THE ECOLOGY OF TAPANULI ORANGUTAN

Pongo tapanuliensis

WORKING GROUP
SUSTAINABLE MANAGEMENT OF BATANG TORU LANDSCAPE
2019

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BATANG TORU SUSTAINABLE LANDSCAPE MANAGEMENT
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The writing of this book is carried out in collaboration:

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FOREWORD

The Working Group (*Pokja*) on Sustainable Management of Batang Toru Landscape is a synergic effort of all development actors and parties in realizing the management of Batang Toru landscape that supports sustainable regional development and community welfare through an agreed dynamic process and will be set forth in the form of an Action Plan and a Sustainable Master Plan Management of Batang Toru Landscape. The stakeholder workshop held on 6-7 February 2018 in Bogor agreed that the National Working Group Secretariat was located at the Faculty of Forestry, IPB University, while the Provincial Working Group Secretariat is at the Faculty of Forestry, University of North Sumatra. The series of stakeholder workshops also resulted in the Joint Commitment to the Conservation of the Batang Toru Ecosystem signed by stakeholders (40 institutions/individuals) that consist of government, private sector, non-governmental organizations and community leaders on February 23, 2018 in Sipirok. This collaboration commitment is expected to be able to encourage the management of the Batang Toru landscape in a sustainable manner, which guarantees its ecological integrity along with the biodiversity maintenance and optimal enhancement of the socio-cultural value and function of the region's economic development.

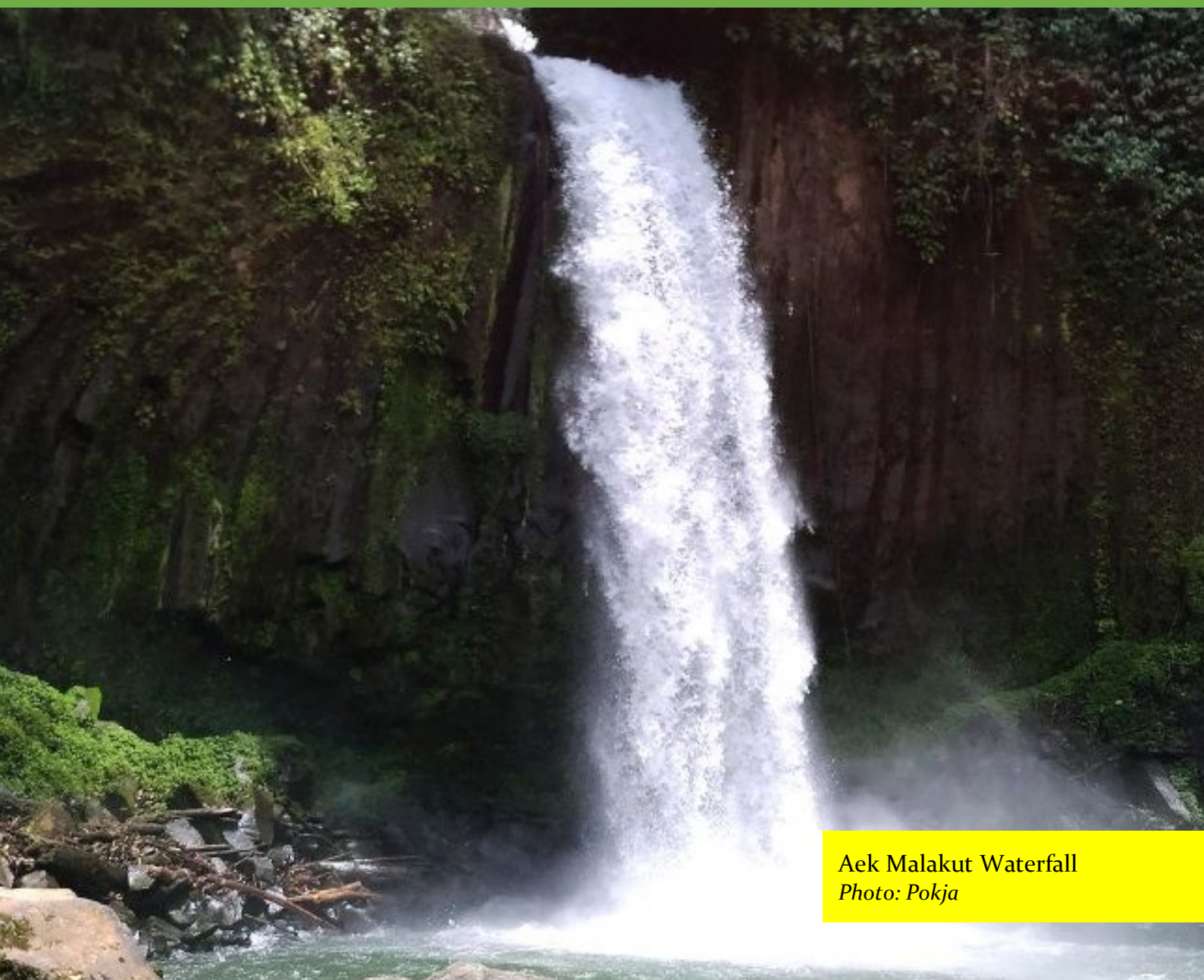
The preparation of the Tapanuli Orangutan (*Pongo tapanuliensis*) Ecology Book is the result of collaboration of the parties who are members of a thematic working group in order to provide basic information about Tapanuli orangutans whose status is protected and endangered. The information in this book is expected to be the basis for stakeholders to actively participate in preserving the Tapanuli orangutan and the function of the Batang Toru landscape as a habitat for the Tapanuli orangutan. In addition, the information in this book can be an input for the Government and Regional Governments and other stakeholders in making decision to maintain biodiversity conservation in the dynamics of regional development and efforts to improve community welfare in the Batang Toru landscape.

This book contains a compilation of the results of various studies conducted by the parties to describe the state of the art of research results on Tapanuli orangutans, presented briefly on aspects that are considered important for the public to know. Presentation of popular scientific information is intended to bridge the communication of the parties in managing the Batang Toru landscape in a sustainable manner. Although there are still many things that have not been presented yet, the results of research and studies of various parties as well as the information summarized in this book are expected to be able to open stakeholders' insights into the conservation of Tapanuli orangutans in the context of sustainable regional development balance, particularly in the Batang Toru landscape. The focus on development in an environmental service based, forest products, an environmentally friendly agriculture, and nature tourism is a hope to reach the future vision of the management of the Batang Toru landscape.

The National Batang Toru Landscape Management Working Group continues to express its high appreciation to those who have actively participated in the preparation of this book. There is no ivory that is not cracked, we are sorry if there is a shortage of this book. All constructive inputs and corrections are expected for the perfection of further arrangements. The book is a "living document" that will be updated periodically.

Bogor, August 17th, 2019

Haryanto R. Putro



Aek Malakut Waterfall
Photo: Pokja

WELCOMING SPEECH OF DEAN OF FORESTRY FACULTY

Praise the presence of Allah Subhanallahuwata'ala, the Almighty God, for a lot of His grace and guidance, the Tapanuli Orangutan (*Pongo tapanuliensis*) Ecology book can be completed well. This book has been compiled in order to disseminate information as well as educate the public about the ecology of orangutans, especially Tapanuli orangutans, whose existence occupies a very specific habitat location and is an endemic species.

This book is a popular scientific work that is easily understood by readers, both general readers and researchers engaged in the field of primates. This book reviews the overall condition of the Batang Toru landscape which is a habitat for Tapanuli orangutans and their administrative boundaries, as well as their bio ecological characteristics.

The bio ecological characteristics of Tapanuli orangutans are explained in this book in detail including genetic differences of Tapanuli orangutan from other orangutan species. This book also clearly describes its distribution, population, and behavior. Some interesting things in this book are presented which are related to the challenges, prospects for the preservation of the Tapanuli orangutan, also the interaction of these species and the people who live and have daily activities around them. It is an interesting phenomenon.

This book is arranged through a series of desk study, literature study, analysis of research results on orangutans, both in Sumatra and Kalimantan in general, especially Tapanuli orangutans in Batang Toru landscape that have been carried out by various parties.

For the compilation of this popular scientific book, we express our thanks and appreciation to the drafting team and the parties who have contributed directly or indirectly in its preparation. Hopefully this small work will be useful for the public to get to know, love, and ultimately contribute to protect the sustainability of the Tapanuli orangutan and the harmony among community, central government, local government, and all elements of related institutions. We expect all forms of constructive input to improve this book.

Greetings.

Bogor, August 17th, 2019

Dean of Faculty of Forestry, IPB University

Rinekso Soekmadi

Fog in Batu Satail Village
Photo: Pokja

WELCOMING SPEECH OF CHAIRMAN OF THE TRUSTEESHIP BOARD, INDONESIAN ORANGUTAN FORUM

Indonesia as a mega biodiversity country has a very high diversity of ecosystems, species, and genetics. One of them is orangutan. Tapanuli orangutan (*Pongo tapanuliensis*) as one of the orangutan species declared by several experts as the one which is separated from Sumatran orangutan, occupies a specific habitat and has a very limited distribution. Tapanuli orangutan is the animal of national pride that must be preserved. If you do not know them, you will not love them. If someone does not know orangutan, he will not love orangutan. Therefore, he will not take any efforts to preserve this species.

FORINA (Indonesian Orangutan Forum) as a national forum who cares about orangutan, has a vision of realizing the conservation of orangutans and their habitat and actively overseeing the implementation of strategies and action plans for conservation of great ape species. FORINA welcomes the presence of this book. It is realized that there are not many references about Tapanuli orangutan, which can be accessed by the general public. So, it is not excessive if this book is said to be the pioneer.

It is a very good moment to introduce the existence of Tapanuli orangutan by publishing this book. This book which gives a popular scientific description is expected to answer the public's curiosity about the ecology or life of the Tapanuli orangutan. Therefore, this book is important for its benefits in the area of awareness raising or education to community as part of efforts to manage Tapanuli orangutan.

Hopefully the book entitled 'The Ecology of Tapanuli Orangutan (*Pongo tapanuliensis*)' which was born from the synergic process of these orangutan experts can be a basic reference as well as it can add the public knowledge on orangutan conservation. It also can be useful for all parties who participate and collaborate in efforts to improve the preservation of Tapanuli orangutan and their habitat in Indonesia in general.

Jakarta, August 25th, 2019

Indonesian Orangutan Forum,
Chairman of the Trusteeship Boar,

Wahjudi Wardojo

Tapanuli Orangutan (*Pongo tapanuliensis*)
Photo: Kuswanda

WELCOMING SPEECH OF DIRECTORATE GENERAL OF CONSERVATION OF NATURAL RESOURCE AND ECOSYSTEMS

Tapanuli orangutan was declared a new species, in an international journal published in "Current Biology" on November 3rd 2017. Based on these findings, the Government has assigned a rapid response team to carry out patrol and population monitoring that institutionally involve the North Sumatra BBKSDA (an association of natural resource conservation), the center of environmental research and development in Aek Nauli, and forest management unit. The government has also established Tapanuli orangutan as protected species based on the Minister of Environment and Forestry regulation No.P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning on the determination of protected plant and animal species.

The government has also issued an action plan through a decree No.308/MENLHK/KSDAE/KSA.2/4/2019 concerning on the strategy and action plan for Indonesian orangutan conservation in 2019-2029 which was launched on August 12th 2019. The document emphasizes the importance of Tapanuli orangutan as one of the national priority targets.

This book was compiled based on the results of the experts' research as a momentum to introduce Tapanuli orangutan to the world and provide basic information for their preservation efforts. A concrete challenge to preserve Tapanuli orangutan is to integrate their management into landscape-scale collaborative planning that includes an interdisciplinary approach and limits of administrative authority. In this context, the role of stakeholders at the site level, whether government agencies, the private sector, and local communities is a key actor to realize its success. In the future, wider participation both in management and monitoring of Tapanuli orangutan which is institutionalized in the collaborative management of the sustainable Batang Toru landscape which is expected to be realized through the synergy of programs and activities of development actors in the landscape. This book is expected to be an initial knowledge base for the parties to build participation and synergy in efforts to preserve the Tapanuli orangutan.

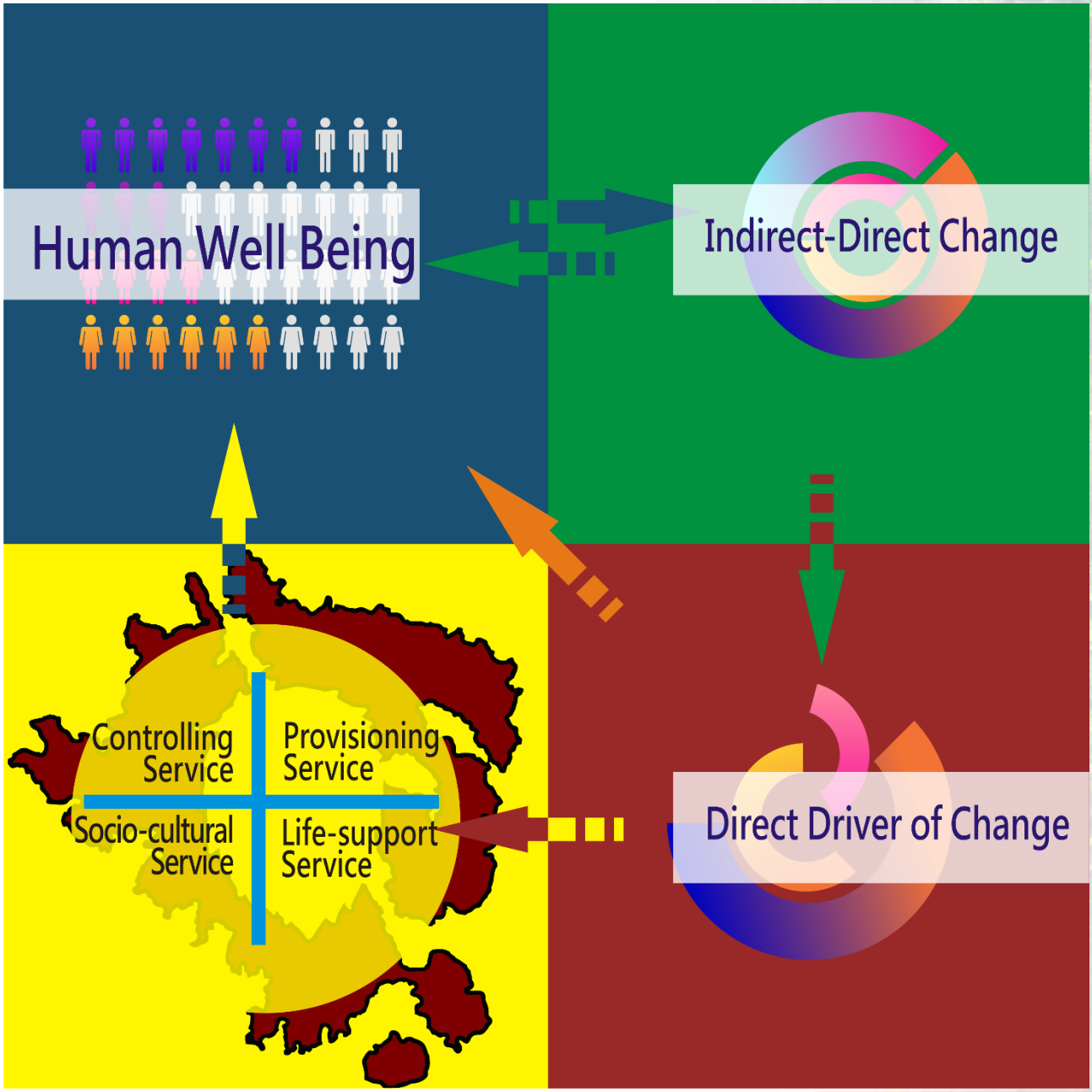
Hopefully, this briefly compiled book "The Ecology of Tapanuli Orangutan" can become a popular scientific book which can be used as a basis for all parties to protect and manage Tapanuli orangutan in the future. Tapanuli orangutan conservation needs to involve stakeholdres such as forest management unit (KPH), North Sumatra BBKSDA, research experts, environmental activists, and traditional leaders who still uphold local wisdom. The challenge is of course how various development efforts can be aligned with the preservation of Tapanuli orangutan.

