – species endemic to Borneo



Crested fireback and great Argus pheasants photo-captured in trail cameras in Trusan Sugut FR.

3.3.5 Fishes

Two waterways were surveyed - the Sugut river extending from the river-mouth up to Kg Pantai Buring in the upstream, and the Sg. Sugut Parai extending from the river-mouth to the narrow point at which the river branches out into the swamp forests. On a smaller scale, the Sugut river estuary was also surveyed. Fishes were also caught and recorded at one point near Kuala Sabang, located outside the forest reserve. Fishes were caught using gill nets, cast nets and fishing lines. On three different occasions, landed fish at the market in Kg. Trusan Sugut were also examined for species diversity and prices. Interviews with villagers and fishermen were also conducted.

28 species of fish were recorded during this survey (Appendix 12). None of the fish species recorded in this survey is endangered or protected by any law.

⁵ The mangrove pitta, although near-threatened, is a naturally rare species and should be given extra attention.

3.3.6 Plants

Ten permanent sample plots (0.13 ha) were established in the different forest types in Trusan Sugut FR (Appendices 14). Trees ≥ 10 cm dbh were identified to species level in the field according to their distinctive field characteristics. For those that could not be readily identified, voucher specimens were collected for subsequent determination at the Sandakan Herbarium.

584 species of plants were identified and described during the survey (see Nilus and Sugau, 2015 for a full list of plant species). Out of these, 7 species are listed as Vulnerable (VU), 4 species as Endangered (EN) and 9 as Critically Endangered (CR) in the IUCN Red List; 35 of these 584 species are further protected by Sabah Forestry Enactment 1968 and 16 under the Wildlife Conservation Enactment (WCE) 1997 (Nilus and Sugau 2015; Table 3.4).

Out of the 584 identified species, 107 were found to be endemic to Borneo, with 10 species further endemic to Sabah. Furthermore, out of the 107 endemic species, 5 are critically endangered, 3 endangered and 2 considered vulnerable according to the IUCN Red List.

Table 3.4. List of threatened and endangered plant species, including those protected by state forestry and wildlife laws.

Family	Species	IUCN	SFD Prohibited	WCE
Anacardiaceae	<i>Dracontomelon dao</i>	NE	Yes	No
Anacardiaceae	<i>Mangifera foetida</i>	LC	Yes	No
Anacardiaceae	<i>Mangifera griffithii</i>	NE	Yes	No
Anacardiaceae	<i>Mangifera macrocarpa</i>	VU	Yes	No
Anacardiaceae	<i>Mangifera swintonioides</i>	NE	Yes	No
Burseraceae	<i>Dacryodes rostrata</i>	LC	Yes	No
Burseraceae	<i>Santiria laevigata</i>	LC	Yes	No
Dipterocarpaceae	<i>Anisoptera costata</i>	EN (VU)	No	No
Dipterocarpaceae	<i>Anisoptera reticulate</i>	CR	No	No
Dipterocarpaceae	<i>Dipterocarpus validus</i>	CR	No	No
Dipterocarpaceae	<i>Parashorea malaanonan</i>	CR	No	No
Dipterocarpaceae	<i>Shorea acuminatissima</i>	CR	No	No
Dipterocarpaceae	<i>Shorea agamii</i>	EN	No	No
Dipterocarpaceae	<i>Shorea almon</i>	CR	No	No
Dipterocarpaceae	<i>Shorea andulensis</i>	EN	No	No
Dipterocarpaceae	<i>Shorea argentifolia</i>	EN	No	No
Dipterocarpaceae	<i>Shorea seminis</i>	CR	No	No
Dipterocarpaceae	<i>Shorea symingtonii</i>	CR	No	No
Dipterocarpaceae	<i>Shorea smithiana</i>	CR	No	No
Dipterocarpaceae	<i>Shorea superba</i>	CR	No	No
Dipterocarpaceae	<i>Vatica maritime</i>	EN	No	No
Fabaceae	<i>Koompassia malaccensis</i>	LC	Yes	No
Malvaceae	<i>Durio acutifolius</i>	VU	Yes	No
Malvaceae	<i>Durio lanceolatus</i>	NE	Yes	No
Malvaceae	<i>Durio testudinarius</i>	NE	Yes	No
Moraceae	<i>Artocarpus dadah</i>	NE	Yes	No
Moraceae	<i>Artocarpus kemando</i>	NE	Yes	No
Nepenthaceae	<i>Nepenthes ampullaria</i>	NE	No	Yes

Family	Species	IUCN	SFD Prohibited	WCE
Nepenthaceae	<i>Nepenthes gracilis</i>	NE	No	Yes
Nepenthaceae	<i>Nepenthes mirabilis</i>	NE	No	Yes
Nepenthaceae	<i>Nepenthes rafflesiana</i>	NE	No	Yes
Orchidaceae	<i>Acriposis liliifolia</i>	NE	No	Yes
Orchidaceae	<i>Bromheadia finlaysonian</i>	NE	No	Yes
Orchidaceae	<i>Bulbophyllum lepidum</i>	NE	No	Yes
Orchidaceae	<i>Claderia viridiflora</i>	NE	No	Yes
Orchidaceae	<i>Dendrobium pinifolium</i>	NE	No	Yes
Orchidaceae	<i>Eria longirepens</i>	NE	No	Yes
Orchidaceae	<i>Liparis lacerate</i>	NE	No	Yes
Phyllanthaceae	<i>Baccaurea cf. sumatrana</i>		Yes	No
Phyllanthaceae	<i>Baccaurea lanceolata</i>	NE	Yes	No
Phyllanthaceae	<i>Baccaurea macrocarpa</i>	NE	Yes	No
Phyllanthaceae	<i>Baccaurea odoratissima</i>	VU	Yes	No
Phyllanthaceae	<i>Baccaurea parviflora</i>	NE	Yes	No
Phyllanthaceae	<i>Baccaurea sumatrana</i>	NE	Yes	No
Phyllanthaceae	<i>Baccaurea tetrandra</i>	NE	Yes	No
Phyllanthaceae	<i>Baccaurea trigonocarpa</i>	NE	Yes	No
Rhizophoraceae	<i>Bruguiera parviflora</i>	LC	Yes	No
Rhizophoraceae	<i>Ceriops decandra</i>	LC	Yes	No
Rhizophoraceae	<i>Ceriops tagal</i>	LC	Yes	No
Rhizophoraceae	<i>Rhizophora apiculata</i>	LC	Yes	No
Rhizophoraceae	<i>Rhizophora mucronata</i>	LC	Yes	No
Rubiaceae	<i>Scyphiphora hydrophyllacea</i>	LC	Yes	No
Rutaceae	<i>Maclurodendron pubescens</i>	VU	No	No
Sapindaceae	<i>Dimocarpus longan</i>	NT	Yes	No
Sapindaceae	<i>Nephelium deadaleum</i>	NE	Yes	No
Sapindaceae	<i>Nephelium ramboutan-ake</i>	NE	Yes	No
Sapindaceae	<i>Nephelium uncinata</i>	NE	Yes	No
Thymelaeaceae	<i>Gonystylus affinis</i>	NE	Yes	No
Thymelaeaceae	<i>Gonystylus bancanus</i>	VU	Yes	No
Thymelaeaceae	<i>Gonystylus forbesi</i>	NE	Yes	No
Thymelaeaceae	<i>Gonystylus nervosus</i>	VU	Yes	No
Vitaceae	<i>Tetrastigma diepenhorstii</i>	NE	No	Yes
Zingiberaceae	<i>Alpinia aquatica</i>	NE	No	Yes
Zingiberaceae	<i>Alpinia havilandii</i>	NE	No	Yes
Zingiberaceae	<i>Etlingera fimbriobracteata</i>	NE	No	Yes
Zingiberaceae	<i>Globba pendula</i>	NE	No	Yes

IUCN Red List: CR= Critically endangered; EN=Endangered; VU=Vulnerable; NT=Near threatened; LC=Least concern; NE=Not Evaluated.

IUCN Conservation status without brackets follows the global assessment; conservation status in brackets () is based on the Malaysian Plant Red List; conservation status in brackets () and * is based on regional assessment for the Sabah endemic Dipterocarp. Blank denotes no data. Adapted from Nilus and Sugau (2015).

3.3.7 **Wildlife: management implications**

Monitoring species of conservation concern:

Given that Trusan Sugut FR is a relatively small sized protected area, the survival of many animal species are likely dependent on usage of adjacent forest areas on a regular basis. Therefore, the land-use changes and other threats to species in adjacent areas will impact the population status of the species that occur in the reserve. A crucial part of management of species of conservation concern, particularly the large-bodied animals and the threatened species of plants and animals is to monitor changes in their distribution and population abundance in the reserve and the threats they face in the larger landscape. Such monitoring would inform relevant and timely management actions and will also help assess the impact of management actions.

Orang-utan – forest restoration for enriching and expanding habitat:

The population of orang-utan that occurs in the reserve may have become isolated over time. The closest population that existed in the past was in Bonggaya FR, which now has largely been deforested and the remaining riparian forests are probably connected to Trusan Sugut FR only through the mangrove forests. Therefore, to maintain or increase the existing orang-utan population in the reserve, the forest habitat may need to be enriched and expanded by restoration planting.

Orang-utan – securing connectivity and expanding habitat:

The survival probability of the largely isolated population of orang-utan in Trusan Sugut FR can be increased by ensuring and strengthening connectivity to the adjacent peat-swamp forests of the Sugut (production) FR to the west, across the river Sg. Sugut. Securing such connectivity will expand habitat for the orang-utan population, increase diversity and seasonal availability of food resources and therefore may make the orang-utan population larger and more viable.

Banteng – enforcement against poaching and extension of protection forest reserve:

It is of great significance that the endangered wild cattle, banteng, was found to occur in Trusan Sugut FR. This large mammal species is likely to be long-ranging and is under severe threat of poaching outside protection forest reserve. Securing the remaining animals of this species require strong law enforcement against poaching. To increase the chance of banteng population growth so it can reach the level required for population viability, much larger and more secure area needs to be made available for it. This would be possible only by securing connectivity to adjacent forest reserves, particularly the larger Sugut FR to the west, across the river Sg. Sugut.

Mammals and birds – enforcement against poaching/trapping:

The biggest threat to the significant diversity of mammal and bird species that occur in Trusan Sugut FR is poaching – carried out with firearms, snares, and live traps for birds. Stronger law enforcement against poaching, particularly along the rivers which give the poachers easy access by boat into the reserve, is needed. Protected species such as Malayan sun bear and the critically endangered helmeted hornbill are particularly threatened by poaching driven by illegal wildlife trade.

Fishes – protection from over-fishing:

The fish diversity and abundance in Sg. Sugut Parai and the brackish water creeks in and near Trusan Sugut FR have not been well documented. Further information is much needed to plan appropriate management measures. Protection from over-fishing is a measure likely to be considered.

Plants – protection from illegal felling:

The threatened and rare species of plants require protection from illegal felling and over extraction for local household use. Some of these species can be usefully included for planting in the enrichment planting areas.



Small-scale clearing of forests on state land, which divides Trusan Sugut FR and Sugut (Class II) FR.



Peat-swamp forests in Sugut (Class II) FR – bringing these areas under legal protection would expand habitat for orang-utans and the long-ranging species occurring in Trusan Sugut FR.

3.4 HCV values (1 to 4) – assessment

Field surveys to document the presence and abundance of various wildlife taxa, and in turn help prepare this FMP, were conducted by WWF-Malaysia's Sabah Terrestrial Conservation Programme team and other experts hired by WWF or Sabah Forestry Department. The flora assessment was conducted by Forest Research Centre of the Sabah Forestry Department (Nilus and Sugau 2015). The data from these surveys also formed the basis of a HCV assessment report, which has been prepared by WWF-Malaysia, according to the guidelines of the HCV Resource Network. Surveys covered terrestrial mammals, orang-utan, proboscis monkey, birds, fish, and flora. Forest cover and condition were mapped, and forest connectivity at the landscape scale was assessed.

HCVs of all types were present in Trusan Sugut FR. The reserve, having been gazetted as a class I (protection) forest reserve would itself make the whole reserve a HCV 1.1. Surveys confirmed that the biodiversity values (HCV 1 & 3) are indeed significant and diverse, with many fauna species currently listed as critically endangered, endangered or vulnerable in the IUCN Red List of Threatened Species (IUCN 2015). Many plant and animal species endemic to Sabah and Borneo have also been found in the reserve. Some threatened forest types (lowland freshwater swamp forest, lowland Kerangas forest and lowland mixed *Dipterocarp* forest) are also present in the reserve. Trusan Sugut FR is one of the few places in Sabah where naturally occurring unique species of plants and animals, forest types and ecosystems can be found within a small protected reserve. Unfortunately, due to past logging and fires, some parts of the reserve have been severely degraded and in need of restoration.

Trusan Sugut FR currently remains connected to the forests of the larger Sugut (Class II, production) FR to the west, and to the class V (mangrove) forest reserves to south, north and east (Figure 3.6). Trusan Sugut FR is thus currently a HCV 2 (landscape level forest) but may become more isolated in the long run as more land surrounding the forest reserve gets converted to non-forest land-use. It is crucial that Trusan Sugut FR stays connected to other forested habitats so that animal/plant populations can use and disperse into.

Mangroves found in the reserve may serve as critical temporal use areas, such as important breeding ground and nurseries for a lot of fish species, whereas estuarine areas are important for migratory shore birds which make full-use of these productive sites during their long journey south or northwards along the East Asian - Australasian flyway. These characteristics make the area important in relation to HCV 1.4.

Of the various forest types found in Trusan Sugut FR, the lowland freshwater swamp forest, lowland seasonal freshwater swamp forest, and the lowland *Dipterocarp* forest have become greatly reduced in extent across Sabah over the past few decades, and are now considered endangered in Sabah (WWF-Malaysia, unpublished report). The areas in the Trusan Sugut FR that contain these endangered forest types are HCV 3. Due to its location upstream of the villages Kg. Pantai Boring and Kg. Terusan Sugut (Figure 2.7), and its part drainage into River Sugut, the Trusan Sugut FR contributes to clean freshwater provisioning service which is HCV 4. Further details, including the maps of distribution of each HCV type in Trusan Sugut FR, can be found in the HCV assessment report prepared by WWF-Malaysia.

A composite map of locations and extent of various types of HCV in Trusan Sugut FR shows that the whole reserve is covered by HCVs (Figure 3.6). This is despite the fact that the locations given here are simply where sampling was done to document the HCV-1 values; had more sampling been done, the extent of HCV-1 would have been potentially larger. On the whole, the overlapping extent of various types of HCVs over the entire area of Trusan Sugut point to the great importance of the reserve as a HCV area, and underline the crucial need for managing the whole reserve effectively and carefully.

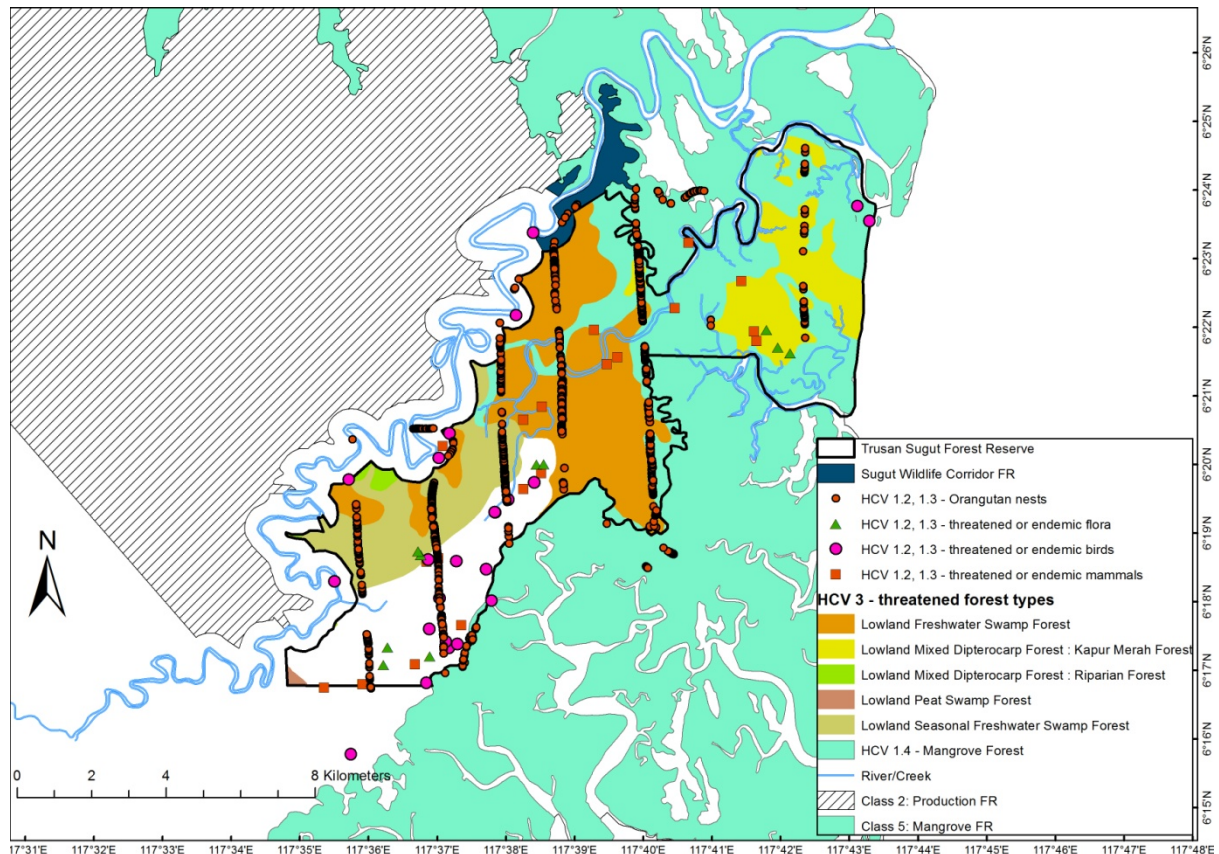


Figure 3.6. A composite map showing locations of various types of high conservation values (HCV 1 to 4) in Trusan Sugut FR.

3.5 HCV values (5 and 6) – assessment

A social baseline assessment was conducted in 2015 by a consultant hired by the SFD (Symbiosis Consulting). In terms of social values, Trusan Sugut FR and adjacent forest reserves remain important for local communities as a source of forest produce, mainly wood for their household needs. The village that relied most heavily upon forest produce is Kg. Pantai Boring, which is closest to the reserve. Several cultural sites which are significant for the nearby local communities have also been identified in and near Trusan Sugut FR.

Data was collected using both quantitative and qualitative methodologies. For the former, this method consisted of focal group discussions, informal interviews, spatial analysis and observational techniques. For the latter, household interviews were conducted. Four villages surrounding Trusan Sugut FR were selected for the study, namely Kg. Kaliaga, Kg. Pantai Boring, Kg. Terusan Sugut and Kg. Kaniogan (Figure 2.7).

4 THREATS AND CHALLENGES TO TRUSAN SUGUT FR

4.1 Encroachment

Encroachment by local people, such as small scale clearing of forests for cultivation and building huts have been observed in the past in Trusan Sugut FR and in the adjacent mangrove forest reserves. Apart from the illegality and direct effect of forest loss due to such clearing, there would be many indirect effects on forests. For instance, increased risk of illegal felling of trees in the nearby areas, increased poaching of animals, soil loss, pollution from the croplands, pollution from domestic waste and transportation, increased risk of fire, invasive species and spread of diseases. Such encroachments, if not controlled, may increase and cause further aggravation of these impacts. Surveillance, patrolling and enforcement are necessary to stop and remove such encroachments and clearings to protect the reserve from these and other related disturbances.

4.2 Illegal timber felling

Illegal felling of large trees of timber value has been observed occasionally in some parts of the reserve. It has been a long-standing issue in the Trusan Sugut FR, and according to district forestry records, many such illegal activities were detected prior to 2014. However, increased protection effort in the recent years has reduced the frequency of this threat. Local people also collect timber at a small scale for domestic use.

4.3 Excessive collection of non-timber forest produce (NTFP)

The main NTFP collected in the reserve is mangrove bark (*Ceriops tagal*, Tengar). The most recent occurrence of mangrove bark theft was recorded along Pintasan River in April 2014. Often such collection is done by smugglers coming in by boats from the Sulu Sea side. About 30% of the Trusan Sugut FR is covered by mangroves and the surrounding forest reserves have extensive mangrove cover. Among the rivers that are vulnerable to such felling and encroachment are Sg. Tagahang Besar, Sg. Koyak, Sg. Geriting, Sg. Manangin, Sg. Matambok, Sg. Sugut Parai, Sg. Parit, and Sg. Wewef. Other NTFP collected include *Gaharu* wood and bird (swiftlet) nests.

4.4 Poaching

Poaching of animals such as sambar deer, muntjac, and mouse deer for household consumption and local trade in bushmeat is a serious threat to the wildlife of the Trusan Sugut FR. Often the animals are caught by snares (*jerat* traps) and many non-target species may also be impacted by this. People from nearby areas with illegal guns (unlicensed or home-made guns [called *bekakuk*]) are often the poachers, while sport-hunters from urban areas and oil palm estates may also occasionally poach, particularly in areas with road access.

Species such as banteng are highly sought after and at a high risk of being poached. Species such as helmeted hornbill fetch a high value ('red ivory') in the local and international markets and

are at high risk as well. Small population sizes of animals potentially supported by such a fairly small reserve means a more serious impact on animal populations due to such bush-meat hunting even if it occurs at low levels. Poaching of pangolin, helmeted hornbill, Malayan sun bear, and other such species of high value in local and global illegal wildlife trade may be done by organized groups.

4.5 Illegal fishing

Prior to the field implementation of the SFM project in Trusan Sugut FR, local community members entered the reserve freely via the many rivers. However, beginning in 2014, with the increased presence of SFD personnel on the ground, access was closely monitored and regulated. In order to ensure that newly introduced access restrictions into the reserve did not affect the livelihood of the local community, the tagal system of regulated fishing has been introduced for the Sugut Parai River. Trawling in the Sugut river estuary and along the coast may also have some impact on the mangrove resources of the reserve.

4.6 Fire

Fire is a major threat to Trusan Sugut FR as most of the reserve has been logged and is categorised as secondary growth vegetation (Nilus and Sugau, 2015). It is known that secondary vegetation or disturbed forests are more susceptible to fire in comparison to pristine forests (Woods, 1989). Furthermore, human settlements and agricultural land located near the reserve increases the risk of fire. In the 1998 El Nino event, drought-related fire events devastated 190,000 ha of forest reserves in Sabah, including some areas of the Sugut FR (SFD, 2015). In 2015, during the dry period, there was a big forest fire in the adjacent Sugut Forest Reserve (north of Sg. Sugut) and the fire nearly spread to Trusan Sugut FR but for Sg. Sugut that separates the two forest reserves (M. Salutan, SFD, pers. comm.).

The main causes of fire are open burning for clearing land for agriculture in the adjacent areas, camping inside the forest reserve by poachers / illegal fisherman, and occasionally arsonists deliberately setting fire to forests. The area that is most vulnerable to fire threats is close to Kg. Pantai Boring. Since the field presence of this project, no fire has been detected within the Trusan Sugut FR. One of the ways of controlling the threat of fire is to create awareness amongst the local communities through garnering support of village heads against the practice of opening burning. The forestry field office should ensure that all fire-fighting equipment are in good order at all times. Near-real time alerts provided by NASA satellites should be utilised for constant fire monitoring during the dry periods.

4.7 El Nino drought

In Southeast Asian tropical rain forests, long drought events are associated with the atmospheric and oceanic anomaly known as the El Niño-Southern Oscillation (ENSO) phenomenon (Walsh, 1996). Frequent occurrences of these severe drought events have increased the susceptibility of vegetation to wildfire. Other than fire, these drought events also cause direct tree mortality due to conditions of water stress.

4.8 Pollution of rivers

Currently, the pollution levels in the river Sugut near the Trusan Sugut FR is not severe, partly due to the high water flow and consequent dilution effect (WWF-Malaysia, 2016). However, the developments in the upper reaches of the river should be monitored and interventions made if the water quality gets any worse. In contrast, the smaller rivers in the nearby oil palm plantations are heavily polluted, although it is not evident at this point if there is any serious impact on the reserve due to this.

4.9 Security of the reserve, staff and users of the forest reserve

A Protection Unit has been established to monitor and control the threat of poaching, encroachment, and fire. A gate has also been installed at the entrance road to regulate vehicle access into the area. The local community living in nearby villages are expected to benefit from the protection and regulated use of forest resources, such as honey, fruits, and fish.



5 MANAGEMENT PRESCRIPTIONS

5.1 Actions to address threats and achieve short term objectives

The specific threat reduction objectives (1 – 2 years scale) include:

- i) Reducing the threats to forests and tree species by surveillance and enforcement against encroachment and illegal logging;
- ii) Reducing the threats to wildlife species by patrolling and enforcement against poaching and illegal fishing activities;
- iii) Preventing and controlling fire, particularly by being prepared during El Nino drought years;
- iv) Monitoring and protecting rivers and streams from upstream pollution sources;
- v) Engaging communities to regulate traditional use of forest resources, to provide benefits of environmental services, and to elicit support for protection of the reserve; and
- vi) Promoting regulated recreation and low-impact tourism in the reserve.

5.1.1 Boundary surveys and demarcation

Boundary surveys and demarcation of the boundary on the ground is necessary to prevent encroachments, enforce law and to ensure a strong case against offenders in the court of law. Field survey and demarcation of the boundary shared with IJM and Sayongmas plantations was completed in 2011. This was followed by the demarcation of boundary adjacent to private lands around Kg. Pantai Boring in 2015. The remaining work on this for the rest of the reserve will be scheduled to be completed in the first two years of implementation of this FMP.

5.1.2 Protection and law enforcement

The primary function of Trusan Sugut FR as a Class I protection FR is conservation of forests and wildlife, and ensuring continued flow of environmental services. Protection and law enforcement against encroachments, fire, illegal felling, illegal extraction of mangrove bark, poaching, illegal fishing and other destructive activities are thus crucial management activities of the reserve.

In case of encroachments, forest fires and illegal hunting offences, action is initiated under the provisions of the Forest Enactment 1968 and Wildlife Conservation Enactment 1997. Forest Enactment 1968 and Forest Rules 1969 provide guidance on the security and protection of the reserve. The following activities are fundamental to effective enforcement: a) formulation of enforcement strategies; b) maintenance of patrolling activities; and c) enhancement of capacity of forestry personnel to remain competent in the enforcement activities.

Authority for law enforcement has been delegated to armed officers who are stationed in the reserve. A forest checking station and boat jetties have been constructed in the reserve to support movement and camping of enforcement officers. Routine land, sea and aerial monitoring will be implemented. The department will also periodically conduct joint operations with the Royal Malaysian Police to curb illegal extraction of mangrove bark by illegal aliens from nearby countries.

To facilitate legal proceedings against offenders, the department has demarcated the reserve boundary on the ground and signages have been installed in various parts of the reserve.

Several sessions of dialogues with local communities have been conducted to create awareness on restrictions in the reserve and on the importance to protect the area. Stakeholder and local community committees have been formed to discuss and resolve issues which are in conflict with the interests of both the reserve and its stakeholders.

Zoning for surveillance and patrolling

The frequency and type of illegal activities varies across the reserve and correspondingly the type and intensity of surveillance and patrolling efforts will need to be varied. To efficiently distribute these efforts, a zoning plan has been prepared for Trusan Sugut FR (Figure 5.1).

Threats in each zone and the proposed type and intensity of patrol efforts:

Zone 1 – Poaching activities with dogs and firearms have been observed in this zone and the poachers are most likely from nearby estates and villages. Poaching was at its peak during the recent drought season when poachers burnt some areas to flush out wildlife to hunt, especially near oxbow lakes. Illegal felling and mangrove bark (*Tengar*) extraction, carried out by smugglers from Philippines, have also been observed in Zone 1.

Proposed actions: Conduct patrols by vehicle and boat four times a week; deploy surveillance camera-traps in the area; and put up signboards.

Zone 2 – Encroachment by villagers, mostly clearing forests for planting crops, have been observed in Zone 2. Encroachers normally access the reserve by boat across the Sugut river.

Proposed actions: Conduct patrols by boat along the Sugut river twice a week normally, and four times a week during seasonal flooding. Explore the use of surveillance drones along the course of the river.

Zone 3 – Relatively less human activity in this zone due to more difficult accessibility. However, permanent presence of rangers in this zone is essential to prevent trespassing.

Proposed actions: Maintain permanent presence of rangers in forestry station or Timbang 1 jetty, and conduct patrols by foot and boat twice a week.



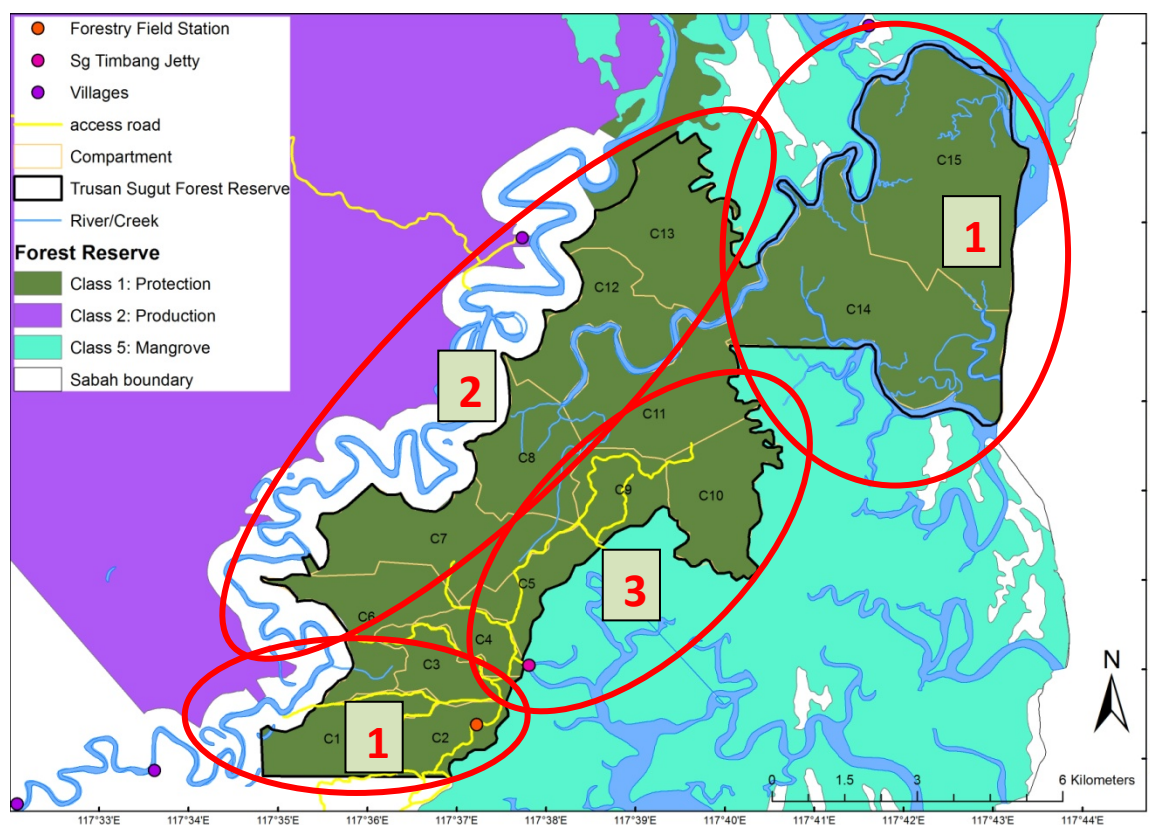


Figure 5.1. Zoning plan (circled and numbered in red) for various types and intensities of surveillance and patrolling in Trusan Sugut FR.

Assessment of enforcement capacity and needs

An assessment of enforcement capacity of the reserve, compared against "Enforcement Minimum Standards (EMS)" was carried out in September 2014, by WWF-Malaysia together with the field manager and rangers of Trusan Sugut FR. The main idea of this assessment is to identify the specific needs, in terms of resources and staff training, for strengthening enforcement capacity.

The EMS standards was established by WWF Greater Mekong program, to assist measuring and monitoring law enforcement in protected areas. 11 criteria were identified in the EMS (details in Appendix 16). Each criterion is given a score subjectively by the project manager and rangers. The total score needed to meet the minimum standards is 23, and excluding criterion #9 (multi agency patrols) where it is not relevant, it is 21. The bare minimum score to meet the standards is 10.5 (50%) and this is expected to be increased over time with increased management inputs towards meeting the minimum standards.

In the assessment conducted in September 2014, the total score obtained by Trusan Sugut FR was 9 (Figure 5.2). The reserve scored full points ('3') for the criteria, 'minimum number of rangers' and 'power of detention', but fell short of ideal in criterion such as 'informer network'. At the same time, the reserve could not get any score for other criteria such as 'having an enforcement plan', 'trained wildlife crime scene investigator (WCSI)', etc. This assessment thus identified the specific inputs needed to further strengthen the enforcement capacity (Table 5.1). These capacity needs are expected to be met in the current FMP period.

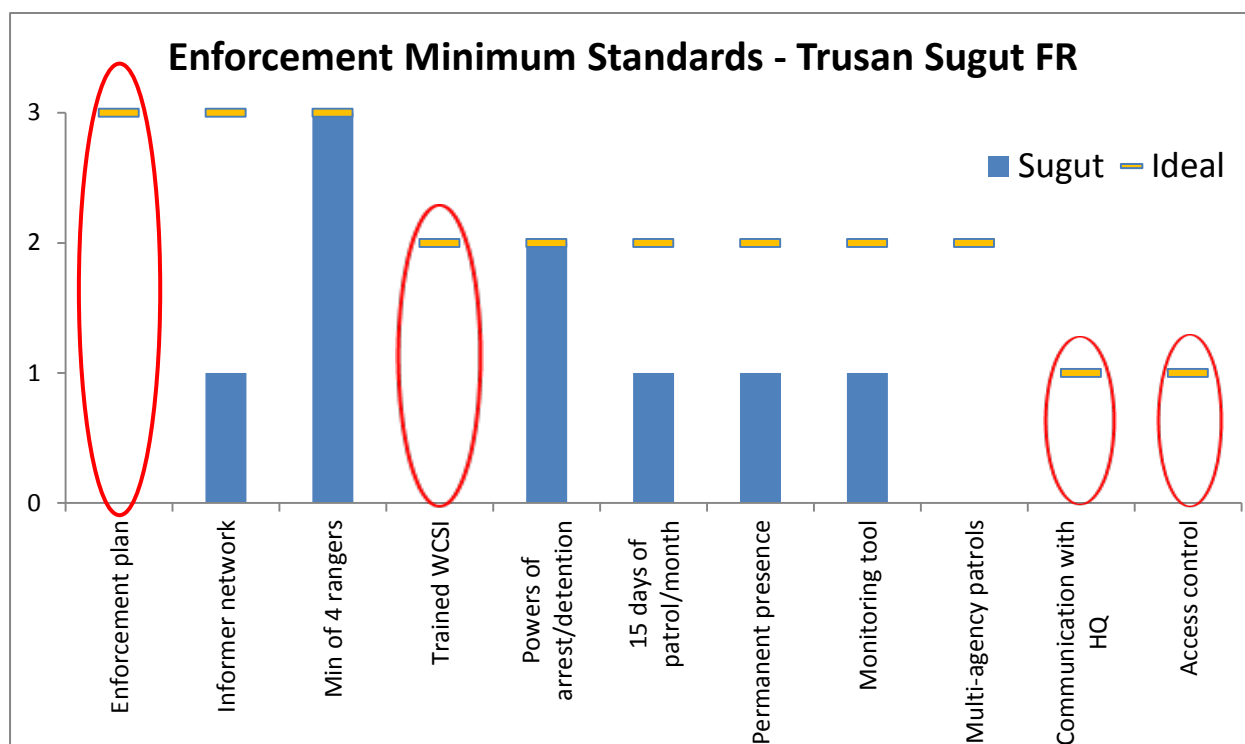


Figure 5.2. Enforcement minimum standards scores obtained by Trusan Sugut FR in September 2014 (blue bars), compared with the minimum acceptable standards (flat markers, called “ideal” here). Some of the main needs are circled in red.

Table 5.1. The additional inputs needed for strengthening enforcement capacity of Trusan Sugut FR, as identified in the assessment conducted in September 2014 against enforcement minimum standards.

No.	Standards/Criterion	Situation in 2014	Inputs needed
1.	Enforcement Plan - An enforcement strategy and implementation plan must be in place for the protected area.	No enforcement plan	An enforcement plan needs to be developed by the reserve management. SMART system of patrols could be adopted for greater effectiveness and efficiency.
2.	Intelligence/Informer network - Enforcement patrols must be supported by an informer network. Information to be used to plan patrols and raids in “hotspots”.	Occasionally received inputs from a marginal set of informers	Currently, the ranger team only receives some occasional tips either from the local villagers or plantation workers. “Hotspots” of poaching and other forest offences need to be identified.
3.	A minimum of 4 Rangers - A minimum of four rangers on an enforcement patrol (for foot patrol). Minimum of 3 Rangers (for mobile patrol).	100% of patrols go out with four or more rangers	There are 10 staff including a manager in Trusan Sugut FR. However, there is only 1 team with 3 staff dedicated to carry out patrolling, which needs to be increased. Also, necessary equipment should be provided.
4.	Trained Investigator / evidence officer / Wildlife Crime Scene Investigator (WCSI) - An enforcement patrol team must include a trained investigator.	No trained investigator / evidence officer / WCSI	The rangers have some on the job experience but would need to be professionally trained further.
5.	Powers of arrest or detention - An enforcement patrol team must have powers of arrest or detention.	The members have powers of arrest/detention and actively enforce forest legislation.	They are already empowered to enforce the Forest Enactment 1968 and Forest Rules 1969.

6.	Fifteen days of patrols per month - Minimum of fifteen days/nights of ranger patrols per month.	5 – 14 days of patrol conducted	Patrol are currently done at least once a week by boat. This needs to be increased.
7.	Permanent presence of rangers - Some rangers should be permanently based in the PA at ranger stations, outposts or access points.	Rangers stationed 10 – 22 days per month, during office hours including weekend duty.	Currently, there is an office in the FR and a quarters adjacent to the reserve (Sabang jetty). A field station and a cabin in Timbang-1 has been built. These are adequate.
8.	Monitoring tool - A law enforcement monitoring tool must be in place. This will depend on the PA, but it is encouraged that a standard system such as SMART be used.	In place – reports are produced irregularly or are regular but need further improvement.	The staff have been trained in SMART system in August 2014, and currently reports are produced after each operation. Periodical checking is needed to ensure that these reports are produced using SMART.
9.	Multi-agency patrols - An enforcement patrol team may include multiple agencies. Some PAs require multi-agency patrols to cover jurisdictional issues.	Required by legislation but teams do not exist.	Teams do not exist.
10.	Communications with Headquarters - A communication system must be in place between patrol teams and HQ (Systems will vary in PAs due to budget and terrain).	Exists, but communications are sporadic and unreliable.	Not all parts of the reserve gets cellular phone network coverage. So, this needs to be improved, or alternative communication equipment such as radio sets need to be added.
11.	Access Control - All major access points/routes must be controlled.	Exists, but is not regular enough to be depended upon to control illegal vehicles, pedestrians.	Not regular enough to ensure strict control, especially from the riverside. This needs to be tightened further.

5.1.3 Fire prevention and protection plan

The Standard Operating Procedures (SOP) outlined in the Forest Fire Management Plan for Sugut Conservation Area (SFD 2015) should be adhered to at all times to prevent the threat of fire and control the fire in case it happens.

Regular patrols should be carried out during drought seasons. Near real-time fire alerts from NASA FIRMS are useful to detect hotspots during the drought period and these needs to be regularly monitored. Fire observation towers at suitable vantage locations can help detect fires early so that losses can be minimised. Fire protection activities will be part of regular routine each year, particularly during the dry season months of March to October (Figure 2.3) and the efforts should be increased during El Nino years.

5.1.4 Soil protection and watershed

Being a high rainfall area and especially with much of the rains falling during the pronounced wet season, soil erosion and nutrient leaching is an important concern. The presence of Kerangas forest in the high ground areas are an adaptation to such a rainfall pattern. However, more than two-thirds of the reserve is made of alluvium formation, allowing growth of seasonally-flooded freshwater swamp forests and tidal mangroves which makes soil erosion limited to only certain parts of the reserve. The swamp forests play an important watershed role, feeding downstream into the estuarine system.

5.1.5 Pollution of rivers and streams

Land development such as land clearing for new plantation, road building and construction works in the upper part of Sugut River basin needs to be monitored and interventions made in order to reduce the export of sediments into rivers/streams, as it could contribute to high suspended materials concentration in the aquatic ecosystems. At the local level, monitoring the application of fertilizers in surrounding oil palm plantations is important. The reserve management should coordinate with the Department of Environment in ensuring environmental compliance of plantations, particularly the limit on use of fertilizers, as excessive fertilizers will contribute to high concentration of dissolved nutrients, which may lead to problems such as eutrophication.