Jakarta, August 22nd, 2019

Directorate general
Conservation of Natural Resources and Ecosystems
Ministry of Environment and Forestry

Ir. Wiratno, M.Sc

Black Flying Squirrel
Photo: Compost


Human Well Being
Indirect-Direct Change
Controlling Service
Provisioning Service
Socio-cultural Service
Life-support Service
Direct Driver of Change

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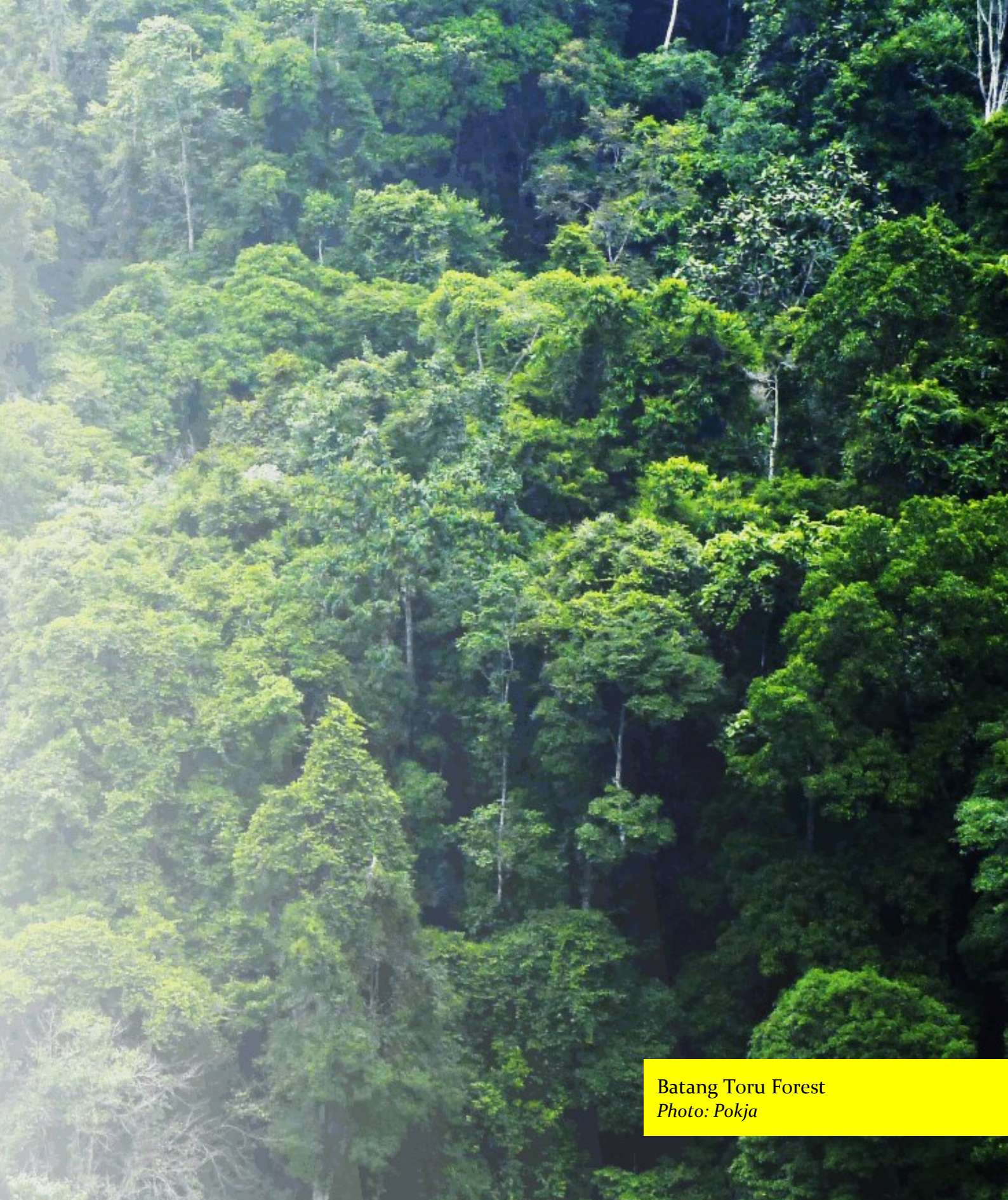


Batang Toru Forest
Photo: Pokja

Tapanuli orangutan (*Pongo tapanuliensis)*
Photo: Compost

1 Introduction

Orangutans that live in the Batang Toru landscape are well known by local communities and orangutan researchers in Sumatra. When it was announced that the orangutan in the Batang Toru landscape was a new species, the Tapanuli orangutan (*Pongo tapanuliensis*) on November 3, 2017 in a scientific journal "Current Biology", the scientific community and conservation activists were surprised and amazed. No one would have thought that a species that was published more than a century ago was a different species compared to other orangutan species. As a consequence, parties like government, private sector, non-governmental organizations and local communities increase their concern on this new icon of conservation in Indonesia, the Tapanuli orangutan.

Fundamental awareness of parties is triggered by the fact that orangutans live in very limited habitats, approximately 132.000 Ha in the Batang Toru landscape and several habitats that its area has not been certainly known yet. These habitats include the area that have been fragmented both naturally and unnaturally as a result of regional development activities. In addition, the lack of comprehensive baseline data on the landscape scale needed to determine appropriate conservation actions also makes the decision difficult to take. As an instance of this is the published population figures indicate allegedly the uncertain estimation of the population of Tapanuli orangutan. The highest estimation is 800 individuals (Nater *et al.* 2017), while Kuswanda (2018) estimated only 495-577 individuals. The official document used by the government is the Orangutan Conservation Strategy and Action Plan in 2019-2029 using 577-760 individuals in a habitat area of 1.051,32 km^2 spread over two meta-populations. The best wisdom from the uncertainty of the situation above is the disruption of stakeholder communication to build a shared commitment in the conservation of Tapanuli orangutans and the sustainable management of Batang Toru landscape.

Of the remaining potential habitat of Tapanuli orangutans, it consists of 34% primary forests, 52% secondary forests, 14% in other types of land cover. The habitat is very rich in biodiversity including various valuable native flora and fauna species. In terms of area function, 7% of the habitat is in the area of a nature reserve whose management is carried out by the Center for Conservation of Natural Resources (*BBKSDA*) of North Sumatra province, 64% are protected forests, 4% are production forests whose management is carried out by the Forest Management Unit (KPH) in Padangsidimpuan region (region X) and Pandan region (region XI), and the remaining 25% are areas managed by district government and community. Policy support from the central government, the provincial government of North Sumatra, the regency government to the village government in Batang Toru is needed in order

to strengthen the capacity of site management and the synergy of programs as well as activities in the management of habitat and population of Tapanuli orangutans.

Up until now, the government has assigned a rapid response team to carry out population patrol and monitoring functions that institutionally involve the North Sumatra Natural Resource Conservation Center (*BBKSDA*), Aek Nauli Forestry and Environmental Research and Development Center, and Forest Management Unit. The government has also established Tapanuli orangutan as protected species based on the regulation of Minister of Environment and Forestry, the Republic of Indonesia No.P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning on the establishment of protected plant and animal species and issuing SRAK Indonesian Orangutan in 2019-2029 which was officially published on 12 August 2019 through the decree of Minister of Environment and Forestry No.308/MENLHK/KSDAE/KSA.2/4/2019. It turns out that the preservation of Tapanuli orangutan is one of the national priority targets. The related provincial and regency governments have also pushed for the realization of detailed provincial and spatial strategic area plans (Batang Toru Forest Conservation Strategic Area). Stakeholders have also drawn up a draft of action plan in a collaborative manner to support efforts of Tapanuli orangutan conservation.

This book entitled 'The Ecology of Tapanuli Orangutan' contains scientific information on the current status of knowledge about habitat, population, and behavior of Tapanuli orangutans; various pressures and threats of Tapanuli orangutan conservation; and some aspects of management that have been carried out and are needed in the future. The entire scientific information is presented concisely in popular language to make it easier for readers with different background knowledge to understand the substance presented. Thus, this book will encourage all parties to actively participate in efforts to preserve Tapanuli orangutan.

The Hills in the Batu Satail Village
Photo: Pokja

2 Knowing More About Orangutan

Orangutan derived from the words 'people or humans' and 'forest' which means forest man' (Galdikas 1978). The genus name is Ourangus and the species name is *Ourangus outangus*. This name is no longer use after the International Commission for Zoological Nomenclature (ICZN) gave a name *Pongo* sp. for the genus of the orangutan great ape family (Groves 1972).

According to Meijaard *et al.* (2001), it is considered that orangutans was originated from the Asian mainland along the Himalayan mountains and had migrated as far as 3000 km to the Sunda mainland during the Pleistosen (2 million–22 thousand years ago). Orangutan in Indonesia had been divided into two subspecies until 2017, namely the Sumatran orangutan (*Pongo abelii*) and the Bornean orangutan (*Pongo pygmaeus*).

Figure 1. Sumatran orangutan (*Pongo abelii*)[1]

Figure 2. Bornean orangutan (*Pongo pygmaeus*)[2]

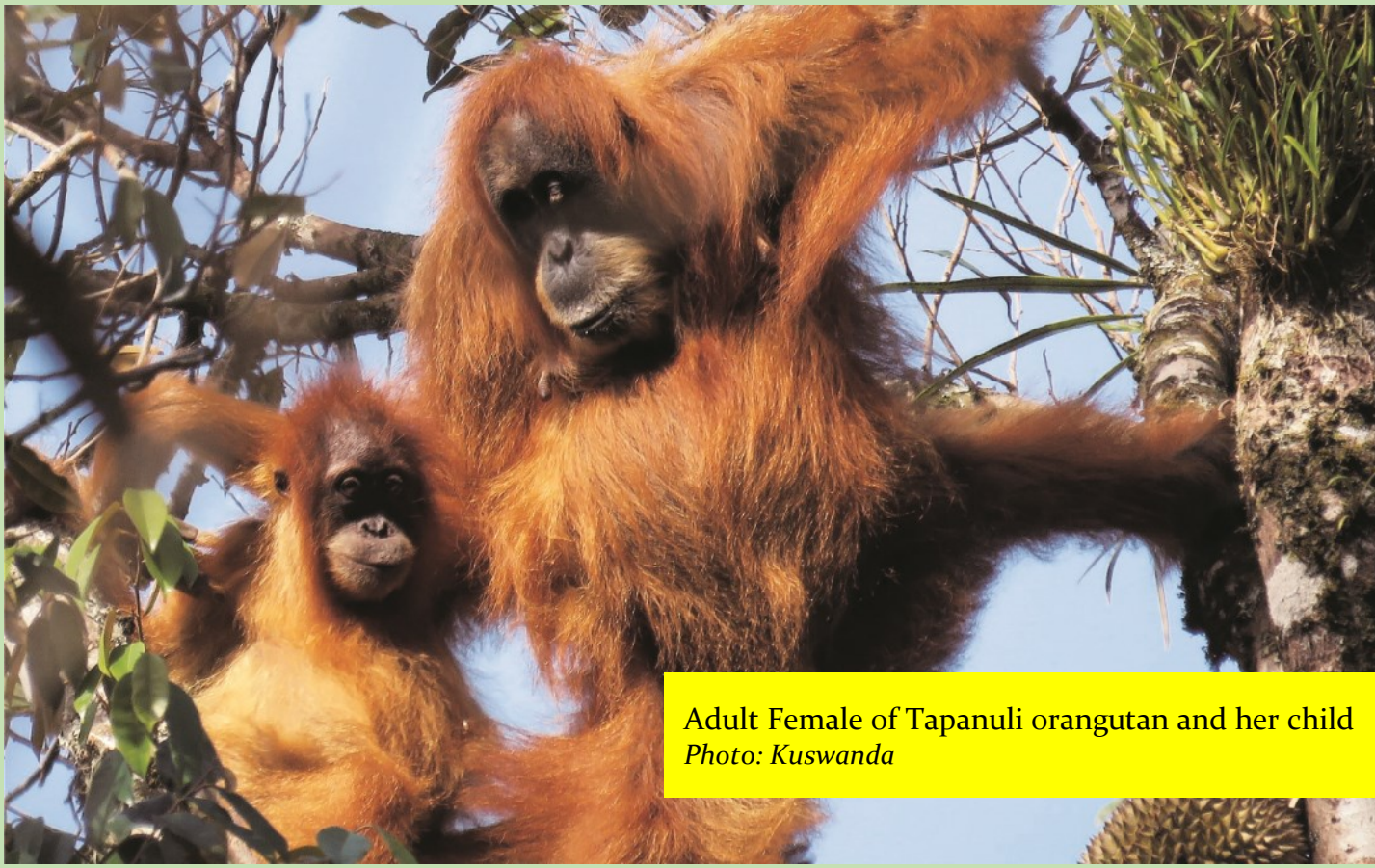
The existence of Sumatran orangutans in Aceh region began to be published in 1890 by a German researcher named B. Hagen. Then Gustav Schneider in 1905 found an orangutan seen in the interior of Sibolga and around the Batang Toru River. In the early 1970s, K. S.