5.1.6 Monitoring threats (indicators and methods)

Monitoring the severity levels of various threats to Trusan Sugut FR is necessary for: (i) assessing the effectiveness of protection/enforcement actions of the reserve management in reducing the threats; and (ii) to help the management make adaptive changes to the methods and efforts on addressing the different threats, based on changing levels of the threats. Some suitable indicators, measurement methods, and the frequency of monitoring for the various threats are proposed here (Table 5.2). Proper documentation of protection efforts and detection of threats and forest offences are crucial for this monitoring. Adopting SMART-based patrols will make this monitoring and reporting easier for the reserve management, and the Trusan Sugut FR rangers are already being trained and gaining experience in SMART patrols.

Table 5.2. Indicators, measurement methods and frequency of monitoring needed for various threats facing Trusan Sugut FR.

Threats	Indicators	Measurement methods	Frequency of monitoring
Encroachment in FR	<ol style="list-style-type: none"> Number of encroachment locations detected per year; Area of encroachments (e.g., acres of land cleared). 	From field patrol reports of rangers; from maps of clearings made by rangers.	Weekly patrols
Illegal tree felling	<ol style="list-style-type: none"> Number of incidents and locations of tree felling detected per year; Total number of trees felled; Number of offences brought to court of law. 	From field patrol reports of rangers; from investigation reports.	Weekly patrols
Over-extraction of NTFP (Tengar)	<ol style="list-style-type: none"> Number of incidents and locations of NTFP collection detected per year; Total volume of NTFP confiscated. 	From field patrol reports of rangers; from DFO's reports on confiscations made and fines compounded.	Weekly patrols
Illegal hunting	<ol style="list-style-type: none"> Number of incidents and locations of illegal hunting detected per year; Total number of animals, grouped by species, illegally hunted; Number of snares detected and destroyed, in 10 foot-patrol hours; 	From field patrol reports of rangers (SMART reports which can account for effort); camera-traps set up on trails	Weekly patrols

	<ol style="list-style-type: none"> Number of poacher movements detected by camera-traps in 100 trap-days; Number of offences brought to court of law. 	in FR; from investigation reports.	
Illegal fishing	<ol style="list-style-type: none"> Number of incidents and locations of illegal fishing detected per year; Total mass of fish confiscated. 	From field patrol reports of rangers; from <i>Tagal Sungai</i> committee; from DFO's reports on confiscations made and fines compounded.	Weekly patrols
Fire	<ol style="list-style-type: none"> Number of fire locations detected per year; Area burnt in fire (hectare of forest burnt). 	From field patrol reports of rangers; from NASA fire/hotspot alerts.	Weekly patrols; daily fire alerts.
Pollution	<ol style="list-style-type: none"> Values of various water quality parameters (as in National Water Quality Standards for Malaysia); Water Quality Index. 	Water testing in Sg. Sugut and swamp forest sites in FR; in collaboration with Department of Environment and nearby oil palm plantations.	Monthly monitoring.



5.2 Actions to achieve long-term (5 – 10 years) management goals

The 5 – 10 year management goals of the FMP include:

- i) Protection and restoration of various forest types in the reserve, such as lowland *Dipterocarp* forest, freshwater swamp forest and mangroves, and the riparian areas;
- ii) Conservation of the rare, threatened and endangered mammal, bird and tree species such as orang-utan, proboscis monkey, helmeted hornbill and the *Dipterocarp* tree species;
- iii) Enhancing the forest structure and tree species diversity by facilitating natural regeneration and through enrichment planting;
- iv) Reversing forest degradation caused by past logging activities and fire damages through reforestation type of planting;
- v) Restoring connectivity between Trusan Sugut FR and the nearby forest reserves for expanding habitat for long-ranging wildlife species such as the banteng, clouded leopard and Malayan sun bear;
- vi) Management of the identified High Conservation Values in the reserve; and
- vii) Protecting and enhancing the environmental services provided by the reserve.

These goals will be achieved primarily by reducing threats to the forests and wildlife, by speedy and effective forest restoration efforts, and by securing forest connectivity to adjacent forests and expanding the Trusan Sugut FR.

5.2.1 Forest restoration (by silviculture, enrichment and reforestation planting)

Considering that much of the forests of Trusan Sugut FR have been severely degraded due to past activities and presently occur as secondary growth, forest restoration is an important aspect of forest management in this planning period. Restoration would mainly take the form of enrichment planting in the secondary forest to bring back species and structural diversity, and stand improvement treatments to facilitate natural regeneration, such as the removal of weedy vegetation, e.g., vines and selected pioneer species. The open areas with sparse tree cover in certain parts of the reserve suggest that the soils have been severely damaged and these areas would need reforestation, largely of pioneer species as a first stage of restoration. Species native to the area will be used in all restoration efforts.



Trees covered by vines require silviculture treatment for improved growth and survival.

Restoration of threatened forest types and endangered tree species

A special feature of Trusan Sugut FR is the diversity of forest types found in and adjacent to the reserve. Some of these forest types have become threatened in Sabah due to their disproportionately high conversion to other land use over the past decades. The threatened forest types found in Trusan Sugut FR include lowland Dipterocarp (*Kapur Merah*) forest, lowland freshwater swamp forest, lowland seasonal freshwater swamp forest, lowland mixed Dipterocarp and kerangas forest and lowland peat-swamp (Perupok) forest (Figure 3.1). However, the tree cover, structure and diversity of these forests have become severely degraded due to heavy logging, illegal tree felling, fire, human encroachments and related disturbances in the past. This calls for management focus on forest restoration - specifically, by promoting natural regeneration and planting native tree species. Such a management focus and large-scale efforts have the potential to restore these threatened forest types to a considerable extent, because the topography, hydrology and soil conditions that naturally created these forest types may still occur in these areas.

Severely degraded (almost open) areas requiring reforestation type of planting (about 500 ha) have been identified using satellite maps and field surveys (Figure 5.3). Other areas requiring intensive enrichment planting (about 250 ha) were additionally identified based on orang-utan abundance (see the following section). In addition, the rest of the reserve, with the exception of mangroves, also requires silviculture and enrichment planting to bring back forest cover speedily. Silviculture efforts have been carried out in the reserve since 2014 as part of an SFM project.

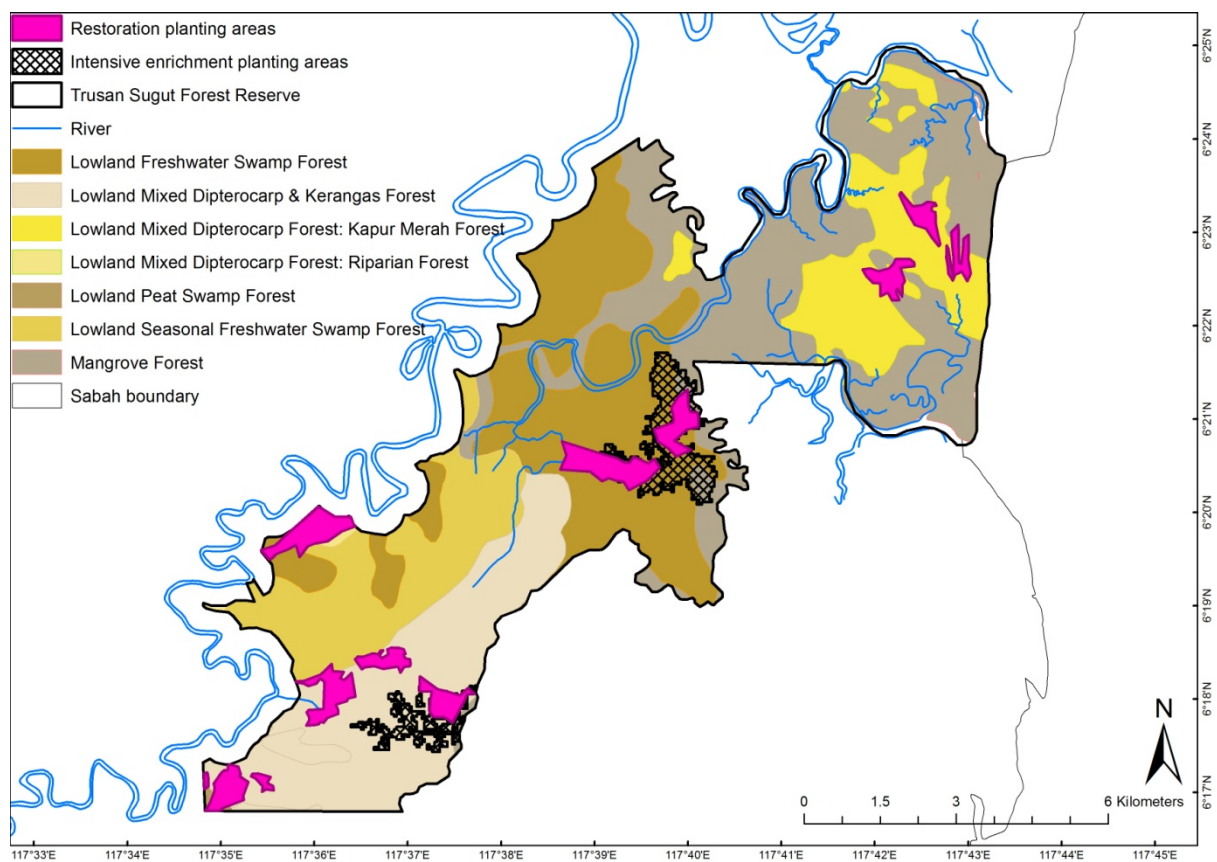


Figure 5.3. Locations identified in Trusan Sugut FR for reforestation planting and enrichment planting to restore threatened forest types.

Along with using tree species native to these forest types and pioneer species for reforestation planting in open areas, some endangered tree species native to the area such as *Dryobalanops beccarii*, *Lophopetalum multinervium*, and *Cratoxylon formosum* will be used as part of enrichment planting in suitable sites to improve the conservation status of these species.

Restoration for expanding and enriching habitat for orang-utan

WWF-Malaysia conducted orang-utan surveys in Trusan Sugut FR in 2014 (unpublished report) and used the orang-utan distribution maps (Figure 3.4), field surveys and forest cover map (Figure 3.3) to identify priority areas for forest restoration. Degraded areas currently occupied by orang-utans were recommended as a priority to be restored through intensive enrichment planting (Figure 5.4). The enrichment planting efforts would include species native to the forest types and will have a special emphasis on figs. Such restoration will expand orang-utan habitat and enrich the forest and this would also contribute to the goal of restoring threatened forest types.

It is crucial for Trusan Sugut FR to expand and enrich the habitat for orang-utan by restoring forests and establishing secure connectivity to the peat-swamp forests to the west of Sugut river (see section 5.4), given the fairly small population size and the largely isolated status of the population in Trusan Sugut FR. With such expansion of habitat, this reserve may serve as the last lowland area hosting a significant population of orang-utan in the northern half of Sabah.

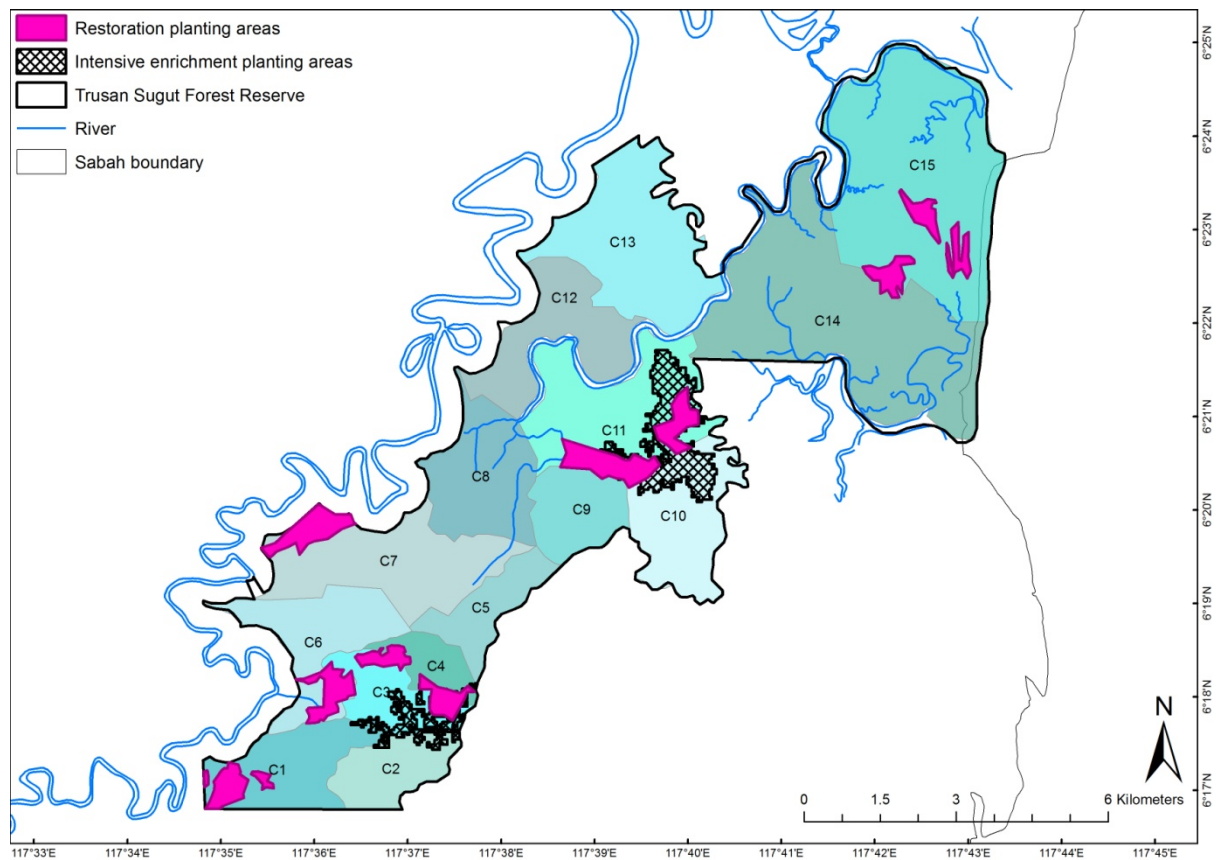


Figure 5.4. Locations identified for forest restoration in Trusan Sugut FR, marked over a map of management compartments, C1 to C15. The restoration areas were identified on the basis of degradation level and priority as orang-utan habitat.

The areas thus identified for forest restoration are planned to be restored during the implementing period of this FMP, most likely in the first half, but would depend on fund availability. The identified areas are distributed across five different forest types and in various compartments of the reserve (Table 5.3). Restoration will be done in a phased manner over the years and with crucial inputs from the Forest Research Centre on species suitability for various forest types.

Table 5.3. Extent (in hectares) planned for reforestation planting and intensive enrichment planting, covering various forest types and in different compartments of Trusan Sugut FR.

Forest type	For reforestation planting (ha)	For intensive enrichment planting (ha)	Compartment numbers
Lowland mixed Dipterocarp (<i>Kapur Merah</i>) forest	100 ha	--	C15
Lowland freshwater swamp forest	150 ha	150 ha	C11, C10
Lowland seasonal freshwater swamp forest	70 ha	--	C7
Lowland mixed Dipterocarp and Kerangas forest	150 ha	100 ha	C1, C2, C3, C4, C6
Lowland Peat-swamp forest	25 ha	--	C1
TOTAL	495 ha	250 ha	

Enrichment planting for hornbills

Six species of hornbills were observed during bird surveys in the reserve (Appendix 11) and all the species are protected under the Sabah WCE 1997. This includes the helmeted hornbill which is also listed as a critically endangered species in IUCN Red List 2016. This species is known to be long-ranging and thus requires large expanse of forests and abundant food-trees to survive. Payne (1998) noted that the *Kapur Merah* (*Dryobalanops beccarii*) trees which occurred abundantly in the whitish sandy soil areas of the reserve contain numerous holes and crevices thus providing plentiful nesting sites for hornbills.

Payne (1998) further documented a large patch of fig trees in the swamp forests just to the west of Trusan Sugut FR (Figure 5.6) and notes that the fig-rich forests represent major food sources sustaining populations of hornbills, imperial pigeons, fruit bats and orang-utans in the area. The forests contained many figs (trees and strangling figs), especially *Ficus obypiramidata*, *F. microcarpa*, *F. involucrata* and *F. linneolykii* var. *coriacea*. A rare and possibly endangered fig species (*F. albipila* - a very large tree fig, known from only a few lowland sites in Borneo) was also recorded in the freshwater swamp forests in the vicinity of Trusan Sugut FR.

Therefore, the reforestation and enrichment planting efforts in the reserve will include planting considerable amount of figs of various species and in many sites across the reserve. This would increase year-round fruit supply especially for the hornbills and orang-utans, improve the conservation status of rare and threatened *Ficus* species, and the symbiotic relationship of fruiting figs and frugivorous seed dispersers will start a cycle of natural regeneration of forests and help speed-up forest restoration across the reserve and in the nearby areas.

Ongoing forest restoration activities

Forest restoration efforts have been going on in the Trusan Sugut FR since 2014 under an SFM project. The efforts include planting of *Dipterocarp* and fleshy-fruit bearing tree seedlings in degraded areas. This is being carried out by contractors appointed by SFD, with active participation of local communities. Silviculture is the main form of forest restoration thus far in the reserve. In 2015, 1,412 ha have been treated this way, and until 2015, 2,112 ha have received silviculture treatment. In addition, 60 ha area has been planted in 2015 with fleshy-fruited trees. As part of SFD's social responsibility and as agreed during the 'Stakeholder and Community Committee' meeting, the labour force needed for this activity is hired locally.

5.2.2 **Monitoring forest recovery**

Permanent Sampling Plots (PSP): It was recommended by Nilus and Sugau (2015) that long-term monitoring using permanent sample plots (Appendix 13, Appendix 14) should be done for monitoring long-term forest recovery and dynamics, including growth, mortality, and recruitment. PSPs are also useful in monitoring the influence of climate change on floristic composition and ecological processes. In this planning period, additional PSPs will be established in selected areas based on forest stratum. This will be done within the first two years of the planning period, with the assistance of researchers of the Forest Research Centre of SFD.

Further botanical inventories: The current botanical knowledge of Trusan Sugut FR is insufficient to provide a complete picture of the conservation status of many tree species. Therefore, it is recommended that more botanical surveys be carried out in the reserve during this planning period. This can be in the form of short term botanical expeditions by various experts. Surveys should emphasize species that are endemic or considered locally endangered.

Monitoring forest cover: Satellite imagery based monitoring of forest cover and condition will be carried out, to supplement field efforts and to provide frequent reserve-wide information. Forest recovery due to natural regeneration, increased protection, and forest restoration efforts is proposed to be monitored using suitable indicators and measurement methods (Table 5.4). This work is expected to be done largely by researchers of FRC and remote sensing technicians of SFD headquarters.

Table 5.4. Indicators and measurement methods for monitoring forest recovery and impact of forest restoration efforts in Trusan Sugut FR.

Forest recovery attributes	Indicators	Measurement methods	Frequency of monitoring
Forest cover	1. Percent tree canopy cover of various forest types; 2. Percent tree canopy cover of areas of various types of restoration efforts.	Interpretation of satellite imageries of the reserve; mapping from aerial photographs; to be conducted by the SFD headquarters.	Every three years
Forest structure	1. Tree stem density per ha; 2. Variation in dbh, and tree	PSP plots; other temporary plot based sampling surveys	Every five years

		height; 3. Basal area.	of various forest types and parts of the FR.	
Tree species diversity / composition	1.	Tree species richness per ha;	PSP plots; other temporary plot based sampling surveys of various forest types and parts of the FR.	Every five years
	2.	Relative abundance of various tree species in plots.		

5.2.3 Wildlife management

Wildlife management of Trusan Sugut FR will largely be done through addressing threats to animal and plant populations and their habitat, such as poaching, illegal tree felling, fire, and pollution and by restoring forest habitat as described in sections above. Establishing forest connectivity with adjacent forests and expanding protection status to adjacent forest reserves (described below in sections 5.4 and 5.5) are crucial for the viability of long-ranging animals. Monitoring wildlife populations, particularly the threatened and protected species, will inform the reserve management if any direct animal population management interventions, such as reintroductions (of fishes and plants), and disease management are needed. Surveys of wildlife taxa with limited information currently, such as proboscis monkey, banteng, helmeted hornbills, and freshwater fishes, will be conducted during the course of implementation of this FMP.