[1] Source: **Figure 1** https://en.wikipedia.org/wiki/Tapanuli_orangutan.
[2] *Ibid* (Source: **Figure 2**).

Figure 3. Tapanuli orangutan (*Pongo tapanuliensis*)[3]

Depari reported that orangutans still existed in the forest along the Batang Toru River (Meijaard *et al.* 2001).[3]

Research on orangutans in Sumatra experienced a very big leap in 2017 with the identification of a new species of orangutan called the Tapanuli orangutan (*Pongo tapanuliensis*) in the hilly region of North Sumatra in the Batang Toru landscape.



Adult Female of Tapanuli orangutan and her child
Photo: Kuswanda

[3] *Ibid* (Source: **Figure 3**).

3 The Distribution of Orangutans In Sumatera

The Ministry of Environment and Forestry states in The Strategy and Plan of Indonesian Orangutan Conservation in 2019-2029 that population of Sumatran orangutan (*Pongo abelii*) is estimated at 13,710 individuals with a habitat area of 20,532.76 km² spread over 8 meta-populations. On the other hand, *Pongo tapanuliensis* is estimated around 577-760 individuals with habitat area of 1.051,32 km² with 2 meta-populations, i.e. Western Batang Toru and Eastern Batang Toru (Eastern Sarulla), that certainly exists. Although there is a wildlife reserve on the southern part of Batang Toru landscape named Barumun Wildlife Reserve, the existence of this orangutan in this wildlife reserve has not been confirmed.

Table 1. The distribution and population of orangutan in Sumatera

No	Location	Habitat unit	Habitat area (km²)**	Population (individual)	
				PHVA 2004	*PHVA* 2016
1	Aceh (North-East)	7	1.679	654	-
2	Aceh (North-West)	1,2	282	180	-
3	Seulawah	6	85	43	-
4	Central Aceh	3,9	826	440	-
5	Western Leuser	4,5,5A,10,11	2.547	2.508	5.920
6	Sidiangkat	12	186	134	-
7	Eastern Leuser	13,14,15,16	1.467	1.052	5.780
8	Rawa Tripa	17	140	280	210
9	Tromon-Singkil	18	725	1.500	1.270
10	Eastern Rawa Singkil	19	80	160	-
11	Western Batang Toru	20	600	400	600
12	Eastern Batang Toru (Eastern Sarulla)	21	375	150	160
13	Sikulaping (Western Pakpak)	25	-	-	260
14	Siranggas/Batu Ardan	24	-	-	90
15	Bukit Tiga Puluh*	22	-	-	120
16	Jantho*	23	-	-	60
Jumlah			**8.992**	**7.501**	**14.470**

Source : Population data were taken from Wich *et al.* (2003) dan Wich *et al.* (2016)

Notes : Orangutan in Western Batang Toru and Eastern Batang Toru (Eastern Sarulla) have been identified since 2017 as *Pongo tapanuliensis* which is different from *Pongo abelii*

(*) If the orangutan reintroduction process continued until the next ten years

(**) The area of orangutan habitat based on population and habitat viability assessment in 2004

In population and habitat viability assessment (*PHVA*) in 2004, it was estimated that the remaining orangutan (*Pongo abelii* dan *P. tapanuliensis*) habitat on the island of Sumatera was 8.992 km² which are divided into 12 distribution areas (21 habitat units) with a population of 7.501 individuals (Singleton *et al.* 2004). Additional data or information and research on the distribution of population in Sumatera Island show an increase of orangutan population. This increase was stated on population and habitat viability assessment (*PHVA*) in 2016 (Utami-Atmoko *et al.* 2017) which estimates the orangutan population in Sumatra Island is 14.470 individuals with 10 meta-population, including 2 meta-population of Tapanuli orangutan. However, the habitat area is not stated explicitly.

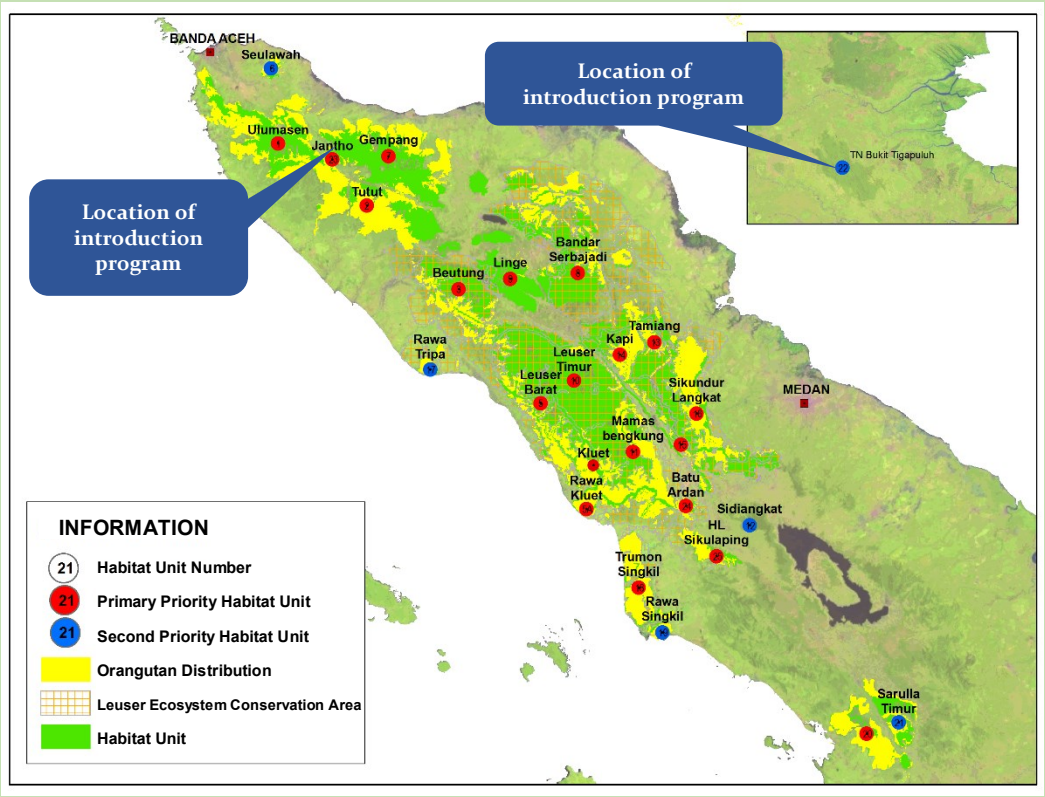


Figure 4. Map of orangutan habitat unit in Sumatra Island[4]

Tapanuli orangutan
Photo: Compost

Tapanuli orangutan
Photo: Compost

[4] Source: Wich *et al.* (2003); Singleton *et al.* (2004); Perbatakusuma *et al.* (2010)

4 Tapanuli Orangutan

The Government of the Republic of Indonesia *cq* the Ministry of Environment and Forestry (*KLHK*) issued a press release regarding a new species of orangutan (*Pongo tapanuliensis*) through SP.330/HUMAS/PP/HMS.3/11/2017 on 3 November 2017. It was published in an international journal named *Current Biology* on 3 November 2017.

The Tapanuli orangutan was initially alleged to be the southernmost orangutan population of the Sumatran orangutan species (*Pongo abelii*) (Singleton *et al.* 2004). Further genetic studies turned out to show large differences with orangutan on the north of Lake Toba, so that they could be declared as a new sub-species for Sumatran orangutan species (*Pongo abelii tapanuliensis*) (Rianti 2015).

More in depth studies suggest that taxonomically, the Tapanuli orangutan is closer to the Bornean orangutan (*Pongo pygmaeus*) and has a significant difference from *Pongo abelii*. So the Sumatran orangutan population in Batang Toru is declared to be a new species by the name of *Pongo tapanuliensis* (Nater *et al.* 2017).

The designation of *P. tapanuliensis* as a new species is signed by enormous genetic differences between the three species of orangutans, as stated by Rianti (2015). Phylogenetic studies using principal component analysis and population genetic models on genetic samples of 37 wild orangutans and morphological analysis of the skeletons of 34 adult male Sumatran orangutans and Bornean orangutans showed that the orangutan population in Batang Toru is a separated species.

Based on the genetic data, the orangutan population in Sumatra can be divided into four genetic population groups, namely the population of North Aceh, Langkat (northern part of North Sumatra), Alas Barat (Tripa, West Leuser population, central Leuser and Batu Ardan) and Batang Toru (southern part of North Sumatra). These genetic differences will indirectly affect the morphology and behavior of orangutans in Batang Toru. Based on Singleton *et al.* (2004) and Ellis *et al.* (2006), there are also differences in terms of social behavior between Tapanuli orangutans in Batang Toru with other Sumatran orangutans.

Another unique thing of *P. tapanuliensis* is that it is the only orangutan population in lowland dry land forests that uses tools on the sapphire fruit (*Neesia sp.*) which were previously only found in orangutans in swamp forests only (van Schaik 2009). Tapanuli orangutan, as a new species is very interesting and provides a challenge for the development of research or research that is different from other great apes.

As a new species that is recently known, Tapanuli orangutans and the biodiversity of their habitat and socio-cultural communities have great potential in the development of ecotourism in the Batang Toru landscape. Tapanuli orangutan is also a symbol to increase awareness of conservation and to mobilize collective action of all parties in ecosystem conservation and sustainable regional development as a flagship species that is categorized as **Critically Endangered** according to the IUCN Redlist.

Tapanuli orangutan
Photo: Kuswanda

5 The Population of Tapanuli Orangutan

Research on orangutans in the Batang Toru area has been conducted since 1997 (Wich et al. 2014). However, until 2017 there has never been a comprehensive study in the Batang Toru landscape as a whole. Research is still being done in several locations that do not fully represent the Batang Toru landscape, i.e.: Conservation International Indonesia (CII) research area, *Yayasan Ekosistem Lestari* (*YEL*) research area, the nature reserve area named *CA Dolok Sipirok* and *CA Sibual-Buali*, the area corridor plan, the area of PT. Martabe and exploration of PT. North Sumatra Hydro Energy (NSHE). The study was conducted using a nest density approach to estimate population.

Based on the nest finding density approach, several researchers have tried to predict the population of Tapanuli orangutans as follows:

1. Kuswanda (2006): West Batang Toru (170-360 individuals)
2. Dephut (2007): West Batang Toru (400 individuals) and Sarulla (150 individuals)
3. Fredrikson and Indra (2007): West Batang Toru (600 individuals) and East Batang Toru (300-400 individuals)
4. Wich *et al.* (2008): West Batang Toru (400 individuals) and East Batang Toru (150 individuals)
5. Simorangkir (2009): Protected forest and potential corridor area (337-421 individuals)
6. Perbatakusuma *et al.* (2010): Forest of West Batang Toru (600 individuals) and East Sarulla Block (300-400 individuals)
7. Kuswanda (2013): Dolok Sibual-Buali Nature Reserve Area (8-27 individuals)
8. Kuswanda (2014): Dolok Sipirok Nature Reserve Area (22-40 individuals)
9. Nater *et al.* (2017): Batang Toru Landscape (800 individuals)
10. Kuswanda (2018): West Batang Toru (360-400 individuals), East Batang Toru (120-150 individuals) dan South part of East Batang Toru (15-27 individuals)
11. Wich *et al.* (2019): Batang Toru Landscape (767 individuals), West Block (581 individuals), East Block (162 individuals) and Sibual-Buali Nature Reserve Area (24 individuals).

The government in this terms the Ministry of Environment and Forestry has determined that the population of Tapanuli orangutans in Batang Toru is 557-760 individuals in the two metapopulations set forth in the Ministry of Environment and Forestry Decree No.SK.308/MENLHK/KSDAE/KSA.2/4/2019 concerning Strategy and the Indonesian Orangutan Conservation Action Plan (SRAK) for 2019-2029.

Although it does not show the concentration of distribution and population of Tapanuli orangutans, from several studies conducted above, it is known that the density of nest (rest

pedestal) orangutans in the Batang Toru landscape are found at an alt
above sea level which can indicate the appropriate height range as th
especially in meeting the needs of life.