5.2.4 Monitoring the status of threatened and protected species of wildlife

Monitoring the population status of threatened and protected species of animals and plants in Trusan Sugut FR will (i) help assess the impacts of protection, forest restoration, forest connectivity efforts of the reserve management; (ii) help the reserve management make adaptive changes to the protection and restoration efforts; and (iii) help the reserve management make additional interventions related to animal population management, such as reintroductions and disease management, when needed. Some suitable indicators, measurement methods, and frequency of monitoring for the various threatened and protected species/taxa are proposed in Table 5.5.

Much of this monitoring is best done by partnering with research institutions and conservation organizations such as WWF. It is proposed that the reserve management set aside suitable monitoring fund in its budget every year to attract students and researchers to conduct monitoring projects in collaboration with the reserve management. Some basic monitoring needs to be done by the rangers as part of their routine activities, such as monitoring presence and mapping occurrence locations of terrestrial mammals through camera-trapping. Suitable training on these aspects has been given to rangers in the recent years which could be further strengthened. Adequate budget for purchasing equipment and allocation of ranger time for such routine monitoring is crucial for successful monitoring.

Table 5.5. Indicators, measurement methods, and frequency of monitoring for the threatened and protected species/taxa in Trusan Sugut FR.

Threatened or protected species/taxa	Indicators	Measurement methods	Monitoring frequency
Orang-utan	<ol style="list-style-type: none"> 1. Proportion of area occupied; 2. Population size. 	Mapping nests using helicopter transects; nest counts using helicopter or ground transects, along with concurrent estimation of nest decay rates; marked nest counts.	Mapping – every two years; Population estimation – every five years ⁶ ; baseline population estimate to be made in the first year of this planning period.
Proboscis monkey	<ol style="list-style-type: none"> 1. Map of locations where monkeys are detected; 2. Number of groups and individuals seen along fixed survey route, during a fixed survey period. 	Survey by boat along river courses – Sg. Sugut, Sg. Sugut Parai, and nearby smaller streams and creeks.	Every two years.
Bornean gibbon	<ol style="list-style-type: none"> 1. Number of pairs/groups detected; 2. Locations of occurrence. 	Call counts; survey designed to cover all parts of the reserve.	Every two years.
Banteng; Clouded leopard; Malayan sun bear; Bay cat.	<ol style="list-style-type: none"> 1. Map of locations of occurrence; 2. Number of times detected in 100 camera-trap days effort; 3. Number of young animals detected in 100 camera-trap days effort. 	Camera-trapping along trails; survey designed to cover all parts of the reserve.	Every two years; to be combined with general terrestrial mammal survey.
Helmeted hornbill; Storm's stork	<ol style="list-style-type: none"> 1. Number of birds seen/heard in bird surveys, during fixed survey period. 	Point-count based surveys; surveys designed to cover all forest types and parts of the FR.	Every two years
Birds	<ol style="list-style-type: none"> 1. Species richness; 2. Relative abundance – number of birds of different species detected during fixed survey period. 	Point count based surveys; surveys designed to cover all forest types and parts of the FR; sampling site characteristics to be measured alongside to address detectability.	Every two years
Terrestrial mammals	<ol style="list-style-type: none"> 1. Species richness; 2. Mapping locations of occurrence of various species. 	Camera-trapping along trails; surveys designed to cover all parts of the reserve.	Three months of survey each in the wet and dry seasons, every two years.

⁶ **Rationale:** orang-utan population is unlikely to change substantially over short time periods, unless there are unforeseen severe impacts due to long drought, fire, or a disease epidemic. Neither will they change in response to protection and restoration efforts over short time spans.

Threatened or protected species/taxa	Indicators	Measurement methods	Monitoring frequency
Population status of rare and endangered tree species	<ol style="list-style-type: none"> 1. Distribution extent (presence across sampling plots); 2. Density per ha; 3. Density of young trees (suggesting recruitment). 	PSP plots; other temporary plot based sampling surveys of various forest types and parts of the FR.	Every five years.

5.2.5 Fisheries management

A system of fisheries management has been put in place in the Trusan Sugut FR along the river Sg. Sugut Parai since August 2014. This system, known locally as the *tagal sungai* system is a form of regulated fishing that has been adopted in many other rivers throughout Sabah. Essentially, it divides the river into three sections, namely the red zone, the yellow zone, and the green zone (Figure 5.5).

Red Zone	No take. For conservation and sport fishing (catch & release)
Yellow Zone	Fishing allowed 2-3 times a year
Green Zone	Fishing allowed year round

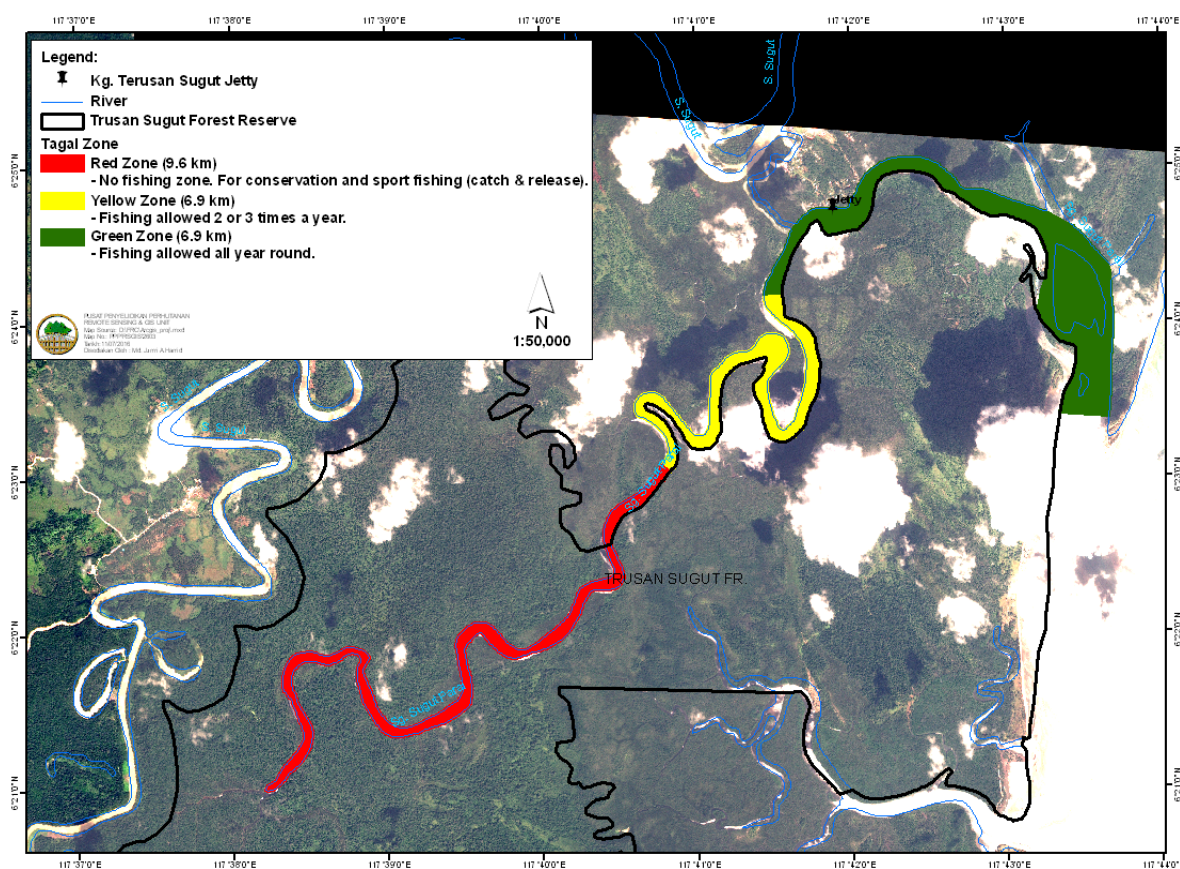


Figure 5.5. Zones of the *tagal sungai* system of regulated fishing in Sg. Sugut Parai river in Trusan Sugut FR.

Considering that almost the entire Sugut Parai river is within the Trusan Sugut FR, the Forestry Department has allowed the local community the right to use the river in accordance with conditions imposed by the Department. A *tagal sungai* committee for Sg Parai, chaired by the Kg. Terusan Sugut village head has been established officially to oversee the implementation of this system. The idea behind imposing the *tagal* system along the Sg. Sugut Parai is to protect and conserve fish populations in general, with a special interest in Bornean black bass (*Lutjanus goldiei*) or *ikan kanai*, a highly valued trophy species in sport fishing. According to the locals from Kg. Terusan Sugut, sport fishermen, including foreign nationals are known to find their way up the Sg. Sugut Parai, specifically targeting the black bass.

The ecological basis of this system is yet to be assessed and the effectiveness of dividing the river simply into three zones, upstream to downstream, and applying various regulations, in terms of conserving fish species diversity and ensuring optimal offtake is unknown. For instance, the three zones along the brackishness gradient of Sg. Sugut Parai may have three different fish communities and they may get exploited to various degrees by such a system. These issues will be assessed in this FMP period and necessary adaptations will be made to the system.

Recommendations

Much more baseline information needs to be gathered in order to effectively manage fisheries in the Trusan Sugut FR. In this 10-year planning period the following activities will be considered:

- i. The SFD explores opportunities to play a more active role in fisheries management;
- ii. Carry out a more comprehensive assessment of fish populations and diversity, with emphasis on Sg. Sugut Parai;
- iii. Establish a system to monitor fish catch from Sg. Sugut Parai;
- iv. Evaluate the effectiveness of the tagal system;
- v. Study the potential of Sg. Sugut Parai for recreational and sport fishing for the purpose of revenue generation.



(left) Bornean black bass (Ikan Kanai), a brackish-water fish highly valued as a sport fish, caught in Sg. Sugut Parai near Trusan Sugut FR.

5.3 Management and monitoring of HCV

Although Trusan Sugut FR itself is a protection forest, several threats to the HCVs have been identified during the field surveys, and management recommendations have been made to reduce these threats and to maintain and enhance the HCVs. Some of the management and monitoring recommendations are applicable to more than one HCV, such as conducting patrolling to detect illegal encroachments, poaching and fires. Actions for reducing threats to HCVs and for maintenance and enhancement of the HCVs are listed below (Table 5.6).

Table 5.6. High Conservation Values (HCV) found in Trusan Sugut FR and their management and monitoring recommendations.

HCV	Attributes	Presence in the area	Management Recommendations	Monitoring Recommendations
1.1	Protected Areas	Present	Determine and mark borders; conduct regular awareness sessions.	Carry out patrolling frequently, according to a SMART ⁷ -based enforcement plan.
1.2	Threatened and Endangered Species – Flora	Present	Put safeguards against fires in place; carry out restoration of degraded areas to improve tree diversity and forest structure; conduct patrolling to monitor for illegal tree felling.	Set up permanent sample plots; use satellite imagery to monitor forest cover and condition.
1.2	Threatened and Endangered Species - Fauna	Present	Carry out frequent patrolling, according to a SMART-based enforcement plan; restore degraded orang-utan habitat; Include fig trees in enrichment planting for helmeted and other hornbills.	Carry out patrolling frequently and as per the zoning plan; monitor indicator species sensitive to environmental change.
1.3	Endemism - Flora	Present	Put safeguards against fires in place; carry out restoration of degraded areas; conduct patrolling to monitor illegal tree felling.	Set up permanent sample plots; use satellite imagery to monitor forest cover and condition.
1.3	Endemism - Fauna	Present	Conduct frequent patrolling, according to the enforcement plan.	Conduct frequent patrolling; monitor indicator species sensitive to environmental change.
1.4	Critical Temporal use	Present	Raise awareness amongst local communities to utilise mangrove spp.	Use satellite imagery to determine the health of mangrove forests; conduct frequent patrolling,

⁷ SMART refers to Spatial Monitoring and Reporting Tool used by enforcement agencies to measure and improve the effectiveness of wildlife law enforcement patrols and site-based conservation activities.

HCV	Attributes	Presence in the area	Management Recommendations	Monitoring Recommendations
			sustainably; conduct patrolling in mangrove areas to deter illegal activities.	according to enforcement plan.
2	Landscape- Level Forest	Present	Ensure Trusan Sugut FR remains connected to other large patches of forests; rehabilitate areas that are degraded.	Use satellite imagery to monitor forest cover.
3	Ecosystems	Present	Rehabilitate degraded areas; put safeguards against fire in place.	Use satellite images to monitor forest cover and health.
4.1	Watershed protection	Present	Construction must take into account watersheds and soil movement should be minimised.	Conduct water quality monitoring on a monthly basis.
4.2	Erosion control	Present	Regular patrols should be done to prevent encroachment; protection and restoration of riparian forests is needed.	Conduct regular patrolling to deter encroachment; Use satellite imagery to monitor any encroachment; monitor water bodies on a monthly basis for soil erosion.
4.3	Barriers to destructive fires	Present	Identify and record nearest fire break / water bodies; restore forest structure by restoration planting, to increase resistance to spreading of fire.	Conduct monthly patrolling to monitor if water bodies are in good condition.
5	Basic needs of local communities	Present	A system of fulfilling the basic wood needs of local communities may be developed after further consultations with local communities.	Develop a monitoring system after further consultation with local communities.
6	Cultural identities of local communities	Present	Hold further consultations with local communities to develop a system of allowing them access to the relevant cultural sites in the reserve.	Develop a monitoring system after further consultation with local communities.

5.4 Establishing and maintaining forest connectivity

Securing forest connectivity between Trusan Sugut FR and the nearby forest reserves will expand habitat and allow free movement for long-ranging wildlife species such as the clouded leopard, Malayan sun bear and banteng. Trusan Sugut FR with its 8,680 ha area (of which about 30% mangroves and another 30% freshwater swamp forests) is too small to serve in isolation as a reserve for maintaining viable populations of some of these long-ranging large mammal species. Therefore, connectivity to nearby forest reserves is crucial for viability of these animal populations.

One such connectivity has been recently established: 300 ha Sugut Wildlife Corridor FR (gazetted in December 2015) connecting the Trusan Sugut FR to the Sg. Sugut, Sg. Paitan and Jembongan Class V (Mangrove) FR in the North (Figure 2.1).

To the South, Trusan Sugut FR is connected to the Bonggaya FR, through the mangrove forest reserves. Bonggaya FR hosted a substantial orang-utan population in the past and is the closest orang-utan population in the landscape. However, the current status of orang-utans in Bonggaya FR, after the recent forest conversion to oil palm and other plantations, is unknown. This connectivity can be expanded slightly to include some dryland areas along the western boundary of the mangrove FR.

A recommendation was made way back in 1998 (Payne and Siambun 1998; Figure 5.6) to connect Trusan Sugut FR (then called Lower Sugut FR) to the peat swamp forest area in the larger Sugut (Production) FR across the Sugut river to the south-west. This part of Sugut FR contained a Ficus tree patch, which was then thought to be a crucial habitat for hornbills and other animals. There are also oxbow lakes and freshwater streams in that area. The possibility of securing this connectivity by bringing the intervening state land and alienated land under protection cover will be explored in the first half of this FMP period.

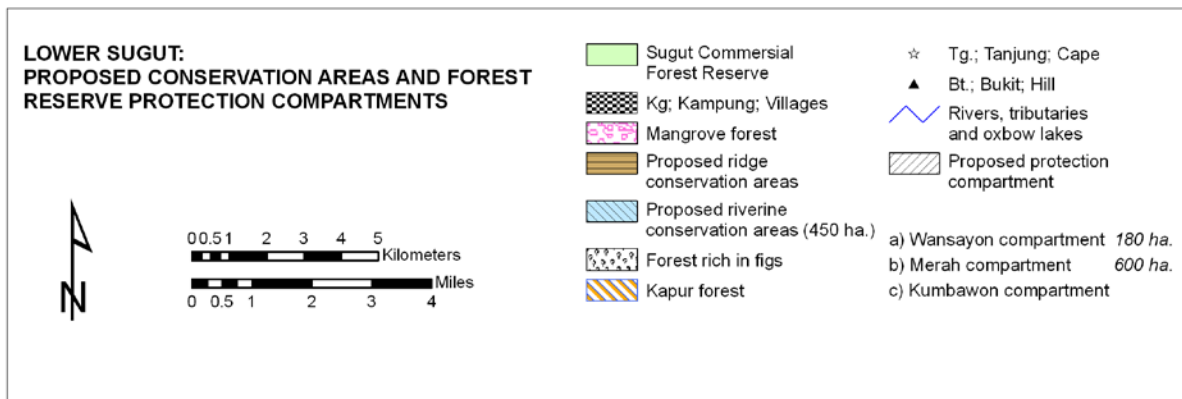
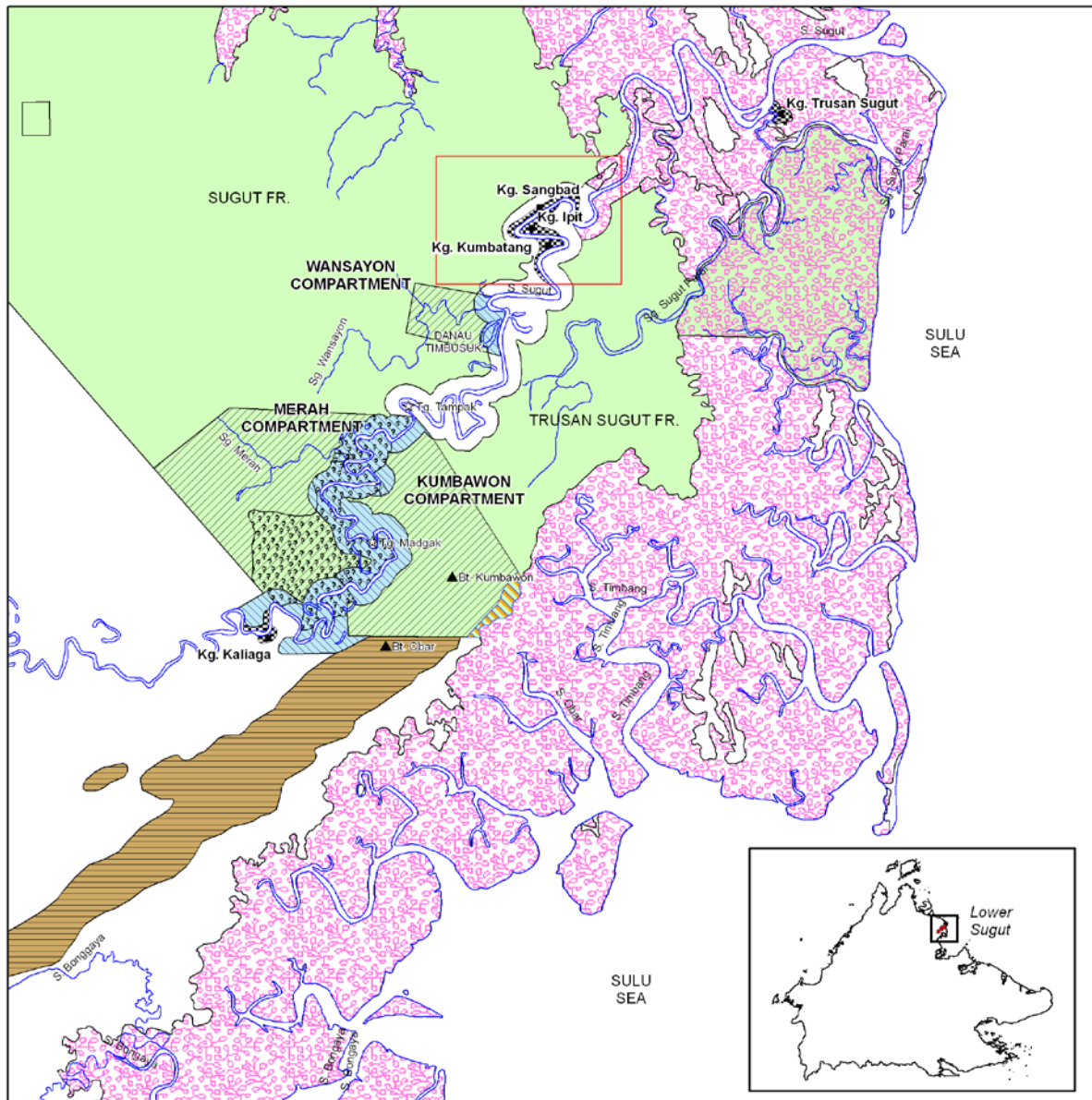


Figure 5.6. Map adapted from Payne and Siambun (1998), showing the recommended areas for protection in Sugut FR. Protected habitat of Trusan Sugut FR can be expanded by connecting these patches of forests to the existing reserve through gazettelement of intervening state land.

5.5 Future expansion of Trusan Sugut FR

It is crucial to expand the Trusan Sugut FR further to the west to include forested parts of the larger Sugut Class II (production) FR, or establish a new protected forest reserve to the west in combination with secured forest connectivity between the two areas, for ensuring viability of long-ranging mammal and bird species currently occurring in the Trusan Sugut FR. The southern Kumbawan, Sg. Merah and Sg. Wansayon compartments of Sugut FR identified by Payne and Siambun (1998; Figure 5.6) are best suited for this expansion.