Table 2. The nest of Tapanuli orangutan nest based on height[5]

Height (m dpl.)	Total number of nest	Percentage
100-300	8	3,9
300-500	36	17,6
500-700	48	23,4
700-1000	101	49,3
1000-1500	12	5,9
Total	205	100,0

Table 3. The nest of Tapanuli orangutan based on land cover[6]

Land cover	Total number of nest	Percentage
Primary Forest	16	7,80
Secondary forest	152	74,15
Bush or shrub	10	4,88
Open land(*)	10	4,88
Dry land farming	7	3,41
Mixed dry land farming	7	3,41
Rice field	3	1,46
Total	205	100,0

Notes: * The nest identified in previous studies have been turned into an empty land, because of the opening forest activity

Table 4 Nest findings based on the status of forest area[7]

Area status	Number of nest	Percentage
Other area	121	59,0
Protected forest	63	30,7
Production forest	3	1,5
Conservation area	18	8,8
Total	205	100, 0

[5] Research result on nest finding by *YEL*, Kuswanda, and *CI* Indonesia.
[6] *Ibid.*
[7] *Ibid.*

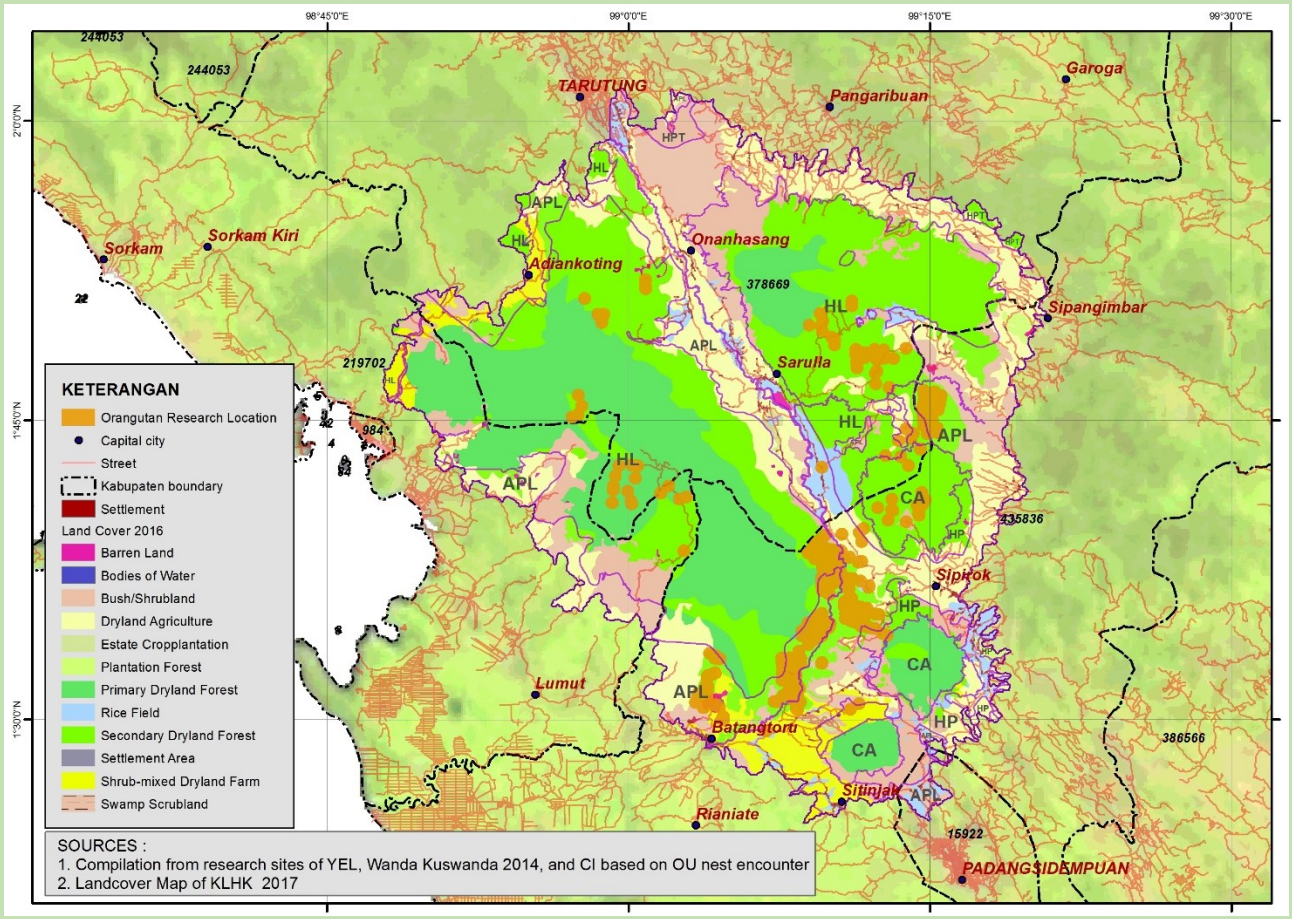


Figure 5. The map of research location of Tapanuli orangutan based on nest finding

Of the 205 identified nests, the majority were found in secondary forests and in area for other purposes (APL). This shows that secondary forests in APL have an abundance of food and a preferred shelter for Tapanuli orangutans. Based on 2016 KLHK land cover, 15,673 Ha (18.89%) out of 82,957 Ha of secondary forests in the Batang Toru landscape are in APL.

The Hills in the Batu Satail Village
Photo: Pokja

Table 5. Land cover and area functions in the Batang Toru landscape

Land cover	Area Function (Ha)						
	Area for other purposes	Nature reserve	Protected forest	Production forest	Limited production forest	Water bodyf	Total area
Primary forest	200	6.135	50.058	6		1	56.400
Secondary Forest	15.673	7.715	55.902	2.800	765	102	82.957
Plantation Forest	701		56	240	181		1.178
Plantation	201			143			344
Settlement	81		1				82
Dryland farming	39.723	37	8.157	2.529	147	205	50.798
Mixed dryland farming	8.084	150	1.843	1.088	127	26	11.318
Rice field	6.852	11	938	292		93	8.186
Shrub	19.176	1.283	11.253	3.638	1.313	70	36.733
Shrub swamp	12						12
Swamp	312		6				318
Open field	637		170	19		3	829
Water	14						14
Jumlah	**91.666**	**15.331**	**128.384**	**10.755**	**2.533**	**500**	**249.169**

Source: Map of land cover in 2016 based on data in *KLHK*

Tapanuli orangutan
Photo: Compost

6 Getting to Know Closely All About Tapanuli Orangutan

BIO-ECOLOGY

Tapanuli Orangutan can be categorized into the following taxonomy:

Kingdom : Animalia – Animal, animaux, animals
Subkingdom : Bilateria
Infrakingdom : Deuterostomia
Phylum : Chordata – cordés, cordado, chordates
Subphylum : Vertebrata – vertebrado, vertébrés, vertebrates
Infraphylum : Gnathostomata
Superclass : Tetrapoda
Class : Mammalia Linnaeus, 1758 – mammifères, mamífero, mammals
Subclass : Theria Parker and Haswell, 1897
Infraclass : Eutheria Gill, 1872
Order : Primates Linnaeus, 1758 – homem, macaco, primata, sagui, primates, primates
Suborder : Haplorrhini Pocock, 1918
Infraorder : Simiiformes Haeckel, 1866
Superfamily : Hominoidea Gray, 1825
Family : Hominidae Gray, 1825 – man-like primates, Great Apes
Subfamily : Ponginae Elliot, 1913 – orangutans
Genus : Pongo Lacépède, 1799 – orangutans
Species : *Pongo tapanuliensis* Nurcahyo, Meijaard, Nowak, Fredriksson and Groves in Nater *et al.*, 2017 – Tapanuli Orangutan
Inggris : Tapanuli Orangutan •
Perancis : Orang-outan de Tapanuli
Spanyol : Orangután de Tapanu

Pongo tapanuliensis, based on mitochondrial genes, has been separated from the *P. abelii* and *P. pygmeus* since 3.5 million years ago (Nater *et al.* 2011). This isolation occurred after the eruption of Lake Toba (Chesner *et al.* 1991; Williams *et al.* 2009) and resulted in the specificity of gene mutation and increased Tapanuli orangutan alleles. Based on autosomal microsatellite data and allelic diversity (Nater *et al.* 2013; Rianti 2015), mitochondrial DNA genome (Ma *et al.* 2013), HVR-I mitochondria (Nater *et al.* 2011; 2013), the Tapanuli orangutan is the most isolated species of orangutan in Batang Toru. These results show that the population of Tapanuli orangutan in Batang Toru is different from other orangutan populations in Sumatra and Borneo (Nater *et al.* 2017).

Based on mitochondrial DNA, it shows that female orangutan in Batang Toru have a closert kinship with Bornean orangutan than Sumatran orangutan (Nater *et al.* 2011).

Napier dan Napier (1967) explain that orangutan hair can be used as a differentiation factor for orangutans. In general, the morphology of *P. tapanuliensis* is more similar to *P. abelii* in body shape, color, and number of hairs than *P. pygmaeus.* Based on Kuswanda (2014), *P. tapanuliensis* has longer and thicker hair so that the ends of the hair tend to be curly. Adult females and males have hair that grows from the top of the lips to the chin. Tapanuli orangutan's head has a smaller size and a more flat face shape.

Like other male orangutans, adult Tapanuli orangutans have a voice sack (air sack) located on their neck that functions to take and collect several litters of air. This sack also functions to make long call (MacKinnon 1972). The frequency of the long call of male Tapanuli orangutan is higher in maximum level of frequency than Sumatran orangutan and last longer also has more rhythm than Bornean orangutan. The frequency of long call of Tapanuli orangutan can reach 800 Hz with a duration of 111 seconds (Nater *et al.* 2017).

Although it does not show the distribution concentration and population of Tapanuli orangutan, according to several studies conducted above, it is known that the density of nest (*rest pedestal*) of orangutan in Batang Toru landscape is found at an altitude of 300-1000 m above sea level which can indicate the appropriate height range as their current habitat, especially their area in order to meet their needs of life.

Figure 6. *Pongo tapanuliensis*, male (left) and female (right) (*Photo: Kuswanda*)

BEHAVIOUR

Daily Activity

Daily activities can generally be defined as activities carried out by orangutans during their active days in daylight because orangutans are animals that are active during the day (diurnal).

Orangutan activity starts when the sun rises and ends about an hour before sunset (Morrogh-Bernard *et al.* 2009) and it is influenced by fruitful seasons and weather. Based on Aini's research in 2011, Tapanuli orangutan is active in the morning at 06.22- 08.30 WIB and end their activity in the afternoon around 15.38-18.34 WIB.

Before starting its activity, orangutans have a habit of removing feces and urine before moving and exploring for food. Hanging on both hands holding branches is the way how they defecate and urinate.

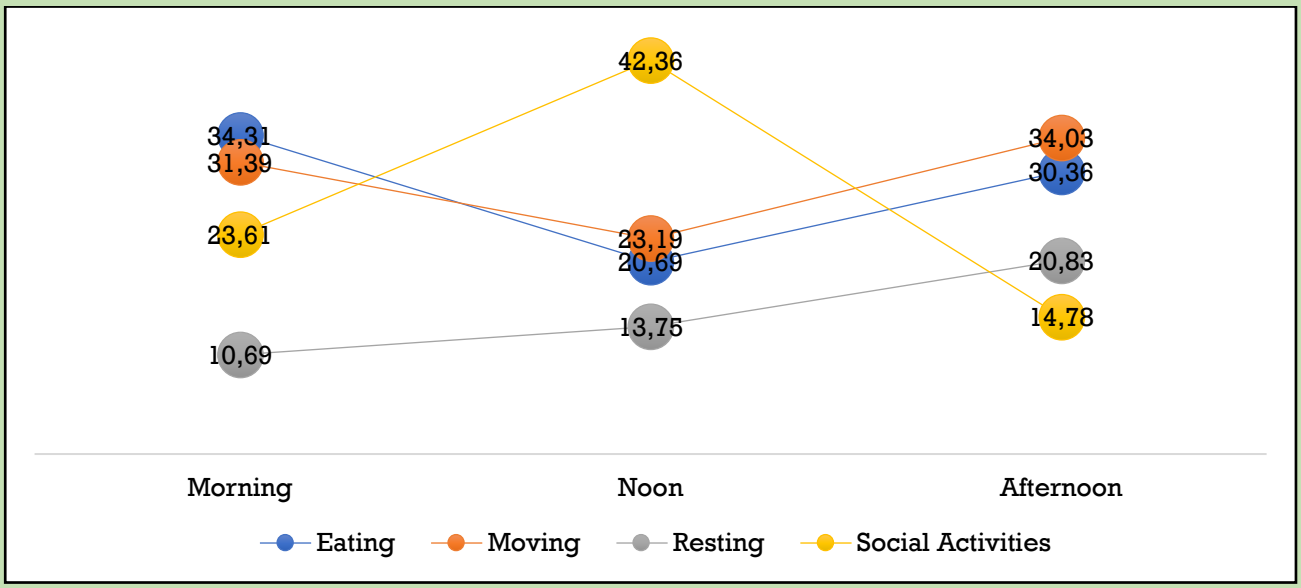


Figure 7. Frequency of duration of activity by Tapanuli orangutan (Modification by Kuswanda and Sugiarti 2003)

Orangutan activity can be grouped into eating, social activity, and other activities. Of these activities, eating constitute the largest percentage of activities (Rijksen 1978; Sinaga 1992; Atmoko and van Schaik 2010; Aini 2011; Wich *et al.* 2014).

This is illustrated by the results of Kuswanda and Sugiarti's research (2003) which states that in the morning and evening, tendencies for eating and moving are higher than other activities. Eating and moving activities are inversely proportional to social activities during

the day. Daytime rest tends to increase from morning to evening. Social behavior is generally very high during the day and it is in line with the decreased eating and moving activities.

Feeding Behavior

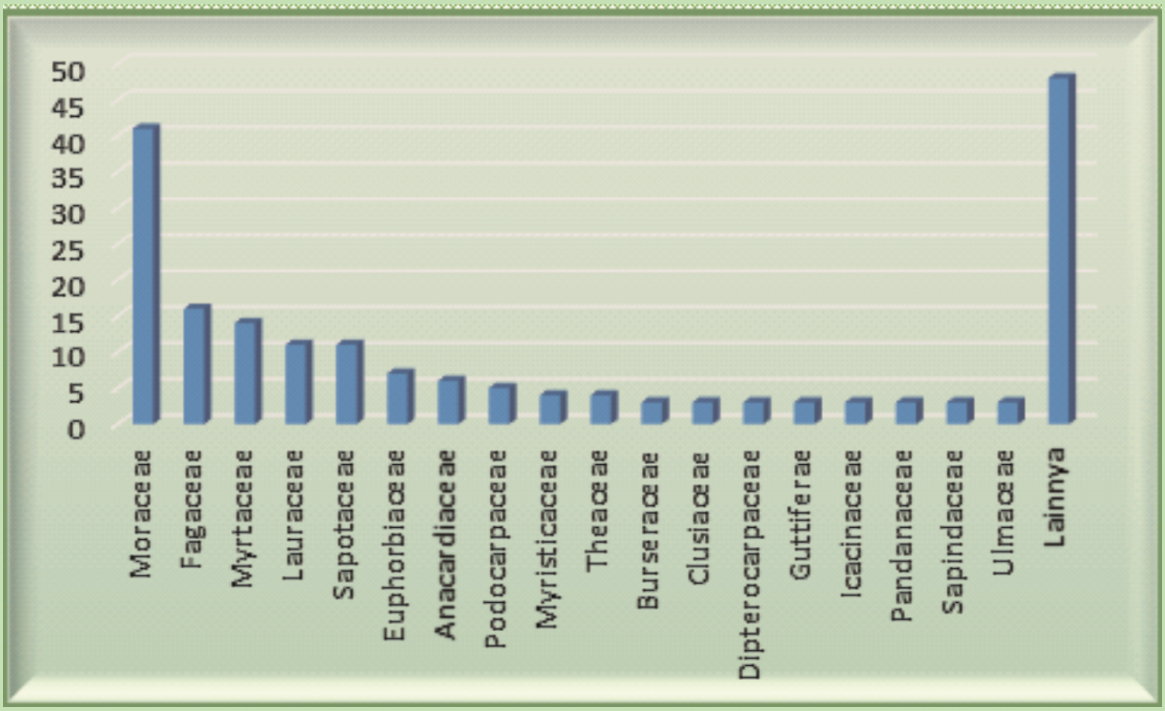
Feeding activity is defined as the time that orangutans use to reach, extract, hold, chew, and swallow food from food sources (Galdikas 1984). Orangutan feeding position can be grouped into sitting, hanging, and standing. Based on Khakim (2015), the highest eating position for orangutans in Tapanuli was sitting at 76.42%, hanging 20.17%, and standing at 3.41%. Orangutans will generally look for food on feed trees that are included in their home range. Orangutans are usually solitary, so they look for food on their own and have never been seen forming groups, but sometimes orangutans can gather together around abundant food sources. Orangutans mainly look for food in the morning (Aini 2011) and afternoon (Kuswanda and Sugiarti 2003).