Sunda clouded leopard and banteng, long-ranging species photo-captured in in Trusan Sugut FR.



Well-grown riparian forests along Sg. Sugut, in the state land between Trusan Sugut FR and Sg. Wansayon compartment of Sugut FR (Class II production forest) – a crucial area to gazette as a protection FR, for expanding protected forest habitat in the Sugut Conservation Area.

5.6 Recreation and tourism

The demand for recreational opportunities in forest reserves is increasing for numerous reasons, partly due to the lifestyle of contemporary society. The Forestry Department is expected to allow more regulated use of forest reserves in order to meet this demand. Recreational activities in forests include watching wildlife, fishing, camping, mountain biking, hiking, picnicking, educational excursions, etc. The use of forests for such activities greatly improves the value of forests to society, despite the exclusion of major economic activities such as commercial timber production.

5.6.1 Current status

Currently, Trusan Sugut FR is not used for any significant public recreational activity. There are also no developed sites for recreational use within the area. However, there appears to be some potential for sport fishing along the Sg. Sugut Parai. According to the locals from Kg. Terusan Sugut, sport fishermen, including foreign nationals are known to find their way up the Sg. Sugut Parai, specifically targeting the Bornean black bass (*ikan kanai*), a highly valued trophy species in sport fishing.

5.6.2 Recreation Potential

In order to assess the suitability of the area for recreational potential, various aspects of the area has to be considered, such as accessibility, aesthetics, unique features (e.g. waterfall, pond, stream, picturesque lookout points, historical landmarks). At present, Trusan Sugut is not likely to be viable for recreational development due to its remoteness and poor access. The easiest way to access the area is by boat from Beluran, and many may find this a hindrance.

5.6.3 Prescribed management activities

For this 10-year planning period, recreation related management activities will focus on studies to explore the potential of the Sg. Sugut Parai for recreational and sport fishing for the purpose of revenue generation. This is elaborated further in Section 5.2.5. Fisheries Management (page 56). In addition, wildlife sightings will also be closely monitored to assess the quality of wildlife-watching as a recreational draw card. Low-impact and small-scale tourism options such as camping facilities, nature trails, bird watching, and student research opportunities will also be explored.

5.7 Regulation of community use and benefits

In a Protection Forest (Class I Forest Reserve), activities such as hunting and the felling of trees is strictly prohibited by law. At this time, there has been no request by the local communities to use Trusan Sugut for any consumptive purpose, apart from fishing along the Sg. Sugut Parai. Fishing is already being regulated by a *tagal sungai* committee according to guidelines set by the Forestry Department. Any request by the local communities for the use of forest reserve land, such as for recreation or tourism related use, may be considered on a case-by-case basis.

5.8 EIA of management activities

An environmental impact assessment report for Trusan Sugut FR has been prepared by SFD separately. Mitigation measures related to soil erosion, water use, fire hazard, and waste disposal from activities that are included in this FMP, namely, tree planting, silviculture, and infrastructure construction have been recommended. The reserve management will follow those recommendations in its day to day operations.

6 ACTION PLAN AND RESOURCE NEEDS

6.1 Action plan and implementation schedule

Several management actions have been planned in this FMP, ranging from boundary demarcation, restoration planting, wildlife monitoring, to forest management certification. These actions have been scheduled for implementation at various times in this planning period, depending on management needs and resource availability. A summary of the management activities planned for implementation over the next 10 years is listed below (Table 6.1).

Table 6.1. Action Plan for the full term of the FMP, subject to a midterm review in year 5.

Management actions	Year									
	1	2	3	4	5	6	7	8	9	10
1 Reducing threats										
1.1 Enforcement on encroachment, illegal felling and mangrove bark (<i>Tengar</i>) extraction	X	X	X	X	X	X	X	X	X	X
1.2 SMART-based patrolling and enforcement against poaching and illegal fishing	X	X	X	X	X	X	X	X	X	X
1.3 Prevention and control of fire	X	X	X	X	X	X	X	X	X	X
1.4 Pollution monitoring of rivers and streams	X	X	X	X	X	X	X	X	X	X
1.5 Regulating use of forests by local communities	X	X	X	X	X	X	X	X	X	X
1.6 Boundary demarcation	X	X	X							
1.7 Threat monitoring	X	X	X	X	X	X	X	X	X	X
2 Forest restoration										
2.1 Silviculture activities to facilitate natural regeneration and growth of trees (2,000 ha)	X	X	X							
2.2 Enrichment planting to restore forest structure, increase tree diversity and endangered tree species abundance (2,000 ha over 8 years)	X	X	X	X	X	X	X	X		
2.3 Enrichment planting of fleshy-fruited trees (Figs, etc) to enrich habitat for rare and endangered species such as hornbills, orang-utan, etc. (250 ha over 5 years)	X	X	X	X	X					
2.4 Reforestation planting in severely degraded areas (500 ha over 6 years)				X	X	X	X	X		
3 Local community engagement										
3.1 Monitoring the <i>Tagal Sungai</i> system for fishing by local communities	X	X	X	X	X	X	X	X	X	X
3.2 Honorary Forest Rangers among local communities – selection and training	X			X			X			X
3.3 Carrying out review of social baseline data					X					
4 Recreation and tourism										
4.1 Exploring potential of regulated recreation for visitors	X	X	X							
4.2 Exploring potential for developing low-impact tourism	X	X	X							

Management actions	Year									
	1	2	3	4	5	6	7	8	9	10
4.3 Exploring potential for sport fishing	X	X	X							
5 Monitoring forest recovery and wildlife										
5.1 Monitoring forest recovery (mapping)	X			X			X			X
5.2 Monitoring structure and composition (PSP)					X					X
5.3 Mapping distribution of orang-utan		X		X		X		X		X
5.4 Monitoring population size of orang-utan	X				X					X
5.5 Monitoring diversity of terrestrial mammals and birds		X		X		X		X		X
5.6 Monitoring population status of endangered species – proboscis monkey, gibbon, helmeted hornbill, banteng, etc		X		X		X		X		X
5.7 Survey for fish diversity and abundance	X	X								
5.8 Mapping locations of endangered tree species	X	X	X							
5.9 Monitoring population status of endangered tree species					X					X
6 Management and monitoring of HCVs	X	X	X	X	X	X	X	X	X	X
7 Field surveys of Sugut Wildlife Corridor FR	X	X								
8 Securing connectivity with adjacent forest areas and expanding Trusan Sugut FR	X	X	X							
9 Sourcing additional finances for restoration and other management activities	X									
10 Infrastructure development	X	X								
11 Staff capacity building for wildlife monitoring, nature interpretation, patrolling, etc	X			X			X			X
12 Monitoring FMP implementation	X	X	X	X	X	X	X	X	X	X
13 Monitoring achievement of goals and objectives	X		X		X		X		X	
14 Certification under credible (FSC, etc) standards	X									
15 FMP review					X					

6.2 Annual work plan

An Annual Work Plan (AWP) is to be prepared every year. It should include details such as activities planned for the year, clear targets for each activity, their schedule of implementation, how they will be carried out, and the budget requirement. The AWP is largely based on activities prescribed in the approved FMP. The AWP is to be submitted to the Director of SFD at the end of each year for approval, and any changes to the AWP also has to be approved by the Director. The compliance report for forest management is evaluated based on compliance to the AWP. Therefore it is important that targets set in the AWP are realistic and achievable.

6.3 Standard Operating Procedures

Clearly documented standard operating procedures (SOP) and guidelines have been drawn up to ensure that certain key activities are carried out according to established procedures or guidelines.

This will also provide a means to objectively assess compliance to prescribed activities, such as the establishment of monitoring systems, herbicide application, occupational safety, etc.

The following SOPs have been prepared by the SFD and will be followed in the management of Trusan Sugut FR:

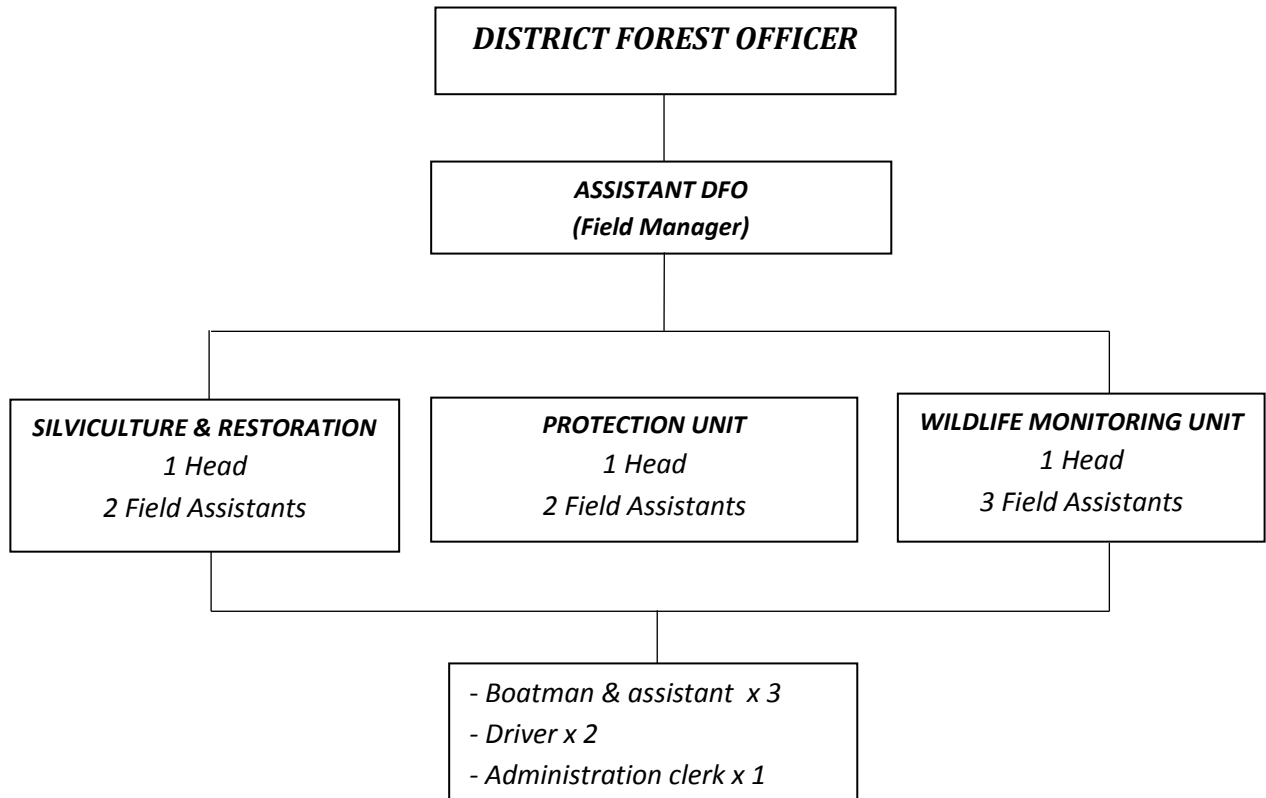
1. Social Assessment (SFD/SGTSFM/SOP-001)
2. Control (SFD/SGTSFM/SOP-002)
3. Resource Protection (SFD/SGTSFM/SOP-003)
4. Chemical & Fuel (SFD/SGTSFM/SOP-004)
5. Safety & Training (SFD/SGTSFM/SOP-005)
6. Campsites & Health (SFD/SGTSFM/SOP-006)
7. Communication Dispute (SFD/SGTSFM/SOP-007)
8. Timber Stand Improvement (SFD/SGTSFM/SOP-008)
9. Forest Restoration (SFD/SGTSFM/SOP-009)
10. Managing Spillage - Fuel & lubricant (SFD/SGTSFM/SOP-010)
11. Handling of Fertilizer (SFD/SGTSFM/SOP-011)
12. Planting Maintenance Workers (SFD/SGTSFM/SOP-012)
13. Silviculture Treatment Workers (SFD/SGTSFM/SOP-013)
14. Forest Rehabilitation Workers (SFD/SGTSFM/SOP-014)

6.4 Staffing and organization chart

The officer responsible for the overall implementation of the FMP is the District Forest Officer (DFO) of the Beluran Forestry District. He is assisted in the field by an Assistant DFO. Presently, Trusan Sugut FR has nine full time staff based in the field (Table 6.2). To be adequately staffed, at least 8 additional staff are needed to be stationed there. A proposed organization chart for the management of Trusan Sugut FR is given below.

Table 6.2. Staff requirement for Trusan Sugut FR.

No	Post	Grade	Current staffing	Additional staff requirement
1	Pen. Pemelihara Hutan	G27	1	
2	Forest Ranger	G 17	1	2
2	Forest Guard	G11	3	3
3	Driver	R3	-	2
4	Boatman (Jurumudi)	A17	1	1
5	Administration Clerk	N17	-	1
6	PRA	R1	3	
Jumlah			9	8



6.5 Staff requirement and capacity building

The DFO concerned will strive to ensure that all field staff are duly trained for their designated assignments. Clear job descriptions will be given to staff members at all levels so that they have a clear understanding of their responsibilities. Considering that wildlife monitoring is expected to be one of the key activities during this planning period, capacity building in this field will be necessary. Skill requirements will be assessed continuously to determine training needs.

Capacity building / training required:

- Kursus Sijil Perhutanan Pengawas Hutan in Institut Perhutanan Sabah for labour grade workers.
- Forest fire prevention course
- Wildlife monitoring course
- Tourist guide course
- Safety & Health course
- Silviculture & Rehabilitation internal training

6.6 Budget

The estimated budget for 10 years, from 2016 to 2026 is RM 18 million, including development and capital costs. This translates to an average annual budget of RM 1.8 million.

Planned development & capital expenditure (for the next 10 years)

Development and capital expenditure required for FMP implementation as listed below is estimated at RM 3.5 million. This outlay is expected to be incurred in the first three years of the planning period. Thereafter, the estimated annual field operations budget is RM 1 million annually (Table 6.3).

- 5 km gravelled road from main road Bosku to Kambawon Hill (Compartment 1 & 2)
- 5 km gravelled road from main road Bosku to Malukap Hill (Compartment 9 & 10)
- 14 km of wildlife trails
- 2 Forest Checking Stations each in Compartment 1 & 14
- 1 Communication Tower System and its equipments
- 4 units of four wheel drives vehicle
- 4 units of 40 hp boat and 1 speed boat

Table 6.3: Estimated annual operations budget for various activities

	Cost Component	RM
1	Road Maintenance	100,000
2	Building Maintenance	50,000
3	Staff Allowances	200,000
4	Forest Restoration & Planting Maintenance	200,000
5	Forest Protection (land, sea & aerial surveillance)	200,000
6	Administration	100,000
9	Vehicle and boat maintenance	100,000
10	Communication system (radio, etc)	50,000
	Total	1,000,000

6.7 Financing options to sustain management activities

The potential to generate revenue from Trusan Sugut FR during this planning period is limited. Current funding for management activities comes largely from SFD's recurrent supply budget and the 'Community Forestry Trust Fund'. Other sources of funding will likely be from state and federal government development allocations under the 5-Year Malaysia Plans.

Future financing options that should be explored include niche tourism products such as bird-watching and sport-fishing, payment for environmental services schemes including carbon credits with biodiversity co-benefits, REDD+, biodiversity offsets (e.g. RSPO compensation liability, 'no nett loss / nett gain' policy currently under development in Sabah), and specific project grants through corporate financing or institutional contributions. The state-level conservation financing trust fund mechanism currently being explored by SFD may become a suitable future source of funding.

6.8 Community and stakeholders consultation

In order to ensure that a consultative approach is adopted in the management of Trusan Sugut FR, two committees were set up in 2015. These two committees are scheduled to meet at least once a year, and are as listed below:

1. The Trusan Sugut FR Stakeholder Committee
2. The Trusan Sugut FR Community Committee

The Stakeholder Committee also includes representation from four large oil palm plantation estates operating in the Sugut area: IJM Plantations, IDC Jadi Sdn. Bhd., Hibumas Sdn. Bhd., Sayongmas Sdn. Bhd. Based on outcomes of the inception meetings, both committees drew up resolutions outlining their requests and working relationship with the SFD (Appendix 17).

7 MONITORING FMP IMPLEMENTATION AND ACHIEVEMENT OF GOALS AND OBJECTIVES

7.1 Monitoring plan: goals, objectives and management actions

To facilitate monitoring of planned management activities and the overall FMP implementation, a set of indicators and methods of monitoring has been prepared (Table 7.1). Another set of indicators and methods for monitoring the achievement of goals and objectives of Trusan Sugut FR as set out in this plan also has been proposed (Table 7.2).

Table 7.1. Monitoring plan for management activities and FMP implementation.

Management activity and target	Indicator	Verification method	Frequency of monitoring
Enforcement on encroachment, illegal felling and NTFP extraction	<ol style="list-style-type: none"> 1. Number of days ranger teams conducted patrolling (average number of days per month); 2. Distance (km) patrolled per month (from SMART report) 	Ranger reports; SMART patrol reports.	Half-yearly
Patrolling and enforcement on poaching and illegal fishing	<ol style="list-style-type: none"> 1. Number of days ranger teams conducted patrolling (average number of days per month); 2. Distance (km) patrolled per month (from SMART report) 	Ranger reports; SMART patrol reports.	Half-yearly
Prevention and control of fire	<ol style="list-style-type: none"> 1. Fire breaks and other preparation measures for fire prevention; 2. Number of fires controlled. 	Field manager's reports	Yearly
Pollution monitoring of rivers and streams	<ol style="list-style-type: none"> 1. Number of locations water samples collected; 2. Number of occasions of water sampling. 	Field manager's reports	Half-yearly
Boundary demarcation	Length of boundary demarcated	Field manager's reports	Half-yearly
Silviculture activities (2,000 ha over 3 years)	Hectares treated	AWP compliance reports	Yearly
Enrichment planting (2,250 ha over 8 years)	Hectares planted	AWP compliance reports	Yearly
Restoration planting (500 ha over 6 years)	Hectares planted	AWP compliance reports	Yearly
Exploration of tourism potential	Assessment report prepared	DFO's reports	Yearly
HCV monitoring	Monitoring reports produced	Field manager's reports	Yearly
Threat monitoring	Monitoring reports produced	Field manager's reports	Yearly
Forest recovery monitoring	Monitoring reports produced	Field manager's reports	Yearly
Wildlife monitoring	Monitoring reports produced	Field manager's reports	Yearly

Table 7.2. Monitoring plan for management goals and objectives of Trusan Sugut FR.

Goals and objectives	Indicators	Verification method	Frequency of monitoring
Reduction of encroachments	1. Number of encroachment locations; 2. Area of encroachments.	From threat monitoring reports	Every 2 years
Reduction of illegal felling and <i>Tengar</i> extraction	1. Number of incidents and locations of tree felling; 2. Total number of trees felled.	From threat monitoring reports	Every 2 years
Reduction of Illegal hunting	1. Number of incidents and locations of poaching; 2. Total number of animals, grouped by species poached; 3. Number of snares detected; 4. Number of poacher movements detected by camera-traps.	From threat monitoring reports	Every 2 years
Reduction of illegal fishing	1. Number of incidents and locations of illegal fishing; 2. Total mass of fish poached.	From threat monitoring reports	Every 2 years
Reduction of fire impact	1. Number of fire locations; 2. Area burnt in fire.	From threat monitoring reports	Every 2 years
Forest rehabilitation and enrichment	Increase in forest structure and tree diversity; classified by forest type.	Forest recovery monitoring report	Every 5 years
Forest restoration	Increase in tree canopy cover; classified by forest type.	Forest recovery monitoring report	Every 3 years
Securing forest connectivity and protection of additional areas	1. Hectares gazetted as FR; 2. Expanded area of protected forest in SCA.	Gazette notification	Yearly
No reduction in orang-utan population	1. Area occupied in TSFR; 2. Estimated population size.	Wildlife monitoring report	Every 5 years
No reduction in extent of occurrence of endangered species⁸ of mammals, birds and trees	1. Extent of locations recorded; 2. Relative abundance index; 3. For trees - population density.	Wildlife monitoring report	Every 2 years; for trees – every 5 years.
No reduction in species richness of mammals and birds	1. Species richness; 2. Extent of locations recorded; 3. Relative abundance index.	Wildlife monitoring report	Every 2 years
No loss of HCV and enhancement of HCV	1. Extent of occurrence of HCV; 2. Index of population status of HCV.	HCV monitoring report	Every 2 years

⁸ More details for different species are in the wildlife monitoring section – Table 5.5.