However, based on the age level, adult female orangutans have the largest percentage of eating activity compared to other age classes (Kuswanda and Sugiarti 2003; Aini 2011). Based on research done by Kuswanda and Sugiarti (2003), adult female feeding activity has the largest allocation of 43,75%. This is supported by a research result done by Aini (2011) which shows female orangutans have the largest percentage of food with a value of 44,92%. Adult female orangutans need more food because they have the biggest body size. Therefore, they need food to produce more energy to carry out other activities such as moving and making noise.

Table 6. Percentage of parts that orangutans feed

Edible part (%)							Source
Fruit	Flower	Pith stem	Leave	Tree bark	Umbut	Avertebrate	
21	–	–	25	37	–	7	Napier and Napier (1985)
62,59	11,56	7,89	7,32	6,52	1,14	2,97	Aini (2011)
73,7	–	–	6,6	–	7,7	–	Wich *et al.* (2014)

The recapitulation result of food plants from various research results such as Nasution (2017) in protected forest areas and potential corridor areas, Kuswanda dan Pudjiatmoko (2012) in Nature Reserve Area (*CA*) Sipirok, Wijiarti (2009); Aini (2011); Khakim (2015) in *Yayasan Ekosistem Lestari*, and Simorangkir (2009) in Conservation International Indonesia showed there are 191 species of food plants in the Batang Toru area. These species include in 46 families or reach 27.76% of the total plants in the Batang Toru area.



Castanopsis argentea Blume (Source: SilentNature.net)

Litsea robusta Blume (Source: https://www.flickr.com/photos/adaduitokla/8083385036)

Source: Kuswanda (2014)

Figure 8. Total number of species and family of orangutan food plants[8]

[8] Processed from: Nasution (2017); Kuswanda and Pudjiatmoko (2012); Wijiarti (2009); Aini (2011); Khakim (2015); Simorangkir (2009)

Moving or Exploring Behavior

Moving or exploring is the activity of moving from one tree to another in search of food, looking for other individuals, and or surrounding the home range (Sinaga 1992). Orangutan move or explore by walking on quadra pedal (using hands and feet) in a tree canopy branching or swinging using strong tree branches to support their bodies. Based on a research done by Sinaga (1992); Kuswanda and Sugiarti (2003); Aini (2011); Wich *et al.* (2014), exploring or moving occupied the second activity after feeding.

The high level of moving activity shows that the availability of orangutan food in Batang Toru area is less abundant so that orangutans continue to move to meet their feeding needs. MacKinnon (1974) states that when it is not in the fruiting season, orangutans will spend more time exploring than time to eat while on a hot day. The orangutans will rest more during the day.

The amount of daily roaming and distribution of orangutan is strongly influenced by the availability of feed in the area (Delgado and van Schaik 2000; Singleton and van Schaik 2001; Wich *et al.* 2011; Khakim 2015). Furthermore, Fiore (2003) states that the length of daily roaming is influenced by an abundance of leaves, flowers, and ripe fruit. Based on Khakim (2015), the average daily range of Tapanuli orangutan is 760,73 m/day - 1.089,28 m/day.

Tapanuli orangutan
Photo: Kuswanda

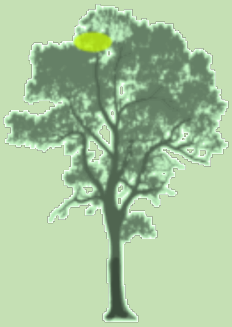
Resting Behavior

Resting is an orangutan activity that includes a quiet position, sleeping, sitting, or hiding in a tree canopy. Orangutans generally rest for a short time by sitting on tree branches or hanging on branches or branches using their hands. During long breaks, orangutans will make a resting pedestal that functions as a base/support or shade made from branches or twigs and leaves to make the rest more comfortable, which is now better known as a "nest".

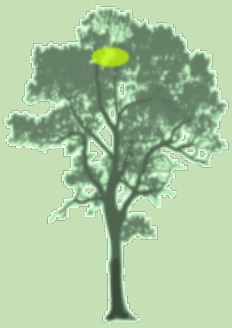
MacKinnon (1974) states that there are some stages of making orangutan nest which takes 2-3 minutes. The stages are as follow:

1. *Rimming*, branches are bent horizontally in a circle of nests and held by bending other branches.
2. *Hanging*, the branch is bent into the nest to form a nest bowl.

3. *Pillaring*, branches are bent down to support the circle of the nest and provide extra strength.
4. *Loose*, the branch is broken from the tree and placed at the bottom of the nest as a base or on the nest as a roof.



(1a)



(1b)

Nest is at the top of the canopy by choosing the top branch. There are two variations in terms of position: (a) at this position, orangutan use more than one top branch (b) this position is chosen whenever there is only one top branch used to support the nest.

(+) a wider view which makes it easier to observe around the nest

(-) easily exposed to rain and wind, the risk of falling is high because the wood in this position is a softwood

(2a)

(2b)

Orangutan nest is on a branch that does not use the main stem as a nest support. It can be categorized into nest at position 2. There are two variations of position 2: (a) lowest branch (b) another higher branch.

(3a)

(3b)

Orangutan nest is also possible on a branch which uses the main stem as a nest support. It is called as nest at position 3. There are two variations of position 3: (a) lowest branch (b) another higher branch.

(+) The nest is sturdy. The material makes the nest sufficient. The wider view makes it easier to observe around the nest.

(4a)

Orangutan can use more than 1 tree as their nest. There are three variations of position 4 as follows: (a) the nest is at a meeting point of two branches; (b) nests or the treetops as the main tree with additional branches from the second large tree; and (c) nests that use three trees at a time.

(+) This position could be chosen whenever there are no trees that are sturdy enough, so orangutan prefer to use two trees.

(4b)

(4c)

Types of nest
Modified by Pujiyani (2009)

There are 91 species of trees used as orangutan nests in Batang Toru, consisting of 27 families. The Fagaceae family is often chosen as a nest because it is a relatively strong tree to support an orangutan's body and has a horizontal branch that is relatively dense with hairless and gummy leaves (Pujiyani 2009), has leaves that are not too large and soft (van Schaik 2006). However, when the tree of the Fagaceae family is bearing fruit, orangutan will not use it as a nest. The reason is to avoid encounters and competition to get the same food as other animals also use the tree (Rijksen 1978).

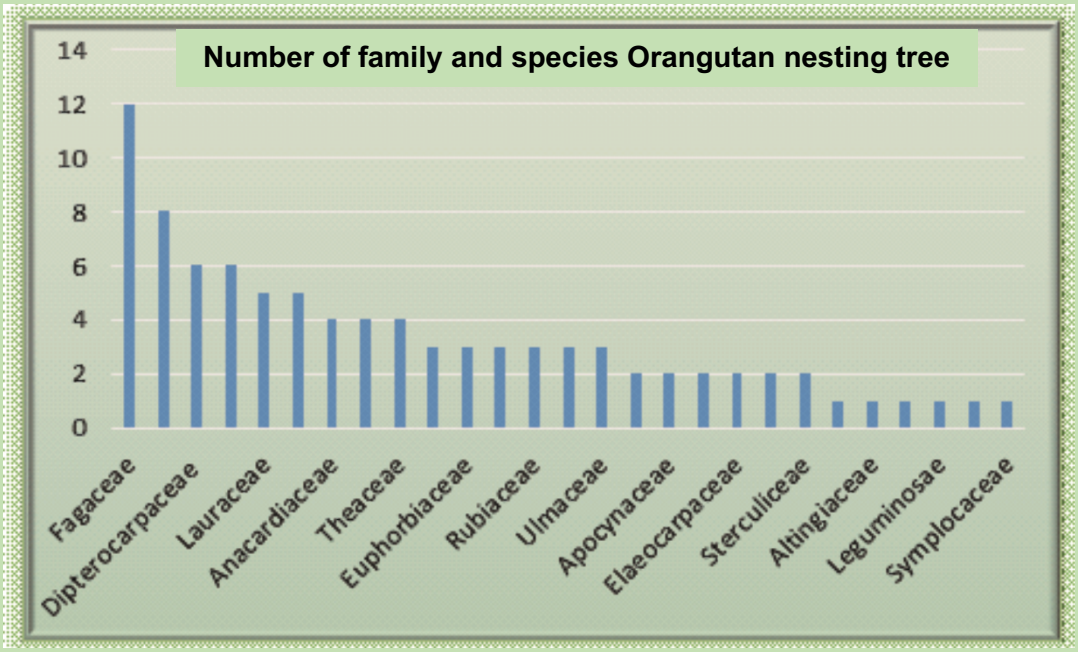


Figure 9. Number of species and family of orangutan nest trees[9]

Tapanuli orangutan
Photo: Kuswanda

[9] Adapted from: Pujiyani (2009); Wijiarti (2009); Kuswanda (2014); Nasution *et al.* (2018)

The nest of Tapanuli orangutan:

1. Tapanuli orangutan prefer trees with a height of more than 16 m to make nests (Pujiyani 2009; Khakim 2015; Nasution *et al.* 2018) with height ranging from 10 to 15 m (Rijksen 1978; Pujiyani 2009; Nasution *et al.* 2018) or are in the C stratum (Suwandi 2000). Orangutan choose to build nests in this forest strata because of some factors like comfort, protection from rain and sunlight (Anderson 1984), strong winds (Anderson 1984; van Schaik 2006; Pujiyani 2009), give broad views (van Schaik 2006; Pujiyani 2009), avoid predatory threats (Prasetyo *et al.* 2009).
2. The choice of orangutan's nest height is proportional to the diameter of the tree used as a nest (Cheyne *et al*. 2013; Nasution *et al.* 2018). The choice of nest diameter is influenced by the presence of predators (Ancrenaz *et al.* 2004), vegetation conditions, safety factors, and experience of each orangutan (Gibson 2005). The diameter of tress that orangutans use to make nests ranges from 10-35 cm (Kuswanda and Sukmana 2005; Pujiyani 2009; Kuswanda 2014; Nasution *et al.* 2018).
3. Nest trees can be distinguished into 6 groups based on the shape of the canopy (Suwandi 2000) namely: (1) round canopy; (2) columnar canopy; (3) weeping canopy; (4) layered canopy; (5) canopy which is empty on one side; and (6) spreading canopy. Orangutans use more trees with a spherical canopy shape, because it has relatively tight horizontal branches, making it easier for orangutans to build their nests. Meanwhile, based on the canopy area, Tapanuli orangutan prefer canopy with an area of less than 11m^2 (36%), then followed by canopy with an area of 11-15 m^2 (23 %), 16-20 m^2 (21%), and the least preference is canopy with an area of 25 m^2 (12 %). The canopy area that is the least preference of Tapanuli orangutan is the canopy with an area ranging from 21 to 25 m^2 (8%). The choice of narrow canopy will benefit orangutans in making nests because they do not need to look for leaves or twigs from other trees.
4. Nests built by Tapanuli orangutans have various sizes with length ranging from 60 to 150 cm (Kuswanda 2014).

Orangutan nests will be destroyed and only the branches will be left after about 2.5 months (Rijksen 1978). Rijksen (1978) further stated that the durability of the nest greatly on the construction technique, the mood when orangutans build the nest, the weight and size of the orangutan, the weather, location and characteristics of the tree, and the presence of other animals that might damage the orangutan's nest. Based on this, Ancrenaz (2004) divided the age criteria for orangutan nests into five, namely:

1. Class A: a new nest, fresh, all leaves are green
2. Class B: a nest that has not been long, all the leaves are still there, the color of the leaves start to be brownish
3. Class C: a nest that is old, some leaves are gone, the nest still looks sturdy and intact
4. Class D: a nest that has been very long, there are holes in the nest building

5. Class E: the nest is almost gone, only a few branches and branches of wood which are left, the original form of the nest is gone

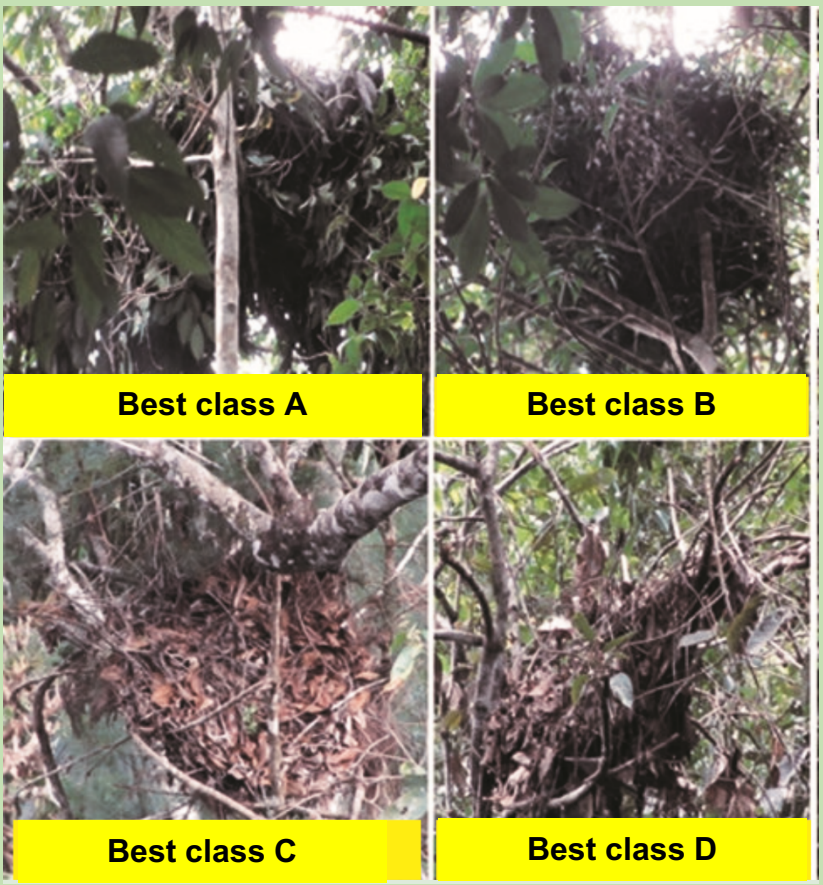


Photo: Kuswanda

Based on the nest class, the majority of orangutan nests in the Batang Toru area are nests that have long been class C and D (Nasution 2017). The low finding of class A nests can be influenced by the broad range of orangutans and low potential of foods in the Batang Toru area.