7.2 Certification of forest management

The SFD intends to have the Trusan Sugut FR certified under a credible forest certification scheme, such as the Malaysian Timber Council Certification Scheme, or the Forest Stewardship Council standards. Such independent third party assessment will ensure that management standards are maintained at a high level.

7.3 Documentation and reporting

Reporting of the progress in FMP implementation and monitoring results will be made by the District and field teams through the Sugut Conservation Area management committee.

7.3.1 Progress & Compliance Reports

Progress reports on FMP implementation and associated field activities need to be submitted to the Director of Forestry on a quarterly basis. In addition, a compliance report needs to be prepared at the end of each year. The compliance report provides details on the achievement of each activity stated in the approved AWP. A compliance certificate will be issued by the Director of Forestry if the overall achievement of the AWP meets a set minimum standards.

7.3.2 Compartment Records

All information and records on restoration planting and silviculture tending will be documented compartment-wise. This will serve as a permanent record to monitor growth and yield for each block. These compartment record books will be updated periodically as needed, and maintained systematically so as to facilitate project monitoring and auditing.

7.4 Adaptive management and mid-term review of the FMP

Adaptive changes will be made to the management, based on monitoring FMP implementation and the progress towards achievement of goals and objectives (Table 7.1 and Table 7.2). This includes re-arranging priorities, re-allocating staff and funding resources, increasing efforts, etc.

If necessary, the FMP may also be reviewed and revised as and when needed. However, a mid-term review of the forest management plan is scheduled in the year 2021. This review will take into account the progress of FMP implementation and any changes in management objectives. Following the review, the FMP may be revised, by incorporating the findings of the midterm review and by making other adaptations to suit the changes in the management situation and needs of the reserve. Any major revisions to the FMP will have to be approved by the Director of Forestry.

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9 APPENDICES

Appendix 1

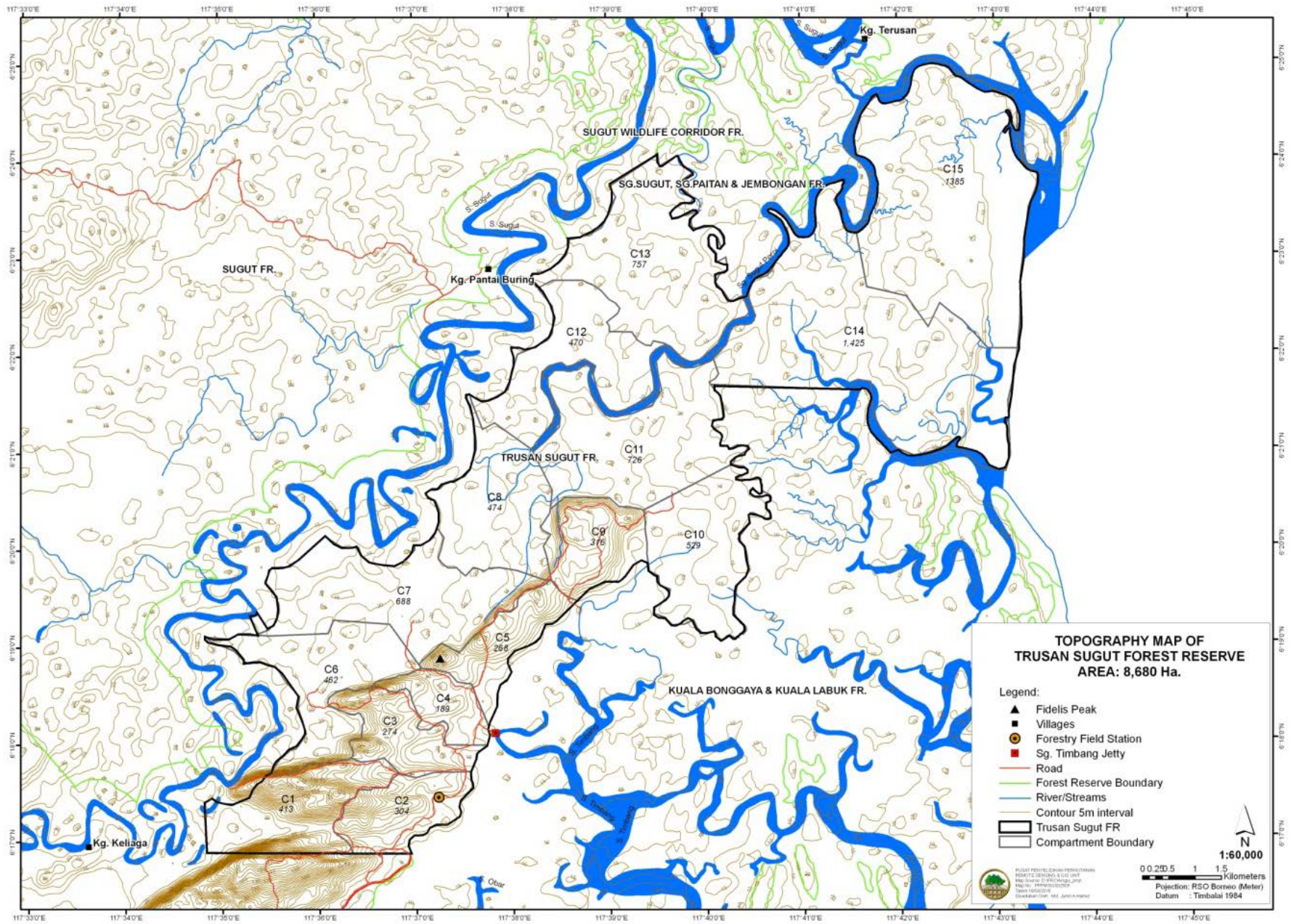
Timber licensees who operated in Sugut Forest Reserve when it was a production forest reserve

1. ROKFA ENT SDN BHD
2. SOGORAMA SDN BHD
3. GEMARA SDN BHD
4. TUNGOD TIMBER SDN BHD
5. SUPPORT AXIS SDN BHD 6.NUSANTARA BIRU SDN BHD
7. UTAMEWAH SDN BHD 8.H.N ENT SDN BHD
9. GRAND LANDMARKS SDN BHD
10. DIGIBIT SDN BHD
11. AMBANG GOLD SDN BHD
12. AZ ZEEHAD SDN BHD
13. DANG SAPIAH OSMAN SDN BHD
14. HERAS JAYA SDN BHD
15. TOTAL DEGREE
16. SANDAKAN PLYWOOD & VENEER SDN BHD
17. SH.TADI SH ALI
18. ATLANTIS HOLDING SDN BHD
19. SALINS ENT SDN BHD
20. KAMARUL ARIFFIN SDN BHD
21. KWONG BORNEO
22. KWONG FUI LOONG

Appendix 2: Monthly rainfall from 2006-2015 recorded in IJM, Sabang estate

Year	Month												
	Jan	Feb	Mac	April	May	Jun	July	August	Sep	Oct	Nov	Dec	Total
2006	623	806	246	159	203	270	203	164	312	157	142	620	3905
2007	1116	171	104	389	174	210	244	298	349	237	105	736	4133
2008	627	1144	288	284	199	419	231	139	455	187	552	488	5013
2009	1256	478	344	250	216	484	103	359	165	184	421	430	4690
2010	376	12	96	154	84	69	284	281	241	145	378	243	2363
2011	1445	345	655	209	144	189	214	309	242	239	456	548	4995
2012	481	386	276	146	260	162	304	210	209	252	487	537	3710
2013	376	343	145	318	229	144	134	157	89	207	427	219	2788
2014	378	348	111	20	248	188	319	178	77	82	161	330	2440
2015	370	23	5	127	73	91	48	428	247	129	624	130	2295
2016	191	214											
Average	705	406	227	206	183	223	208	252	239	182	375	428	3633

Appendix 3: Topographic contours in Trusan Sugut FR



Appendix 4

Common tree species (> 10 cm dbh) found at different canopy positions in some main forest types in Trusan Sugut Forest Reserve (Nilus and Sugau, 2015).

Forest type / Family / Species	Main canopy	Mid-storey	Under-storey
Lowland Kerangas Forest			
Annonaceae			
<i>Mezettia</i> sp.		✓	
<i>Xylopia ferruginea</i>		✓	✓
Myrtaceae			
<i>Syzygium biabas</i>			✓
<i>Syzygium incarnatum</i>			✓
<i>Syzygium</i> sp.			✓
<i>Tristaniopsis obovata</i>	✓	✓	✓
Sapotaceae			
<i>Palaquium pseudorostratum</i>			✓
<i>Palaquium</i> sp.			✓
Lowland Mixed Dipterocarp (Kapur Merah) Forest			
Clusiaceae			
<i>Garcinia gaudichaudi</i>			✓
<i>Garcinia parvifolia</i>			✓
<i>Garcinia</i> sp.			✓
Dipterocarpaceae			
<i>Dryobalanops beccarii</i>	✓	✓	✓
<i>Vatica umbonata</i>			✓
Myrtaceae			
<i>Syzygium cf. acuminatissima</i>			✓
<i>Syzygium clavatum</i>			✓
<i>Syzygium confertum</i>			✓
<i>Syzygium</i> sp.		✓	✓
Peraceae			
<i>Chaetocarpus castanocarpus</i>		✓	
Rubiaceae			
<i>Gardenia elata</i>			✓
<i>Timonius luzonensis</i>			✓
Lowland Mixed Dipterocarp & Kerangas Forest			
Anacardiaceae			
<i>Gluta oba</i>	✓	✓	✓
<i>Mangifera griffithii</i>			✓
<i>Mangifera macrocarpa</i>			✓
<i>Mangifera swintonioides</i>			✓
Annonaceae			
<i>Mezettia</i> sp.		✓	
<i>Xylopia</i> sp.		✓	

Dipterocarpaceae

<i>Anisoptera marginata</i>		✓	✓
<i>Cotylelobium melanoxydon</i>		✓	✓
<i>Dipterocarpus grandiflorus</i>			✓
<i>Dryobalanops beccarii</i>		✓	
<i>Hopea beccariana</i>		✓	
<i>Shorea atrinervosa</i>			✓
<i>Shorea kudatensis</i>	✓	✓	✓
<i>Shorea multiflora</i>	✓	✓	✓
<i>Shorea parvifolia</i>	✓	✓	✓
<i>Shorea rubra</i>		✓	

Myrtaceae

<i>Rhodammia cinerea</i>			✓
<i>Syzygium attenuata</i>		✓	✓
<i>Syzygium caudatilimbium</i>			✓
<i>Syzygium clavatum</i>			✓
<i>Syzygium confertum</i>			✓
<i>Syzygium sp.</i>		✓	✓
<i>Tristaniopsis obovata</i>		✓	✓

Lowland Seasonal Freshwater Swamp forest**Dipterocarpaceae**

<i>Dipterocarpus validus</i>		✓	✓
<i>Hopea nervosa</i>			✓
<i>Hopea sangal</i>	✓	✓	✓
<i>Parashorea malaanonan</i>			✓
<i>Shorea gibbosa</i>		✓	
<i>Vatica umbonata</i>	✓	✓	✓

Leguminosae

<i>Cassia nodosa</i>	✓		
<i>Crudia reticulata</i>		✓	
<i>Crudia sp.</i>	✓		
<i>Neolamarckia cadamba</i>	✓		
<i>Sindora cf. coriacea</i>	✓		
<i>Sindora sp.</i>		✓	

Phyllanthaceae

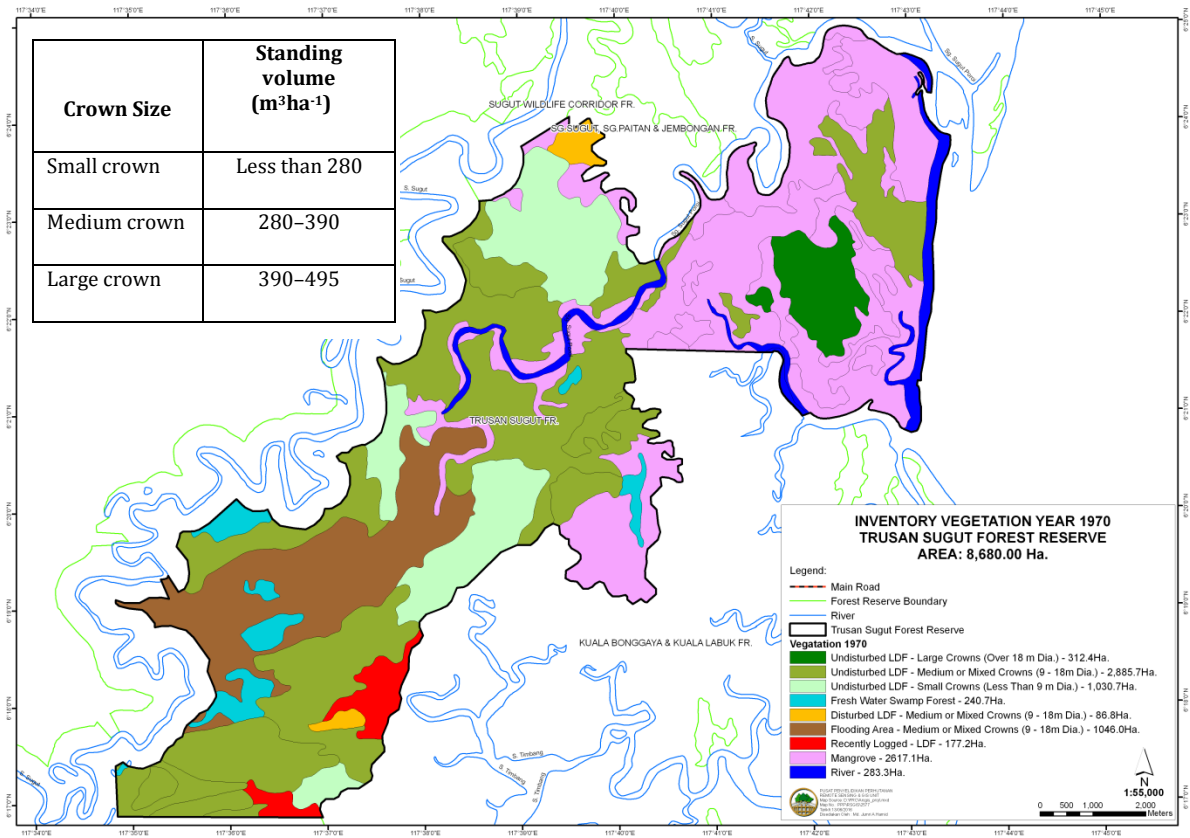
<i>Baccaurea lanceolata</i>			✓
<i>Baccaurea tetrandra</i>			✓
<i>Cleistanthus myrianthus</i>			✓
<i>Glochidion rubrum</i>			✓

Rubiaceae

<i>Pleiocarpidia sandakanica</i>			✓
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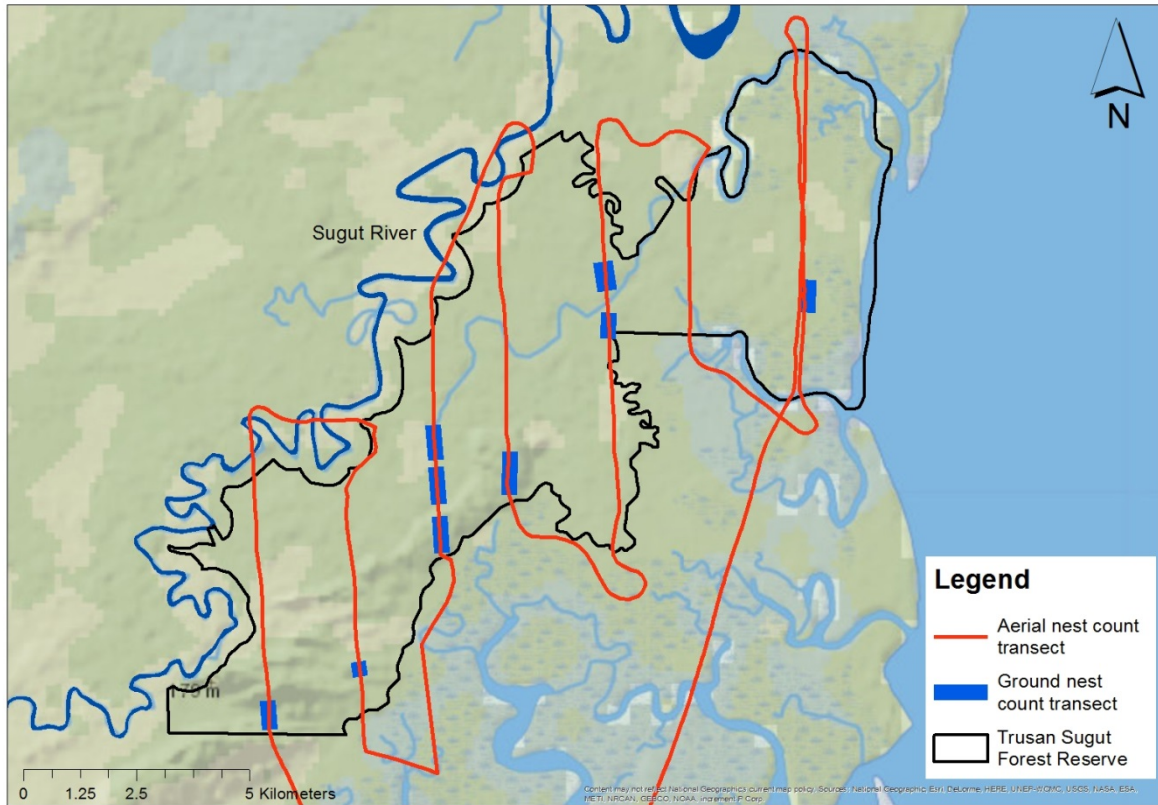
Appendix 5

Historical forest cover of Trusan Sugut FR, based on crown size as interpreted from aerial photographs taken in 1970 (Source: Sabah Forest Inventory 1969–1972, Project No.F 644/2, Canada Colombo Plan Programme).



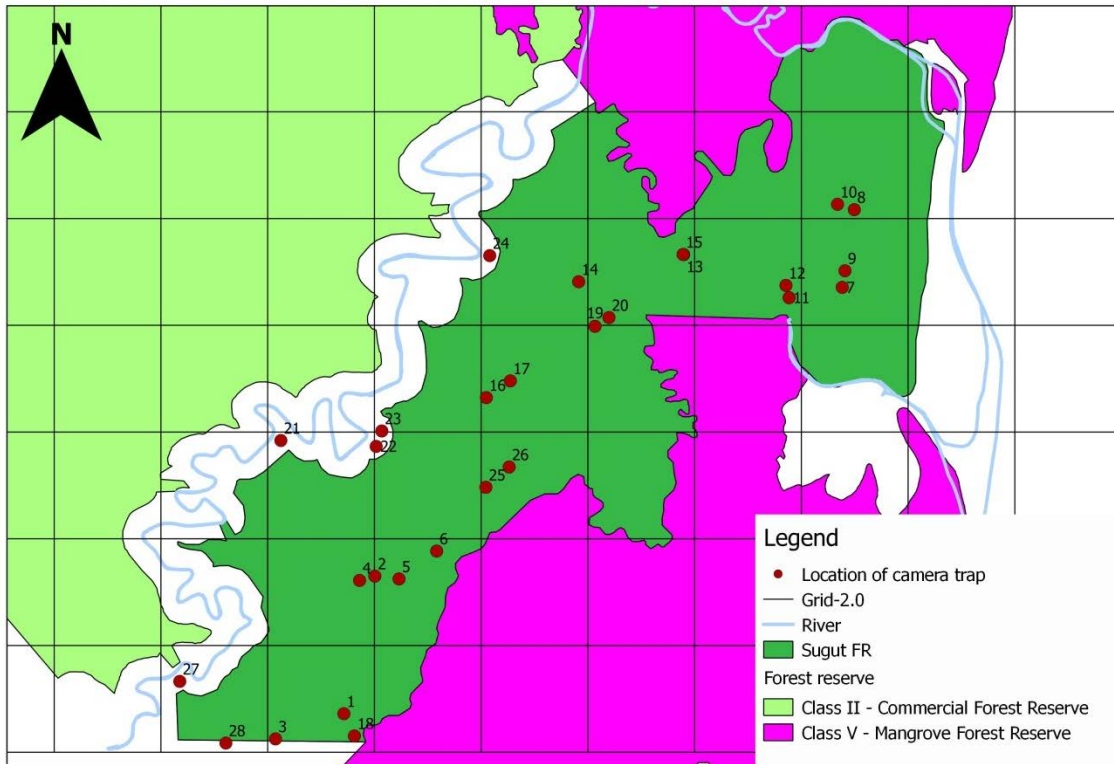
Appendix 6

Locations of helicopter transects and ground survey plots used for orang-utan nest counts in Trusan Sugut FR.