Tapanuli orangutan
Photo: Kuswanda

7 Batang Toru Landscape-Last Fortress

Batang Toru landscape is determined based on the approach of the physical characteristics of the landscape, especially the watershed and hydrological aspects, topography (height/slope) as well as geology and soil; the characteristics of biodiversity are mainly based on the distribution of orangutans as flag and umbrella species and the biodiversity contained in their potential habitats. In addition, the landscape boundary is also determined by considering settlements and villages that are highly dependent on the existence and sustainability of the ecological processes of the Batang Toru landscape, as well as the occurrence of earthquake natural disasters that have occurred since 1907 - 2018.

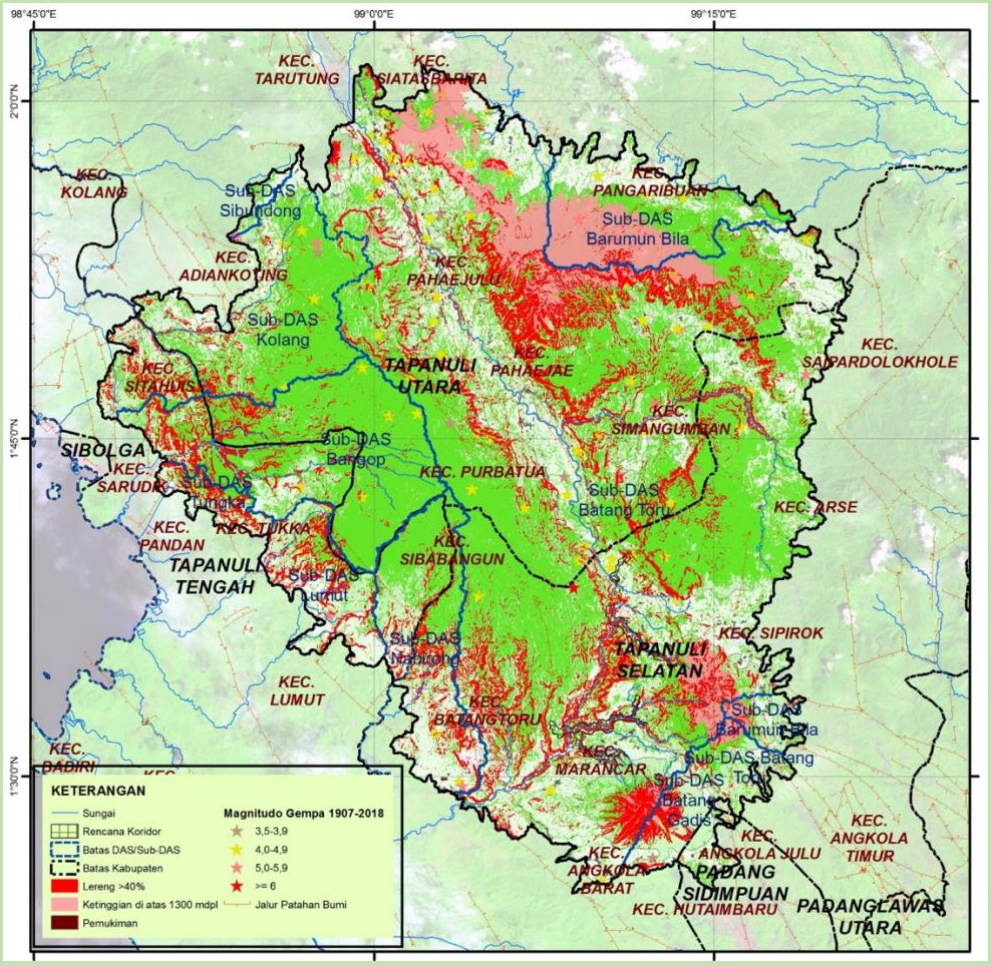


Figure 10. Batang Toru Landscape

Batang Toru landscape is included in 3 regencies, namely South Tapanuli, Central Tapanulil, North Tapanuli also Padangsidimpuan city, which covers at least 26 subdistricts and 187 villages that are directly related to the landscape, especially the influence and dependence on environmental aspects and hydro-climatic function. Based on a decree and the designation of forest area No.579/Menhut-II/2014 issued by *KLHK,* the Batang Toru area is mainly a protected forest (51,5%), a nature reserve area (6,2%), a production forest (5,3%) and the rest is in the form of area for other purposes (*APL*) covering 36,8% also water bodies covering 0,2%.

The area of Batang Toru landscape is 249.169 Ha. There is an area of 140.535 Ha and a degraded land which is not include into the Batang Toru landscape. According to the analysis of land cover, the remaining potential orangutan habitat is 132.040 Ha. However, based on Kuswanda (2006); Simorangkir (2009); Kuswanda (2014); Wich *et al.* (2016); Nater *et al.* (2017), people cannot find orangutan in all of these areas because orangutan live in a small number of forest fragments.

Habitat of Tapanuli orangutan is widespread ranging from lowland forest ecosystems (Kuswanda 2014) to mountainous forests with an altitude of 1.500 m above sea level (Wich *et al.* 2008). The population density of orangutan will decrease with the increase of a place in the Batang Toru landscape due to the reduced availability of foods in the form of fruits, both in terms of diversity in fruit species and quantity.

Meanwhile, according to Laumonier *et al.* (2010), the distribution of *P. tapanuliensis* is now almost completely limited to hills of medium height and sub mountainous forests (300–1.300 m asl). Wich *et al.* (2016) stated that suitable habitat for Tapanuli orangutans is in the highlands with an area of ± 1.022 km_2. According to Kuswanda (2006); Simorangkir (2009); Laumonier *et al.* (2010), orangutan especially in the western part of Batang Toru namely highland (sub mountains to mountains) with an altitude of 800 m above sea level. Meanwhile, the habitat of orangutans in the lowlands has turned into an agricultural land, oil palm plantations and rubber.

Batang Toru area is also an area with a high biodiversity. Based on Perbatakusuma *et al.* (2006) Batang Toru area has 688 species of flora, 67 species of mammals, 110 species of herpetofauna dan 287 species of birds. Some protected animals which live in this area are: Sumatran tiger (*Panthera tigris sumatrae*), tapir (*Tapirus indicus*), forest goat (*Capricornis sumatraensis*), wallace eagle (*Niseatus nanus*), the largest and the longest flower in the world, namely *Rafflesia gadutnensis*, *Amorphophallus baccari* and *Amorphophalus gigas.*

The types of plants in the Batang Toru landscape are generally very diverse. The dominant plant species found in the Sibual-Buali Dolok nature reserve area, according to Kuswanda (2014) are hard milkwood (*Alstonia macrophylla*), *Syzygium* sp., *Choriophyllum malayanum*, *Eleaocarpus obtusus*, and *Quercus maingayi*. Plant diversity in the Dolok Lubuk Raya nature reserve area (https://bbksdasumaterautara.com/sa-lubuk-raya/) in tropical rain

forests are: 1) mountainous area dominated by *Quercus* sp., *Litsea* sp., *Shorea* sp., *Eugenis* sp, *Pinus merkusii*, *Schima wallichii*, *Shorea arabica*; and 2) lowland forest is dominated by pine trees, *Casuarina sumatrana, Podocarpus imbricatus, Dacridium junghunii*, Dipterocarpaceae family, *Cinnamomum burmanii*, forest fir, and various rattan.

In terms of vegetation, there are around 1500 species of plants at the *YEL* research station which is also a habitat of Tapanuli orangutans at altitude 800 m above sea level. The plants are mainly belong to some families that is Sapotaceae, Myrtaceae, Anacardiaceae, Fagaceae, dan Podocarpaceae. According to Putri (2013), 1)at altitude 856–911 m asl in transitional forest named hill montana, there are some plant species such as *Campnosperma auriculatum, Schima walichii, Palaquium rostratum, Labisia pumila* and *Stemonurus scorpiodes*; 2) at altitude 868-938 m asl in the peat forest, the plant species found are *Madhuca laurifolia, Palaquium rostratum, Tristaniopsis whiteana, Syzygium sp., Gluta aptera, Stemonurus mallacensis, Campnosperma auriculatum*; 3) at altitude 914–1.047 m asl in the upper dipterocarpaceae forest, the plant species found are *Gironniera subaequalis, S. napiformis, Diplospora cf. malaccensis, P. rostratum, Carallia eugeniodea* dan *S. platyclados*; 4) at altitude 933–937 m asl especially in Liang cave, the plant species which are found is *Bambusa sp*.

The diversity of plant species in the Batang Toru landscape is generally very diverse. PT Agincourt Resources (2008) showed that at an altitude of 100-300 m above sea level (hilly forest ecosystem), there are at least 22 species of tree level plants, 28 species of sapling level plants, and 14 species of seedling level plants which dominantly consist of *Baccaurea sumatrana, Ixonanthes petiolaris, Santiria apiculata (*sapling level plant), *Palaquium* sp. (sapling level plant), *Ixonanthes petiolaris* (seedling level plant), *Santiria* (seedling level plant) and *Shorea* sp (seedling level plant). At altitude 300–500 m asl (hilly rain forest ecosystem), there are 121 species of tree level plants which is as many as 150 species of sapling level, and 90 species of seedling level plants. Some species of tree level living in this area are *Styrax benzoin, Durio axleyanus, Nephelium lappaceum,* and *Persea declinata.* Sapling level plants living in this area are *Pternandra caerulescens*, *Mallotus peltatus*, *Baccaurea sumatrana*, *Shorea ovata*, *Diospyros sumatrana, Nephelium rubescens*, *Sloetia elongata, Mesua lepidota*, *Timonius splendens* and *Santiria apiculata.* Seedling level plants living in this area are *sumatrana*, *Nephelium rubescens*, *Psychotria robusta*, *Canarium littorale* and *Santiria apiculata.*

At an altitude around ± 400–800 m above sea level which is included in the lower mountain ecosystem, it can be found 56 species of tree level plants, 54 species of sapling level plants and 58 species of seedling level plants dominated by tree level plants namely *Chionanthus montanus* and *Shorea falcifera;* sapling level plants namely *Mallotus penangensis* and *M. stipularis;* and seedling level plants namely *Rinorea anguifera.* Furthermore, at an altitude of ± 850 m above sea level, tree level plants dominated by *Adinandra dumosa, Schima wallichii, Rapanea avenis, Lithocarpus lucidus, Artocarpus kemando*; sapling level plants dominated by *Memecylon edule*, *Garcinia rostrata*, *Trigonostemon* sp. *Aralidium pinnatifidum*

and *Urophyllum glabrum*; seedling level plants dominated by *Symplocos* sp. *Casuarina sumatrana, Diospyros buxifolia, Elaeocarpus petiolatus, Syzygium suringarianum, Ardisia zollingerii, Adinandra sarosanthera, Ilex alternifolia, Lasianthus stipularis, Lithocarpus bancanus,* and *Syzygium sp*.

Batang Toru Hills
Photo: Rinaldi

Based on a regional economic perspective, the existence of the Batang Toru forest as a habitat of Tapanuli orangutan also has a strong economic role for local communities whose life are still dependent on environmental services provided from the forest area, specifically for the availability of drinking water, agricultural water, fisheries, and hydroelectric power plant. The gross regional domestic product (GRDP) in 2005 was dominated by agricultural sector in North Tapanuli district (55%), central Tapanuli district (46%), and South Tapanuli district (46%).

Batang Toru landscape contains 9 sub wathershed namely: 1) Bangop (23.125 Ha), 2) Barumun Bila (14.880 Ha), 3) Batang Gadis (8.071 Ha), 4) Batang Toru (157.440 Ha), 5) Kolang (21.302 Ha), 6) Lumut (7.397 Ha), 7) Nabirong (13.691 Ha), 8) Sibundong (780 Ha) and Tungka (2.497 Ha). Batang Toru is the largest sub watershed (63,18%) and Tungka is the smallest one (only 1%).