Appendix 7

Locations of camera traps deployed for terrestrial mammal surveys in Trusan Sugut Forest Reserve.



Appendix 8

Full list of terrestrial mammals found in Trusan Sugut FR using camera-traps.

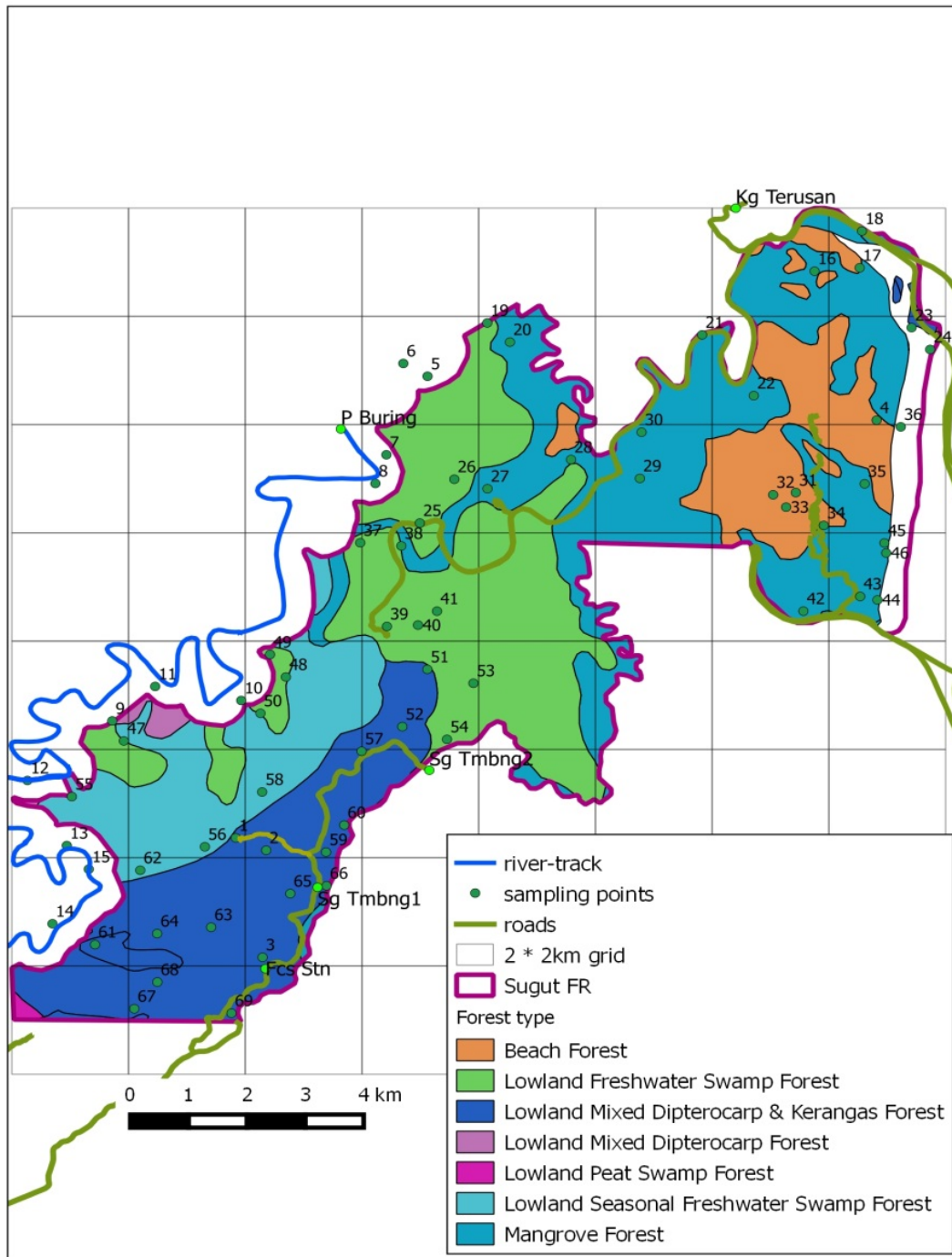
Common Name	Species	Conservation / Legal Status	
		IUCN Red List	Sabah Wildlife Conservation Enactment 1997
Orang-utan*	<i>Pongo pygmaeus</i>	Critically Endangered	Schedule 1
Banteng	<i>Bos javanicus</i>	Endangered	Schedule 1
Clouded leopard	<i>Neofelis diardi</i>	Vulnerable	Schedule 1
Malayan sun bear	<i>Helarctos malayanus</i>	Vulnerable	Schedule 1
Bay cat*	<i>Catopuma badia</i>	Endangered	Schedule 2
Pig-tailed macaque	<i>Macaca nemestrina</i>	Vulnerable	Schedule 2
Oriental small-clawed otter	<i>Aonyx cinerea</i>	Vulnerable	Schedule 2
Banded palm civet	<i>Hemigalus derbyanus</i>	Vulnerable	Schedule 2
Bearded pig	<i>Sus barbatus</i>	Vulnerable	Schedule 3
Sambar deer	<i>Rusa unicolor</i>	Vulnerable	Schedule 3
Long-tailed macaque	<i>Macaca fascicularis</i>	Least concern	Schedule 2
Short-tailed mongoose	<i>Herpestes brachyurus</i>	Least concern	Schedule 2
Yellow-throated marten	<i>Martes flavigula</i>	Least concern	Schedule 2
Malay badger	<i>Mydaus javanensis</i>	Least concern	Schedule 2
Thick-spined porcupine*	<i>Hystrix crassispinis</i>	Least concern	Schedule 2
Common palm civet	<i>Paradoxurus hermaphroditus</i>	Least concern	Schedule 2
Lesser mouse-deer	<i>Tragulus kanchil</i>	Least concern	Schedule 3
Greater mouse-deer	<i>Tragulus napu</i>	Least concern	Schedule 3
Bornean yellow muntjac*	<i>Muntiacus atherodes</i>	Least concern	Schedule 3
Bornean red muntjac	<i>Muntiacus muntjak</i>	Least concern	Schedule 3

Wildlife listed under Wildlife Conservation Enactment 1997: Schedule 1 – Totally protected species; Schedule 2 – Protected species for which hunting license is required and collection is limited; Schedule 3 – Protected species for which hunting license is required.

* denotes species endemic to Borneo.

Appendix 9

Map of locations of the 69 points pre-determined for bird survey and monitoring in Trusan Sugut FR.



Appendix 10

The protocol used for recording birds in point-counts in Trusan Sugut FR

1. The standard method used for this bird survey will be the ***'point count'*** method; time spent at each point must be ***10 minutes***.
2. Please survey the points as indicated in the maps – each point is given an ID code. The points have been placed so as to cover all the various habitat/forest types and the different parts of Sugut FR. Further, points have been laid out to avoid roadside 'edge' habitats.
3. It is left to the team(s) how they want to cover the points, as long as it is **systematically done** to cover all the points, and that there is **no overlap** ('double count' of the same point) between the teams.
4. During counts, species detected (seen or heard) are recorded in the datasheet. After 10 minutes time is up, the team should move to the next point.
5. A fresh datasheet(s) must be used for each point (the point ID is to be recorded in the datasheet).
6. In the datasheet, please write down the ***date, survey start time, end time, GPS location (including datum), weather (sunny, cloudy, rainy, etc), names of team members, habitat description (Closed canopy / open canopy / tall trees / short trees / scrub / grassland / mangrove / nipah / swamp / riverine / coast / any other (please specify))***.
7. After a bird/ a group of birds have been sighted during the count, write down ***the species name, number seen or heard*** and the ***location the bird(s) was recorded (canopy, understory tree, undergrowth, ground, in flight, river bank, in water, etc.)***.
8. Birds should be identified down to ***species*** level. If not possible, then to the ***genus level***. If during the survey, the common name was recorded, please ensure that the scientific name is filled in after the survey. Please provide ***details of the bird guide*** that was used during the survey to ensure consistency.
9. If some of the points cannot be reached for various reasons (flooding, too steep, etc), then a **new point** should be located as close as possible (***within 100 – 200 metres***) to the pre-prepared point, and the bird survey carried out. **GPS location** of the new point must be recorded in the datasheet.
10. Birds which are detected **outside of the point counts** (ad hoc, e.g., birds **found when walking to points, driving along roads, night drives, during camping, etc**) should be recorded in another datasheet provided for that purpose. Please write down ***date, time, GPS coordinate, species and number seen/ heard, and the location bird was recorded in that datasheet***.
11. This systematic method of bird survey is expected to give information on population abundance and distribution status of birds in the survey area, which in turn will be useful for identifying HCV areas, long-term monitoring, etc. **Completed datasheets should be submitted to Dr. Robert Ong, FRC**. Data analysis and preparation of detailed report will be done by WWF-Malaysia team in coordination with FRC, and shared with the survey team.

Appendix 11

Full list of bird species detected during surveys in Trusan Sugut FR in December 2014 and June 2015. (IUCN Red List Status: NT = Near Threatened; VU = Vulnerable; LC = Least Concern; NE = Not Evaluated)

NO	COMMON NAME	SCIENTIFIC NAME	Dec 2014	June 2015	IUCN	WCE 1997 (SCHEDULE 2)
1	Argus Pheasant	<i>Argusianus argus</i>		x	NT	x
2	Ashy Tailorbird	<i>Orthotomus ruficeps</i>	x	x	LC	
3	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>		x	LC	
4	Asian Fairy-Bluebird	<i>Irena puella</i>	x	x	LC	
5	Asian Glossy Starling	<i>Aplonis panayensis</i>		x	LC	
6	Asian Koel	<i>Eudynamis scolopaceus</i>		x	NE	
7	Asian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	x	x	LC	x
8	Asian Palm Swift	<i>Cypsiurus balasiensis</i>		x	LC	
9	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	x	x	LC	
10	Banded Broadbill	<i>Eurylaimus javanicus</i>	x	x	LC	
11	Banded Kingfisher	<i>Lacedo pulchella</i>	x	x	LC	
12	Banded Woodpecker	<i>Chrysophlegma miniaceum</i>	x	x	LC	
13	Bar-bellied Cuckooshrike	<i>Coracina striata</i>	x		LC	
14	Barn Swallow	<i>Hirundo rustica</i>	x	x	LC	
15	Bar-tailed Goodwit	<i>Limosa lapponica</i>	x	x	LC	
16	Bat Hawk	<i>Macheiramphus alcinus</i>	x		LC	x
17	Black and Crimson Pitta	<i>Erythropitta ussheri</i>	x	x	NE	
18	Black and Red Broadbill	<i>Cymbirhynchus macrorhynchos</i>	x	x	LC	
19	Black and Yellow Broadbill	<i>Eurylaimus ochromalus</i>	x	x	NT	
20	Black-bellied Malkoha	<i>Phaenicophaeus diardi</i>		x	NT	
21	Black-capped Kingfisher	<i>Halcyon pileata</i>	x		LC	
22	Black Hornbill	<i>Anthracoceros malayanus</i>	x	x	NT	x
23	Black Nest Swiftlet	<i>Aerodramus maximus</i>	x	x	LC	x
24	Black-backed Kingfisher	<i>Ceyx erithaca</i>	x		NE	
25	Black-capped Babbler	<i>Pellorneum</i>	x	x	LC	

		<i>capistratum</i>				
26	Black-headed Bulbul	<i>Pycnonotus atriceps</i>		x	LC	
27	Black-headed Pitta	<i>Erythropitta ussheri</i>	x		NE	
28	Black-naped Monarch	<i>Hypothymis azurea</i>	x	x	LC	
29	Black-throated Babbler	<i>Stachyris nigricollis</i>	x	x	NT	
31	Black-throated Wren-Babbler	<i>Turdinus atrigularis</i>	x		NT	
32	Black-winged Flycatcher-shrike	<i>Hemipus Hirundinaceus</i>	x	x	LC	
33	Blue Rumped Parrot	<i>Psittinus cyanurus</i>	x		NT	x
34	Blue-crowned hanging parrot	<i>Loriculus galgulus</i>	x	x	LC	x
35	Blue-eared Barbet	<i>Megalaima australis duvaucelii</i>	x	x	LC	
36	Blue-eared Kingfisher	<i>Alcedo meninting</i>	x	x	LC	
37	Blue-headed Pitta	<i>Pitta baudii</i>	x		VU	x
38	Blue-throated Bee-eater	<i>Merops viridis</i>	x	x	LC	
39	Blyth's Hawk Eagle	<i>Nisaetus alboniger</i>		x	LC	
40	Bobook	<i>Ninox scutulata</i>		x	NE	x
41	Bold-striped Tit-Babbler	<i>Macronus Bornensis</i>	x	x	LC	
42	Borneon Black Magpie	<i>Platysmurus leucopterus aterrimus</i>	x	x	NT	x
43	Borneon Brown Barbet	<i>Caloramphus fuliginosus</i>	x	x	LC	
44	Brahminy Kite	<i>Haliastur indus</i>	x	x	LC	x
45	Bronzed Drongo	<i>Dicrurus aeneus</i>		x	LC	
46	Brown Barbet	<i>Caloramphus fuliginosus</i>	x	x	LC	
47	Brown Hawk-Owl	<i>Ninox scutulata borneensis</i>		x	LC	x
48	Brown Shrike	<i>Lanius cristatus</i>	x		LC	
49	Brown-Throated Sunbird	<i>Anthreptes malacensis</i>		x	NE	
50	Buffed-necked Woodpecker	<i>Meiglyptes tukki</i>	x	x	NT	
51	Buff-rumped Woodpecker	<i>Meiglyptes grammithorax</i>	x	x	LC	
52	Bulbul	<i>Bulbul spp.</i>	x			
53	Buff-Vented Bulbul	<i>Lole olivacea</i>		x	NT	
54	Buffy Fish Owl	<i>Ketupa ketupu</i>	x		LC	x
55	Bushy Crested Hornbill	<i>Anorrhinus galeritus</i>		x	LC	x
56	Caspian Term	<i>Hydroprogne</i>		x	LC	

		<i>caspia</i>				
57	Cattle Egret	<i>Bubulcus ibus</i>		x	LC	
58	Changeable Hawk Eagle	<i>Nisaetus cirrhatus</i>		x	LC	
59	Checker-Throated Woodpecker	<i>Chrysophlegma mentale</i>		x	NT	
60	Chestnut Munia	<i>Lonchura atricapilla</i>	x	x	LC	
61	Chestnut-Backed Scimitar Babbler	<i>Pomatorhinus montanus</i>		x	LC	
62	Chestnut-breasted Malkoha	<i>Phaenicophaeus curvirostris</i>	x		LC	
63	Chestnut-Necklaced Partridge	<i>Arborophila charltonii</i>	x	x	VU	x
64	Chestnut-rumped Babbler	<i>Stachyris maculata</i>	x	x	NT	
65	Chestnut-winged Babbler	<i>Stachyris erythroptera</i>	x	x	LC	
66	Chinese Egret	<i>Egretta eulophotes</i>	x		VU	x
67	Chinese Sparrowhawk	<i>Accipiter soloensis</i>	x		LC	
68	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	x		LC	x
69	Collared Kingfisher	<i>Todiramphus chloris</i>	x	x	LC	
70	Common Iora	<i>Aegithina tiphia</i>	x	x	LC	
71	Common Sandpiper	<i>Actitis hypoleucos</i>	x		LC	
72	Copper Throated Sunbird	<i>Nectarina calcostetha</i>		x	LC	
73	Cream-vented Bulbul	<i>Pycnonotus simplex</i>	x	x	LC	
74	Crested Serpent Eagle	<i>Spilornis cheela</i>	x	x	LC	x
75	Crimson Sunbird	<i>Aethopyga siparaja</i>	x	x	LC	
76	Cuckooshrike	<i>Coracina spp.</i>	x			
77	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	x	x	LC	
78	Dark-throated Oriole	<i>Oriolus xanthonotus</i>	x	x	NT	
79	Diard's Trogon	<i>Harpactes diardii</i>	x	x	NT	
80	Drongo-cuckoo	<i>Surniculus spp.</i>	x	x		
81	Dusky Broadbill	<i>Corydon sumatranus</i>	x		LC	
82	Dusky Munia	<i>Lonchura fuscans</i>	x	x	LC	
83	Emerald Dove	<i>Chalcophaps indica</i>	x	x	LC	x
84	Eurasian Curlew	<i>Numenius arquata</i>	x	x	NT	
85	Eurasian Tree Sparrow	<i>Passer montanus</i>		x	LC	
86	Eyebrowed Thrush	<i>Turdus obscurus</i>	x		LC	
87	Far Eastern Curlew	<i>Numenius madagascariensis</i>	x	x	VU	x

88	Ferruginous Babbler	<i>Trichastoma bicolor</i>	x	x	LC	x
89	Fiery Minivet	<i>Pericrocotus igneus</i>	x	x	NT	
90	Fluffy-backed Tit-Babbler	<i>Macronous ptilosus</i>	x		NT	
91	Fulvous-chested Jungle Flycatcher	<i>Rhinomyias olivaceus</i>	x	x	LC	
92	Glossy Swiftlet	<i>Collocalia esculenta</i>		x	LC	
93	Great Egret	<i>Ardea alba</i>	x	x	LC	
94	Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	x	x	VU	
95	Great-Billed Heron	<i>Ardea sumatrana</i>	x		LC	x
96	Greater Coucal	<i>Centropus sinensis</i>	x	x	LC	
97	Greater Crested Tern	<i>Sterna bergii</i>	x		LC	
98	Greater Green Leafbird	<i>Chloropsis sonnerati</i>		x	LC	
99	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	x	x	LC	
100	Greater Sand Plover	<i>Charadrius leschenaultii</i>	x	x	LC	
101	Green Broadbill	<i>Calyptomena viridis</i>		x	NT	
102	Green Imperial Pigeon	<i>Ducula aenea</i>	x	x	LC	
103	Green Iora	<i>Aegithina viridissima</i>	x		NT	
104	Grey and Buff Woodpecker	<i>Hemicircus sordidus</i>		x	LC	
105	Grey Plover	<i>Pluvialis fulva</i>	x	x ⁹	LC	
106	Grey-bellied Bulbul	<i>Pycnonotus cyaniventris</i>	x		NT	
107	Grey-chested Jungle Flycatcher	<i>Rhinomyias umbratilis</i>		x	NT	
108	Grey-cheeked Bulbul	<i>Alophoixus bres</i>	x		LC	
109	Grey-rumped Treeswift	<i>Hemiprocne longipennis</i>	x	x	LC	
110	Grey-tailed Tattler	<i>Tringa brevipes</i>		x	NT	
111	Gull-Billed Tern	<i>Gelochelidon nilotica</i>		x	LC	
112	Hairy-backed Bulbul	<i>Tricholestes criniger</i>		x	LC	
113	Helmeted Hornbill	<i>Rhinoplax vigil</i>		x	CR	x
114	Hill Myna	<i>Gracula religiosa</i>	x	x	LC	x
115	Hooded Pitta	<i>Pitta sordida</i>		x	LC	x
116	Indian Cuckoo	<i>Cuculus micropterus</i>	x		LC	
117	Intermediate Egret	<i>Mesophoyx</i>		x	LC	x

⁹ This individual was sighted in breeding plumage

		<i>intermedia</i>				
118	Javan Myna	<i>Acridotheres javanicus</i>	x		NE	
119	Jerdon's Baza	<i>Aviceda jerdoni</i>		x	LC	x
120	Kentish Plover	<i>Charadrius alexandrinus</i>	x		LC	
121	Large-billed Crow	<i>Corvus macrorhynchos</i>	x		LC	
122	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	x	x	LC	
123	Lesser Adjutant	<i>Leptoptilos javanicus</i>	x		VU	x
124	Lesser Coucal	<i>Centropus bengalensis</i>		x	LC	
125	Lesser Cuckooshrike	<i>Coracina fimbriata</i>	x		LC	
126	Lesser Green Leafbird	<i>Chloropsis cyanopogon</i>	x	x	NT	
127	Lesser Sand Plover	<i>Charadrius mongolus</i>	x	x	LC	
128	Little Egret	<i>Egretta garzetta</i>	x	x	LC	x
129	Little Green Pigeon	<i>Treron olax</i>	x	x	LC	
130	Little Spiderhunter	<i>Arachnothera longirostra</i>	x	x	LC	
131	Long-tailed Parakeet	<i>Psittacula longicauda</i>	x	x	NT	x
132	Magpie Robin	<i>Copsychus saularis</i>		x	LC	x
133	Malayan Night Heron	<i>Gorsachius melanolophus</i>	x		LC	x
134	Malaysian Blue Flycatcher	<i>Cyornis turcosus</i>	x		NT	x
135	Malaysian Hawk Cuckoo	<i>Hierococcyx fugax</i>	x	x	LC	
136	Mangrove Blue Flycatcher	<i>Cyornis rufigastra</i>	x	x	LC	
137	Mangrove Pitta	<i>Pitta megarhyncha</i>	x		NT	
138	Mangrove Whistler	<i>Pachycephala cinerea</i>	x	x	LC	x
139	Maroon Woodpecker	<i>Blythipicus rubiginosus</i>	x	x	LC	
140	Maroon-Breasted Philentoma	<i>Philentoma velata</i>		x	NT	
141	Mossy-Nest Swiftlet	<i>Aerodramus salangana</i>		x	LC	
142	Moustached Hawk-Cuckoo	<i>Hierococcyx vagans</i>	x	x	NT	
143	Myna	<i>Myna spp.</i>	x			
144	Olive-backed Sunbird	<i>Cinnyris jugularis</i>		x	LC	
145	Olive-backed Woodpecker	<i>Dinopium rafflesii</i>	x		NT	

146	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	x	x	LC	
147	Orange-backed Woodpecker	<i>Chrysocolaptes validus</i>	x	x	LC	
148	Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	x	x	LC	
149	Oriental Bay Owl	<i>Phodilus badius</i>		x	LC	x
150	Oriental Darter	<i>Anhinga melanogaster</i>	x	x	NT	x
151	Oriental Dollarbird	<i>Eurystomus orientalis</i>	x	x	LC	
152	Oriental Dwarf Kingfisher	<i>Ceyx erithaca</i>	x	x	LC	
153	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>		x	LC	x
154	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	x	x	LC	x
155	Oriental White-Eye	<i>Zosterops palpebrosus</i>		x	LC	
156	Pacific Reef Egret	<i>Egretta sacra</i>	x		LC	x
157	Pacific Swallow	<i>Hirundo tahitica</i>	x	x	LC	
158	Paddyfield Pipit	<i>Anthus rufulus</i>		x	LC	
159	Pied Fantail	<i>Rhipidura javanica</i>	x	x	LC	
160	Pied Thriller	<i>Lalage nigra</i>		x	LC	
161	Pink-necked Green Pigeon	<i>Treron vernans</i>	x	x	LC	
162	Plain Sunbird	<i>Anthreptes simplex</i>	x	x	LC	
163	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	x	x	LC	
164	Prinia	<i>Prinia</i> spp.	x	x		
165	Puff-backed Bulbul	<i>Pycnonotus eutilotus</i>		x	NT	
166	Purple Heron	<i>Ardea purpurea</i>		x	LC	x
167	Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	x	x	LC	
168	Purple-Throated Sunbird	<i>Leptocoma sperata</i>		x	LC	
169	Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	x		LC	
170	Raffles's Malkoha	<i>Rhinortha chlorophaea</i>	x	x	LC	
171	Red-bearded Bee-eater	<i>Nyctornis amictus</i>	x	x	LC	
172	Red-Billed Malkoha	<i>Phaenicophaeus javanicus</i>	x	x	LC	
173	Red-Crowned Barbet	<i>Megalaima rafflesii</i>		x	NT	
174	Red-eyed Bulbul	<i>Pycnonotus brunneus</i>	x		LC	
175	Red-Naped Trogon	<i>Harpactes</i>		x	NT	

		<i>kasumba</i>				
176	Red-necked Stint	<i>Calidris ruficollis</i>	x	x	LC	
177	Red-throated Barbet	<i>Megalaima mystacophanos</i>	x		NT	
178	Red-throated Bee-Eater	<i>Nyctyornis amictus</i>		x	LC	
179	Red-throated Sunbird	<i>Anthreptes rhodolaemus</i>		x	NT	
180	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	x	x	NT	x
181	Ruby-cheeked Sunbird	<i>Chalcoparia singalensis</i>	x	x	LC	
182	Ruddy Kingfisher	<i>Halcyon coromanda</i>	x	x	LC	
183	Rufous Piculet	<i>Sasia abnormis</i>		x	LC	
184	Rufous Woodpecker	<i>Micropternus brachyurus</i>	x	x	LC	x
185	Rufous-Bellied Hawk-Eagle	<i>Lophotriorchis kienerii</i>		x	LC	
186	Rufous-crowned Babbler	<i>Malacopteron magnum</i>	x	x	NT	
187	Rufous-fronted Babbler	<i>Stachyris rufifrons</i>	x		LC	
188	Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	x	x	LC	
189	Rufous-winged Philentoma	<i>Philentoma pyrhoptera</i>	x	x	LC	
190	Sanderling	<i>Calidris alba</i>		x	LC	
191	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	x	x	LC	
192	Scarlet-breasted Flowerpecker	<i>Prionochilus thoracicus</i>	x		NT	
193	Scarlet-Rumped Trogon	<i>Harpactes duvaucelii</i>		x	NT	
194	Short-tailed Babbler	<i>Malacocincla malaccensis</i>	x		NT	
195	Silver-rumped Spinetail	<i>Rhaphidura leucopygialis</i>	x	x	LC	
196	Slender-billed Crow	<i>Corvus enca</i>	x	x	LC	
197	Sooty-caped Babbler	<i>Malacopteron affine</i>	x	x	NT	
198	Spectacled Bulbul	<i>Pycnonotus erythrophthalmos</i>	x	x	LC	
199	Spectacled Spiderhunter	<i>Arachnothera flavigaster</i>	x		LC	
200	Spotted Dove	<i>Spilopelia chinensis</i>		x	LC	
201	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	x	x	LC	
202	Streaked Bulbul	<i>Ixos malaccensis</i>	x		NT	
203	Striated Heron	<i>Butorides striata</i>		x	LC	

204	Terek Sandpiper	<i>Xenus cinera</i>	x	x	LC	
205	Thick-billed Green Pigeon	<i>Treron curvirostra</i>		x	LC	
206	Van hasselt's Sunbird	<i>Leptocoma brasiliana</i>	x		NE	
207	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	x		LC	
208	Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	x		LC	x
209	Wallace's Hawk Eagle	<i>Nisaetus nanus</i>	x		VU	x
210	Whimbrel	<i>Numenius phaeopus</i>	x	x	LC	
211	Whiskered Treeswift	<i>Hemiprocne comata</i>	x		LC	
212	White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	x	x	LC	
213	White-bellied Woodpecker	<i>Dryocopus javensis</i>	x	x	LC	x
214	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	x	x	LC	
215	White-Breasted Wood-Swallow	<i>Artamus leucorhynchus</i>	x	x	LC	
216	White-chested Babbler	<i>Trichastoma rostratum</i>	x	x	NT	x
217	White-collared Kingfisher	<i>Halcyon chloris</i>		x	LC	
218	White-crowned Forktail	<i>Enicurus leschenaulti</i>		x	LC	
219	White-crowned Shama	<i>Copsychus stricklandii</i>	x	x	NE	
220	White-winged Black Tern	<i>Chlidonias leucopterus</i>		x	LC	
221	Wrinkled Hornbill	<i>Aceros corrugatus</i>		x	NT	x
222	Woodpecker spp.	<i>Woodpecker spp.</i>	x			
223	Yellow Bittern	<i>Ixobrychus sinensis</i>		x	LC	
224	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	x		LC	
225	Yellow Wagtail	<i>Motacilla flova</i>	x	x	LC	
226	Yellow-bellied Bulbul	<i>Alophoixus phaeocephalus</i>	x		LC	
227	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	x	x	LC	
228	Yellow-Eared Spiderhunter	<i>Arachnothera chrysogenys</i>		x	LC	
229	Yellow-Rumped Flowerpecker	<i>Prionochilus xanthopygius</i>		x	LC	
230	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	x		LC	

Appendix 12

Fish species recorded in Trusan Sugut FR during this survey conducted in June 2014. (Adapted from WWF-Malaysia/Hamid A., *unpublished report*). Commercial fish species are marked with an asterisk.

Freshwater fish:

Local/Common Name	Family	Species Name	Location/ Station	Ref: Muhamad Saini S. (1998)
Jalan/Pangal/ Haruan/striped-snakehead	Channidae	<i>Channa striatus</i>	St 1	-
Turungou	Cyprinidae	<i>Osteochilus spp.</i>	St 3,4,5	+
Turungou	Cyprinidae	<i>Cyclocheilichthys enolops</i>	St 2,4,5	-
Lais	Siluridae	<i>Kryptopterus spp.</i>	St 1, 4	+

Marine/brackish water fish:

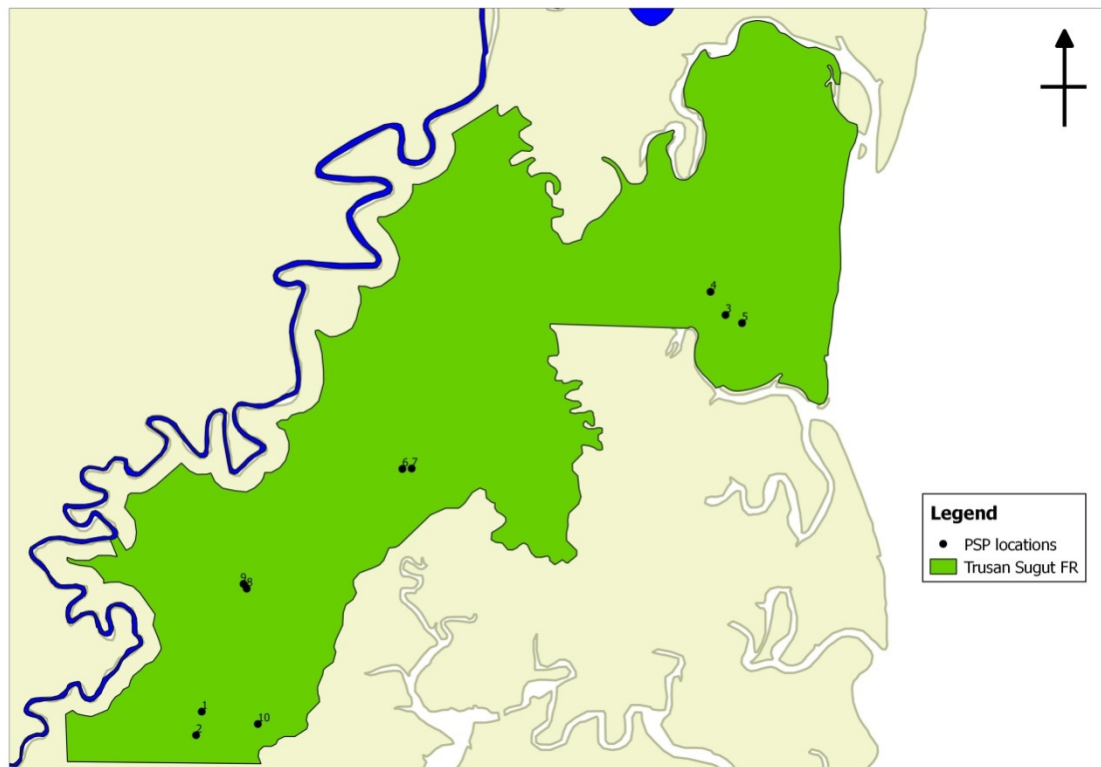
Local/Common Name	Family	Species	Location/ Station	Ref: Muhamad Saini S. (1998)
	Leiognathidae	<i>Leiognathus equulus</i>	St 6,7,8	-
		<i>Leiognathus sp</i>	St 6,7,8	+
Belanak	Mugilidae	* <i>Liza tade</i>	St 6,7,8, Sugut Bay	-
	Drepanidae	* <i>Drepane punctana</i>	St 6,7,8	-
	Gerreidae	<i>Gerres kapas</i>	St 6,7,8	-
	Ambassidae	<i>Ambassis kopsii</i>	St 6,7	-
Sembilang laut	Plotosidae	<i>Plotosus sp</i>	St 8, Kuala Sabang	-
Ikan sumpit	Toxotidae	<i>Toxotes chatareus</i>	St 6,7,8	-
	Siganidae	* <i>Siganus vermiculatus</i>	St 7,8	-
	Tetraodontidae	<i>Tetraodon sp</i>		-
Talang, Ikan putih	Carangidae	* <i>Scomberoides sp</i> * <i>Caranx sp</i>	Sugut Bay	- -
Kanai	Lutjanidae	* <i>Lutjanus sp</i>	St 7	-
	Megalopidae	* <i>Megalops sp</i>	St 6,7	-
	Sciaenidae	* <i>Nibea soldado</i>	St 7,8	-
Tembakul	Gobiidae	<i>Periophthalmus sp</i>	St 6	-
	Terapontidae	* <i>Mesopristes sp</i>	St 6	-

Marine fish recorded at the collection centre:

Local/Common Name	Family	Species Name	Ref: Muhamad Saini S. (1998)
Senangin	Polynemidae	<i>*Eleutheronema rhadinum</i>	-
	Sillaginidae	<i>*Sillago sp</i>	-
Belanak	Mugilidae	<i>*Liza vaigiensis</i>	-
	Scatophagidae	<i>Scatophagus sp</i>	-
Kanai	Lutjanidae	<i>*Lutjanus russeli</i>	-
	Monodactylidae	<i>Monodactylus argenteus</i>	-
	Clupeidae	<i>Hilsa keele</i>	-

Appendix 13

Locations of the permanent sampling plots established in Trusan Sugut FR for vegetation surveys and monitoring



Appendix 14

Permanent sample plots established in Trusan Sugut FR for forest assessment and plant diversity inventory (Nilus & Sugau, 2015).

Plot No	Soil Association	Forest type	Latitude	Longitude	Altitude (m)
1	Maliau	Disturbed LMDKF	6° 17' 21.9"	117° 36' 27.5"	91
2	Maliau	Disturbed LMDKF	6° 17' 06.5"	117° 36' 23.8"	82
3	Tanjung Aru	Disturbed LMDF	6° 21' 41.6"	117° 42' 10.1"	15
4	Tanjung Aru	Disturbed LMDF	6° 21' 56.8"	117° 42' 00.3"	13
5	Tanjung Aru	Disturbed LMDF	6° 21' 36.3"	117° 42' 20.9"	12
6	Maliau	Disturbed LMDKF	6° 20' 00.8"	117° 38' 38.7"	65
7	Maliau	Disturbed LMDKF	6° 20' 01.1"	117° 38' 44.8"	58
8	Kinabatangan	Disturbed FWSF	6° 18' 42.4"	117° 36' 56.9"	10
9	Kinabatangan	Disturbed FWSF	6° 18' 45.5"	117° 36' 54.8"	11
10	Maliau	Disturbed LKF	6° 17' 13.8"	117° 37' 04.2"	16

(Notes: Lowland Mixed Dipterocarp Forest (LMDF); Lowland Mixed Dipterocarp & Kerangas Forest (LMDKF); & Lowland Kerangas Forest (LKF); Freshwater Swamp Forest (FWSF)).

Appendix 15

Various criteria included in the Minimum Enforcement Standards for protected areas.

1. An enforcement strategy and implementation plan must be in place for the protected area.

The enforcement plan will be based on the enforcement strategy and will provide guidelines for patrol activities and planning. It should contain:

- a) Situation: containing a list of Threats to the Protected Area, maps, aerial photos, etc.
- b) Mission (Objectives): E.g. Maintain an effective compliance and enforcement capacity to mitigate the impacts of users, visitors and illegal activities.
- c) Execution (Methodology): E.g. i) Maintaining regular reserve patrols particularly along the boundaries, ii) Ensuring the effective deployment of the enforcement and compliance members towards controlling illegal activities, enforcing legislation and regulations, iii) Mapping areas where illegal activities occur and maintaining an inventory of incidents
- d) Administration and logistics: Include i) essential provisions for transportation, clothing, and equipment ii) a safety and risk assessment, iii) training requirements.

2. Enforcement patrols must be supported by an information network.

As in many areas of law enforcement, confidential informers (CIs) are a crucial part of the system. Most protected areas (PAs) are too large to be adequately patrolled. Therefore, using informants and targeting known hotspots or suspected individuals, will make the patrols more effective. (UNODC claim that 86% of border seizures result from informers).

3. There should be a minimum of four rangers on an enforcement patrol team.

If patrolling by vehicle, this may be reduced to three members. In addition to normal enforcement patrol requirements and efficiency (contact & cover officers) this is also an officer safety issue. If a ranger is injured then two of the rangers can carry him out, while one is available for point, or one ranger can stay with the injured ranger while the other two go for assistance. If the rangers are travelling by vehicle or boat, then the difficulty with the transport of apprehended persons or injured individuals changes, therefore three rangers will be adequate

4. An enforcement patrol team must include a trained investigator.

At least one of the enforcement patrol team must be trained in wildlife crime scene investigations (WCSI) and informant handling and interrogation techniques. The minimum standards expected are the successful completion of the following modules, ASEAN Standards for PA Staff (2003) ENF 2.3 Correctly secure, manage and process a crime scene, ENF 3.4 Follow correct procedure for dealing with violations, seized or confiscated evidence, ENF 3.7 Develop and manage informant networks.

5. An enforcement patrol team must have powers of arrest or detention.

Enforcement patrol rangers must have powers of arrest. This includes the powers of detention necessary until the suspect has been handed over to the police, or powers of arrest to process for court, within the agency. These powers are necessary to effectively deal with poaching and other incidents or threats the rangers may face.

6. There should be a minimum of fifteen days/nights of ranger patrol per month.

The patrol schedule and adequate staff numbers may allow for 100% coverage over the month, but at the minimum, a random 50% coverage using available staff is required.

7. Some rangers should be permanently based on site.

These rangers may either be in an outpost, a ranger station or a guard house at the PA's entrance or other available site.

The public must:

a) In an emergency or circumstances requiring assistance, be able to contact rangers at a known location, and

b) be aware that there exists a ranger presence in the area to show "ownership" of the PA – that Government is paying attention to its PAs.

8. A law enforcement monitoring tool must be in place. (E.g. MIST, MStripes, SMART)

Some types such as MIST, SMART (currently being introduced) or written patrol reports, are already in use. We often cannot dictate which system is in use but we must be able to keep track of results, plan for future activities, show improvements.

9. An enforcement patrol team may include multiple agencies.

Different Government legislation and regulations apply. In some PAs the enforcement rangers will be trained, authorized and capable of properly carrying out all their duties (i.e. Thailand's National Parks rangers in Maewong /Klong Lan NP's). In this case the PA would be exempt from this requirement.

10. A communication system must be in place between patrol teams and HQ.

The system must be in place between patrol teams and Headquarters (HQs) – The type of communication system will only be as sophisticated as budgets and terrain allow, however rangers must be able to get emergency assistance by some method.

11. All major access points/routes must be controlled.

There should be a "gate house" at the entrance to the PA, or on the road traversing the PA, to welcome visitors, monitor traffic access and egress, and search suspicious vehicles if necessary. This forms part of the visible deterrent approach.

Appendix 16

Resolutions of the Community Committee for the Sugut Conservation Area – meeting held on 4th March 2015, IPS, TELUPID

Resolusi 1: Memohon Jabatan Perhutanan Sabah membuat rondaan di setiap sungai dalam Hutan Simpan, melarang orang luar memasuki dan sebarang kegiatan pukat tunda.

Resolusi 2: Memohon Jabatan Perhutanan Sabah membenarkan muda-mudi penduduk kampung melakukan aktiviti dalam Hutan Simpan.

Resolusi 3: Memohon Jabatan Perhutanan Sabah bersama-sama mengawal kemasukan pemburu haram yang melalui gate-gate ladang kelapa sawit untuk mengelakkan salah faham antara pengurusan ladang dan penduduk setempat.

Resolusi 4: Memohon Jabatan Perhutanan Sabah memberikan peluang perkerjaan kepada penduduk kampung jika ada aktiviti pembersihan hutan, penanaman dan pembersihan sempadan di sepanjang sempadan Hutan Simpan.

Resolusi 5: Memohon Jabatan Perhutanan Sabah memantau papan-papan tanda sempadan dan kawasan Hutan Simpan jika ada yang rosak. Dan memohon tahap keselamatan diperketatkan bersama Polis dan Jabatan Perhutanan Sabah.

Resolusi 6: Memohon Jabatan Perhutanan Sabah membekalkan peta kawasan Hutan Simpan Trusan Sugut kepada ahli-ahli komuniti. Dan memohon latihan memadam api, kerana persekitaran perkampungan senantiasanya berhadapan masalah api apabila musim kemarau.

Resolusi 7: Memohon Jabatan Perhutanan Sabah melantik Renjer Kehormat di kalangan penduduk kampung atau di kalangan ahli-ahli komuniti.

Resolusi 8: Memohon Jabatan Perhutanan Sabah melarang sebarang kegiatan meracun dan aktiviti pengeboman ikan dikawasan sungai dalam Hutan Simpan.