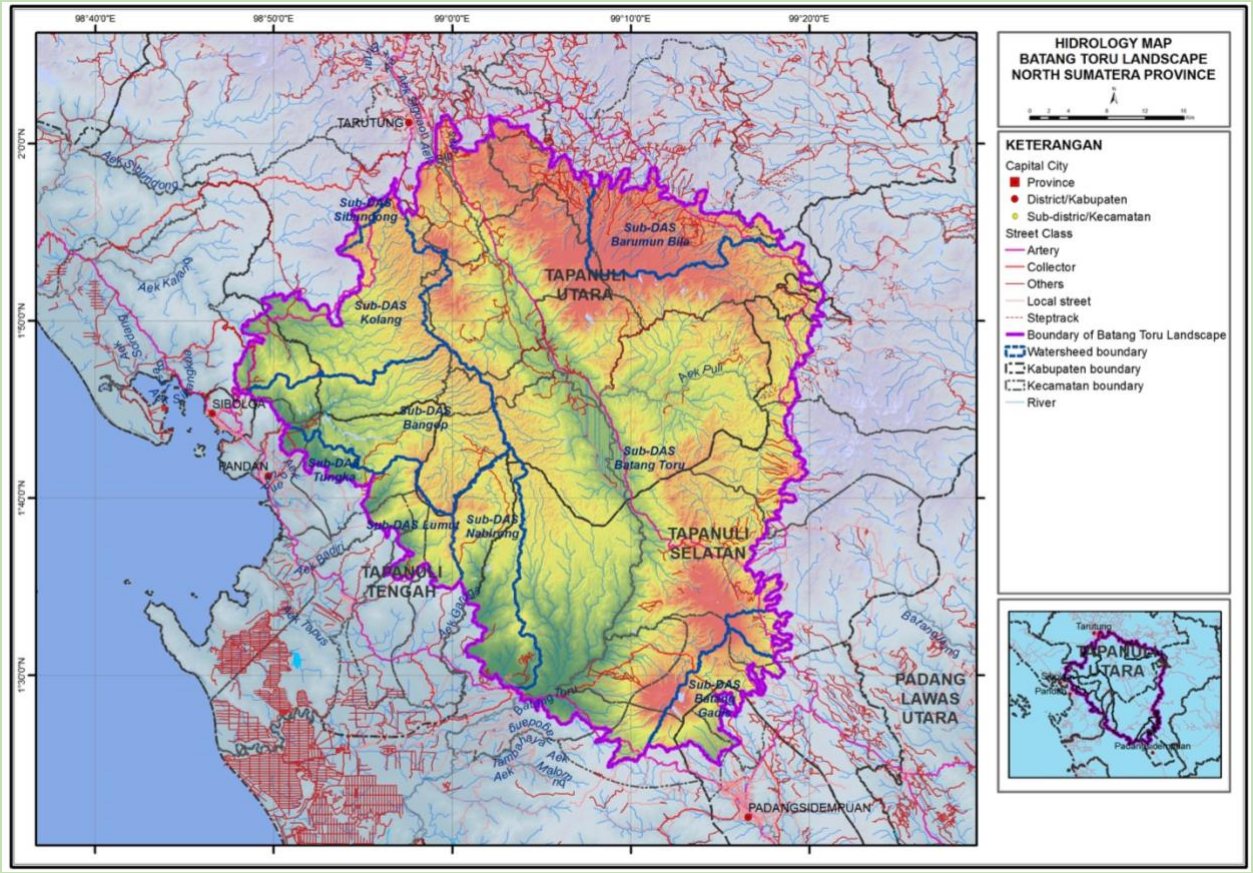


Figure 11. Hydrological map of Batang Toru landscape

Orangutan tapanuli
Photo: Compost

8 Pressure And Threat Of The Tapanuli Orangutan Population

Land Clearing

At present, the remaining habitat of Tapanuli orangutan is naturally fragmented by Batang Toru river and a provincial road. As a result, it becomes 2 blocks or more with a potential habitat area of 132.000 Ha in the entire Batang Toru landscape. Many people do land clearing to fulfill their daily needs and as a result of implementing government policies for the benefit of regional development. Budidarsono (2006) states that 90% of the population in Batang Toru landscape has developed various forms of tree-based farming systems that dynamically adjust the slope conditions which is steep with relatively infertile soils. Forest encroachment and forest clearing for plantation area, agriculture, settlement, facilities, and infrastructure (Singleton *et al.* 2014; Kuswanda 2007) also the occurrence of illegal logging causes the area and habitat quality of the Tapanuli orangutan continue to decrease.

Table 7. Changes of land cover area in Batang Toru landscape in the period 1990-2016

Land cover	Forest cover (Ha)					
	1990	1996	2000	2006	2012	2016
Primary forest	56.529	56.529	56.529	56.529	56.448	56.395
Secondary dry land forest	83.433	83.433	83.433	83.433	82.663	82.949
HTI	1.214	1.214	1.214	1.214	1.176	1.177
Bush/shrub	36.417	36.417	36.417	36.417	37.388	36.739
Plantation	0	0	0	0	0	344
Settlement	82	82	82	82	82	82
Open field	141	141	141	141	315	830
Shrub/shrub swamp	12	12	12	12	12	12
Dry land farming	22.836	22.836	22.836	22.836	50.997	50.798
Mixed dry land farming	40.100	40.100	40.100	40.100	11.683	11.323
Rice field	8.087	8.087	8.087	8.087	8.087	8.188
Swamp	318	318	318	318	318	332
Total	249.169	249.169	249.169	249.169	249.169	249.169

Source: Map of land cover in 2016 from *KLHK*

Conflict With Community

An observation over the last 10 years of human-orangutan conflict in Tapanuli continues to increase in frequency, especially in the fruit season such as the durian and petai season (Kuswanda 2014). Conflict of human-Tapanuli orangutan occurs mostly in villages supporting the conservation area, such as around Dolol Sipirok nature reserve area

and Dolok Sibual-Buali nature reserve area. Villagers who manage a lot of fruit trees are often consumed by orangutans at harvest time, such as in Bulu Mario village and Marancar Julu village.

Data from North Sumatra *BBKSDA* (2014–2019) showed Tapanuli orangutan conflict with the community occur repeatedly in several of the same hamlet/village, including: *Aek Nabara*, *Sitandiang*, *Batu Satail*, *Simaningir*, and *Aek Batang Paya*. Tapanuli orangutan has been known as an orangutan species which come to the ground and eat coffee fruit in *Sitandiang* and *Batu Satail* since 2018. Conflicts occur repeatedly in the same location to get petai, durian, coffee, and even take juice of water that has been tasted.

Some community plants that become orangutan food are durian, petai, jengkol, sugar palm, rattan, and banana. One type of fruit that is loved by Tapanuli orangutan and becomes a source of conflict is durian (*Durio zibethinus*). Many Tapanuli orangutans enter community land during the durian fruit season and consume 20-30 durian that still hang on the tree in a day, and only stay a few days until the durian fruit is almost gone (Kuswanda 2019). On July 2019, North Sumatra *BBKSDA* recorded cases in 3 hamlets, *Aek Batang Paya*, where Tapanuli orangutans entered 43 farmers' land and did feeding activities on 94 durian trees out of 358 trees (26 %) and 49 trees out of 116 petai trees (42 %) owned by farmers. It is estimated that the number of trees targeted for consumption will still increase, bearing in mind that until now, August 17 2019, the Tapanuli orangutans still live in the conflict location.

Result of a research done by Siregar *et al.* (2015) in Dolok Sipirok Nature Reserve area showed that the villages most prone to conflict were located on secondary dry land forest at an altitude of 742-1.015 m asl, at slope of 0-25% and it is 0-4.250 m from the area of nature reserve. Biophysical factors that greatly influence the occurrence of conflict is the distance of fields from the forest boundary. The research also showed crop losses experienced by 21 durian farmers amounting to 888.600.000,- IDR due to 414 damaged stems, 20 sugar palm farmers amounting to 319.300.000,- IDR due to 103 damaged stems and 21 petai farmers amounting to 189.000.000,- IDR due to 195 damaged stems. It can be said that the value of loss is a contribution of the community to provide food for Tapanuli orangutans that have been taken place in the field. Public awareness that the Tapanuli orangutan is a protected species and its traditional wisdom provides high tolerance for the loss they feel.

Communities around the Batang Toru forest have understood the behavior of Tapanuli orangutans who like to consume durian, petai, palm sugar or jengkol in their fields. Most people will expel them. The communities take the disadvantages when they cannot harvest their crops. They drive away by setting fires under a tree or banging on tree trunks or shouting in order to disturb the orangutan and push them to leave the fields or trunk of the food source. The phenomenon of human-Tapanuli orangutan conflict needs to be immediately mitigated because the conflict can lead to the bad condition or even death of Tapanuli orangutans.

Figure 12. Tapanuli orangutans in the durian garden owned by the community (Photo: Kuswanda)

Hunting

Until 2005, the hunting of Tapanuli orangutans occurred, including for consumption purposes. Tapanuli orangutans are potentially killed whenever a community expels them who enter their fields to find food such as durian and petai, especially if the eviction is carried out using air guns. Confirmation from North Sumatra BBKSDA and some researchers who still study Tapanuli orangutan and are working in the field, currently, there is no more hunting on them, but the increasing intensity of conflicts with the community potentially kills the Tapanuli orangutan due to hostile eviction methods. However, hunting

should be a concern of all parties so that bad effect will not happen, as there is a small population of Tapanuli orangutans and they are slow breeding species.

Tapanuli orangutan
Photo: Compost

9 Protection And Management

The Indonesian Orangutan SRAK document 2019-2029 emphasizes that fragmentation due to forest conversion in the habitat of Tapanuli orangutans and poaching is a major threat to its sustainability and it is projected that sustainability for each meta population occurs from moderate to low.

As a guideline for the parties to determine the priority of Tapanuli orangutan conservation activities, including awareness, policies, funding, partnerships, cooperation and design development programs that support the sustainability and increase of the population of Tapanuli orangutans. Therefore, the condition of Tapanuli orangutans and their natural habitat will be better ten years later. The targets to be achieved until 2029 are:

1. Population of 577-760 individuals of Tapanuli orangutans and their habitat covering an area of at least 105,132 Ha, can be maintained or increased
2. Law enforcement, including litigation efforts must be carried out maximally to improve the protection of orangutans and their habitat
3. Public support for the conservation of orangutans in their natural habitat is increasing marked by the role of orangutan conservation forums, both at the national and regional levels.
4. The government and the private sector of forestry, plantations, mining, energy and infrastructure implement governance that ensures the sustainability of orangutan populations and their habitats
5. Increased understanding and appreciation of all parties towards the existence of orangutans in their natural habitat.

In the context of the sustainable management of the Batang Toru landscape, the overall objectives of the Indonesian Orangutan SRAK that are relevant to the Tapanuli orangutans above are being developed through a collaborative management approach, "The Batang Toru Sustainable Management Initiative for Landscape and Ecosystem of Batang Toru" (SMILE Batang Toru). Some of the main actors in site management who work daily in the Batang Toru landscape are: North Sumatra BBKSDA, KPHP X Padangsidimpuan and KPHL XI Pandan, PT AR, PT NSHE, PT SOL, PT SOL, Sipansihaporas Hydroelectric Power Plant, PTPN III, and the local community. Most of these actors, supported by various other actors, including government agencies, universities, research institutes, NGOs and community leaders, have committed to support collaborative conservation efforts of the Tapanuli orangutan.

The principle that all parties must uphold in preserving Tapanuli orangutans is to maintain, stop damage and improve their habitat, prevent human-orangutan conflicts from causing the death of Tapanuli orangutans and ensure that Tapanuli orangutans can breed naturally. The implementation of this principle is very important in the Batang Toru landscape considering that many Tapanuli orangutans utilize other areas of use as their habitat. Some enabling conditions to support the ongoing commitment of stakeholders to achieve the above objectives are needed, including:

1. Detailed spatial planning of the Strategic Area of the Batang Toru Forest Conservation at the provincial level, which is integrated with the Spatial Details of the Strategic Area at the district and village levels. The draft academic study results for the Batang Toru Forest Conservation KSP Spatial Plan are available. In addition, three related districts, namely North Tapanuli, Central Tapanuli and South Tapanuli have committed to compile detailed spatial plans in the strategic area of the province. South Tapanuli Regency has a draft local regulation regarding the detailed spatial plan for the strategic area.
2. The formulation of an Action Plan that can be implemented by stakeholders as an initial instrument to measure the short-term success of the conservation of Tapanuli orangutans. At this time a draft action plan for managing the Batang Toru landscape in a sustainable manner is available and is in the process of being translated into thematic work plans, including those aimed at preserving the Tapanuli orangutan as a shared priority.
3. The realization of collaborative institutions which are the institutional basis for stakeholders to bridge the process of negotiation, facilitation, participation and conservation of Tapanuli orangutans. The principles of participation, transparency and accountability form the basis for developing these institutions. Discussion on this matter has begun and is expected to produce a collaborative institution that is reliable and trusted by all stakeholders. Collaborative institutional development is part of dynamic communication processes that are currently underway.

Figure 13. Workshop of the parties (Photo: Pokja)

At the program and activity scale, several important agreements that need to be followed up include:

Baseline Data Strengthening

Strengthening baseline data on Tapanuli orangutan populations and habitats is very important, as a basis for making management decisions in the future. Difficult access in the Batang Toru landscape causes a variety of data and information to be focused on several locations that are accessible to researchers. This causes a buildup of information about orangutan findings at certain locations even though it is suspected that the number of individuals is small, whereas in habitats which are thought to have more individuals, the number of findings is very small. Strengthening baseline data on populations and habitats in the Batang Toru landscape requires technological-based methodological innovations, as well as continuity of Tapanuli orangutan inventory and census activities. In this case the role of stakeholders, especially actors working on the site, including the local community is very important to be developed in the future.

Given that the population of Tapanuli orangutans is small and has 2-3 meta populations, strengthening genetic baseline data is also needed to determine future genetic-based population management decisions.

In addition, baseline data on community interactions with Tapanuli orangutans is also needed to develop an appropriate incentive system, so that community contributions to the conservation of orangutans as part of their traditional wisdom, in the form of value losses of fruits, coffee, jernang and palm juice consumed by Tapanuli orangutans, can be replaced with appropriate incentives, such as income from community-based orangutan tourism activities and other incentives.

Habitat and Corridor Rehabilitation

The orangutan population in the Batang Toru landscape area in general has been divided into 2 meta populations, namely the Western Batang Toru sub-population and the Eastern Batang Toru sub-population, although there is a tendency to become 3 meta populations in the southern Batang Toru region. The separation of the sub-population occurred due to the absence of trees that have a related canopy connecting between these 2-3 locations. For this reason, efforts are needed to maintain vegetation cover and tree planting that can function as corridors between these sub-populations. Species that can be planted are mainly tree species which are food or nests of the Tapanuli orangutan. In the event that natural corridors cannot be built, the government and stakeholders need to prepare themselves to build an "eco-bridge" that ensures the ecological connectivity of the Tapanuli orangutan sub-population in the Batang Toru landscape.

Corridor development needs to be supported by improving the quality of habitat throughout the area that allows it to be improved and used by Tapanuli orangutans. The biodiversity offset program of all stakeholders in the Batang Toru landscape can be directed towards improving the habitat of the Tapanuli orangutan.

Population and Habitat Monitoring

Population management requires support for regular monitoring of the orangutan population, especially by managers working on the site supported by community participation and other stakeholders. Monitoring can be done with a combination of conventional methods and the application of technologies such as drones and Android utilization. The accumulation of monitoring results by stakeholders can be used to determine the population structure and population development of orangutans in the Batang Toru landscape, as well as to develop rapid responses in the context of decision-making in the management of Tapanuli orangutans and the necessary law enforcement.

Community Capacity Development

Community participation in the conservation of Tapanuli orangutans will be encouraged if the community gets benefits and / or has a level of welfare that allows them to participate actively. In this case the development of various social and economic capital of the community is an inseparable part of the ongoing management of the Batang Toru landscape, including within the framework of conservation of the Tapanuli orangutan. Agreements to develop community-based ecotourism, social forestry development, and prevention of plastic waste pollution have developed in thematic working groups on community empowerment in the Batang Toru landscape. Awareness programs have also begun to be developed by stakeholders, including conservation and environmental education activities, as well as educational tourism.

Reference

Aini F. 2011. Preferensi dan kandungan nutrisi pakan orangutan sumatera (*Pongo abelii* Lesson, 1827) di stasiun penelitian hutan lindung Batang Toru, Tapanuli Tengah, Sumatera Utara. [Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Ancrenaz M, Calaque R, Lackman-Ancrenaz I. 2004. Orangutan nesting behavior in disturbed forest of Sabah, Malaysia: Implications for nest census. *International Journal of Primatology,* 25:983-1000.

Anderson JR. 1984. Ethology and ecology of sleep in monkeys and apes. *Advances in the Study of Behavior,* 14:165-230.

Atmoko SSU, van Schaik CP. 2010. The natural history of sumatran orangutan (*Pongo abelii*). Dalam: Gursky-Doyen S, Supriatna J (ed). *Indonesia Primates*. New York (USA): Springer Science+Business Media.

Budidarsono S. 2006. Kondisi sosial ekonomi masyarakat di bentang alam orangutan di DAS Batang Toru. [laporan penelitian]. Bogor (ID): ICRAF.

Campbell-Smith G, HV Simanjorang, N Leader-Williams, M Linkie. 2010. Local attitudes and perceptions towards crop-raiding by orangutans (*Pongo abelii*) and other non-human primates in Northern Sumatra, Indonesia. *Am J Primatol,* 72:866-876.

Chesner C, Rose W, Deino A, Drake R, Westgate J. 1991. Eruptive history of earth's largest quaternary caldera (Toba, Indonesia) clarified. *Geology,* 19:200–203.

Cheyne SM, Rowland D, Höing A, Husson SJ. 2013. How orangutans choose where to sleep: comparison of nest-site variables. *Asian Primates Journal*. 3: 13–7.

Delgado RA, van Schaik CP. 2000. The behavioral ecology and conservation of the orangutan (*Pongo pygmaeus*): A tale of two islands. *Evol. Anthropol,* 9(5):201–218. DOI:10.1002/1520-6505(2000)9:5<201::AID EVAN2>3.3.CO;2-P.

Departemen Kehutanan, CII. 2004. *Orangutan*. [laporan akhir]. Workshop 15-18 Januari 2004. Kerjasama Departemen Kehutanan dengan Conservation International-Indonesia. Jakarta (ID): Departemen Kehutanan, Conservation International-Indonesia.

Di Fiore A. 2003. Ranging behavior and foraging ecology of lowland woolly monkeys (*Lagothrix lagotricha* poeppigii) in Yansuni National Park, Ecuador. *American Journal of Primatology,* 59: 47-66.

Ditjen KSDAE. 2019. *Strategi dan Rencana Aksi Konservasi Orangutan Indonesia 2019-2029*. Jakarta (ID): Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia.

Ellis S, Singleton I, Andayani N, Traylor-Holzer K, Supriatna J. 2006. *Sumatran Orangutan Conservation Action Plan*. Washington DC and Jakarta, Indonesia: Conservation International.

Fredriksson G, Indra M. 2007. *Hutan Batang Toru Harta Karun Tapanuli*. Tapanuli (ID): Yayasan Ekosistem Lestari.

Galdikas BMF. 1978. *Adaptasi orangutan di Suaka Margasatwa Tanjung Puting Kalimantan Tengah*. Jakarta (ID): Universitas Indonesia.

Galdikas BMF. 1984. *Adaptasi orangutan di Suaka Margasatwa Tanjung Puting Kalimantan Tengah*. Jakarta (ID): Universitas Indonesia.

Gibson A. 2005. Orangutan nesting preferences in a disturbed tropical deep-peat swamp forest, Central Kalimantan, Indonesia [graduate thesis]. Suffolk (UK): Otley College.

Groves CD. 1972. *Systematics and Phylogeni of Gibbon*. Kargul Basel

Khakim MFR. 2015. Ekologi makan orangutan sumatera (*Pongo abelii*, Lesson 1827). [Tesis]. Bogor (ID): Institut Pertanian Bogor.

Kuswanda W, Pudjiatmoko S. 2012. Seleksi tipe habitat orangutan sumatera (*Pongo abelii* Lesson 1827) di Cagar Alam Sipirok, Sumatera Utara. *Jurnal Penelitian Hutan dan Konservasi Alam,* 9(1): 85-98.

Kuswanda W, Sugiarti. 2003. Potensi habitat dan pendugaan populasi orangutan (*Pongo abelii* Lesson 1827) di Cagar Alam Dolok Sibual-Buali, Sumatera Utara. *Jurnal Penelitian Hutan dan Konservasi Alam,* 2(6): 555-566.

Kuswanda W, Sukmana A. 2005. Karakteristik pohon sarang orangutan liar: Kasus di Cagar Alam Dolok Sibual-buali, Sumatra Utara. *Konifera*, 1(20).

Kuswanda W. 2006. Status terkini populasi dan ancaman fragmentasi habitat orangutan (*Pongo abelii* Lesson 1827) di kawasan hutan DAS Batang Toru. *Makalah Lokakarya* "Masa Depan Orangutan dan Pembangunan di Kawasan Hutan DAS Batang Toru", 17-18 Januari 2005. Kerjasama Direktorat Jenderal Perlindungan Hutan dan Konservasi Alam, Pemda Kabupaten Tapanuli Tengah dan Conservation International. Sibolga.

Kuswanda W. 2007. Ancaman terhadap populasi orangutan sumatera (*Pongo abelii* Lesson). *Jurnal Penelitian Hutan dan Konservasi Alam*, 4(4): 409-417.

Kuswanda W. 2013. Pendugaan populasi orangutan (*Pongo abelii* Lesson 1827) berdasarkan sarang di Cagar Alam Sipirok, Sumatera Utara. *J Penelitian Hutan dan Konservasi Alam*, 10(1):19-31.

Kuswanda W. 2014. *Orangutan Batang Toru Kritis Diambang Punah*. Bogor (ID): Forda Press.

Kuswanda W. 2018. Update sebaran habitat dan populasi orangutan tapanuli (*Pongo tapanuliensis*). [Laporan sintesa penelitian]. Medan (ID): Balai Litbang LH dan Kehutanan AEK Nauli.

Laumonier Y, Uryu Y, Stüwe M, Budiman A, Setiabudi B, Hadian O. 2010. Eco-floristic sectors and deforestation threats in Sumatra: Identifying new conservation area network priorities for ecosystem-based land use planning. *Biodivers. Conserv,* 19:1153-1174.

Ma X, Kelley JL, Eilertson K, Musharoff S, Degenhardt JD, Martins AL, Vinar T, Kosiol C, Siepel A, Gutenkunst RN, *et al.* 2013. Population genomic analysis reveals a rich speciation and demographic history of orang-utans (*Pongo pygmaeus* and *Pongo abelii*). *PLoS One,* 8(10):1–11. DOI:10.1371/journal. pone.0077175.

MacKinnon JR. 1972. *The Behavior and Ecology of the Orangutan (Pongo pygmaeus) with Relation to the Other Apes*. Oxford (GB): Oriel College.

MacKinnon JR. 1974. The behaviour and ecology of wild orangutan (*Pongo pygmaeus*). *Animal Behaviour,* 22: 3-74.

Meijaard E, Rijksen HD, Kartikasari SN. 2001. *Di ambang kepunahan! Kondisi orangutan liar di awal abad ke-21*. Jakarta (ID): The Gibbon Foundation.

Mitani JC. 1985. Mating behaviour of males orangutans in the Kutai Game Reserve, Indonesia. *Animal Behaviour*, 33: 392-402.

Morrogh-Bernard HC, Husson SJ, Knott CD, Wich SA, van Schaik CP, van Noordwijk MA, Lackman-Ancrenaz I, Marshall AJ, Kanamori T, Kuze N, bin Sakong R. 2009. Orangutan activity budgets and diet. In: Wich SA, Utami Atmoko SS, Setia TM, van Schaik CP, editors. *Orangutans*. New York (USA): Oxford University Pr Inc. hlm 119-133.

Napier JR, Napier PH. 1967. *Habitat of Primates.* Cambridge Massachusets (GB): The MIT Press.

Napier JR, Napier PH. 1985. *The Natural History of the Primates*. Cambridge Massachusets (GB): The MIT Press.

Nasution A, Farajallah DP, Atmoko SSU. 2018. Nesting characteristics of The tapanuli orangutan (*Pongo tapanuliensis*) in two unprotected forests of Batang Toru, North Sumatra. *Trop Life Sci Res*, 29(2): 77-87.

Nasution A. 2017. Studi populasi dan distribusi orangutan sumatera (*Pongo abelii*) di hutan penyangga dan potensi koridor Batang Toru Sumatera Utara. [Tesis]. Bogor (ID): Institut Pertanian Bogor.

Nater A, Arora N, Greminger MP, van Schaik CP, Singleton I, Wich SA, Fredriksson G, Perwitasari-Farajallah D, Pamungkas J, Krützen M. 2013. Marked population structure and recent migration in the critically endangered Sumatran orangutan (*Pongo abelii*). *J. Hered.* 104(1):2–13. DOI:10.1093/jhered/ess065.

Nater A, Mattle-Greminger MP, Nurcahyo A, Nowak MG, de Manuel M, Desai T, Groves C, Pybus M, Sonay TB, Roos C, *et al.* 2017. Morphometric, behavioral, and genomic evidence for a new orangutan species. *Current Biology,* 27: (1-12).

Nater A, Nietlisbach P, Arora N, van Schaik CP, van Noordwijk MA, Willems EP, Singleton I, Wich SA, Goossens B, Warren KS *et al.* 2011. Sex-biased dispersal and volcanic activities shaped phylogeographic patterns of extant orangutans (genus: Pongo). *Molecular Biology and Evolution*, 28 :2275–2288.

Nowak MG, Rianti P, Wich SA, Meijaard E, Fredriksson G. 2017. Pongo tapanuliensis. The IUCN Red List of Threatened Species 2017: e.T120588639A120588662. DOI:10.2305/IUCN.UK.2017-3.RLTS.T120588639A120588662.en. Downloaded on 11 April 2019.

Paryogo A. 2014. Pendugaan kesesuaian habitat orangutan kalimantan (*Pongo pygmaeus pygmaeus*) dan karakteristik genetiknya di Kabupaten Kapuas Hulu Kalimantan Barat. [Disertasi]. Bogor (ID): Institut Pertanian Bogor.

Perbatakusuma EA, Damanik A, Lubis AH. 2010. Penilaian Prioritas dan Tindakan Aksi Konservasi Blok Hutan Sarula Timur-Provinsi Sumatera Utara. [laporan teknik]. Sibolga (ID): CII.

Perbatakusuma EA, Siregar RS, Siringo Ringo JB, Panjaitan L, Wurjanto D, Adhikerana A, Sitaparasti, Dhani (eds). 2007. *Membangun Kolaborasi Strategi Konservasi Habitat Orangutan Sumatera di Ekosistem Batang Toru*. [laporan lokakarya para pihak]. Sibolga (ID): Conservation International – Departemen Kehutanan.

Perbatakusuma EA, Supriatna J, Siregar RSE, Wurjanto D, Sihombing L, Sitaparasti D. 2006. Mengarustamakan Kebijakan Konservasi Biodiversitas dan Sistem Penyangga Kehidupan di Kawasan Hutan Alam Sungai Batang Toru Provinsi Sumatera Utara. [laporan teknik]. Jakarta (ID): Program Konservasi Orangutan Batang Toru, Conservation International Indonesia, Departemen Kehutanan.

Prasetyo D, Ancrenaz M, Bernard HM, Utami-Atmoko SS, Wich SA, van Schaik CP. 2009. Nest building orangutans. In: Wich SA, Utami SSU, Setia TM, van Schaik CP, editors. *Orangutans: Geographic Variation in Behavioral Ecology and Conservation.* New York (USA): Oxford Univ. Press. hlm 226 – 227.

PT Agincourt Resources. 2008. Analisis Dampak Lingkungan Proyek Tambang Emas Martabe.

Pujiyani H. 2009. Karakteristik pohon tempat bersarang orangutan sumatera (*Pongo abelii* lesson, 1827) di kawasan hutan Batang Toru, Kabupaten Tapanuli Utara - Sumatera Utara. [Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Putri AM. 2013. Keanekaragaman jenis dan karakteristik habitat kelelawar di kawasan hutan Batang Toru bagian barat (HTBB), Sumatera Utara. [Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Rianti P. 2015. Conservation genetics of sumatran orangutans (*Pongo abelii)*. [Disertasi]. Bogor (ID): Institut Pertanian Bogor.

Rijksen HD. 1978. A Field Study of Sumatran Orangutans (*Pongo pygmaeus abelii* Lesson 1827). [Disertasi]. Wageningen (NL): Veenman and Zonen BV.

Simorangkir RH. 2009. Kajian habitat dan estimasi populasi orangutan sumatera (*Pongo abelii* Lesson, 1827) di kawasan Hutan Batang Toru, Sumatera Utara. [Tesis]. Bogor (ID): Institut Pertanian Bogor.

Sinaga T. 1992. Studi habitat dan perilaku orangutan (*Pongo pygmaeus abelii*) di Bohorok Taman Nasional Gunung Leuser. [Tesis]. Bogor (ID): Institut Pertanian Bogor.

Singleton I, van Schaik CP. 2001. Orangutan home range size and its determinants in a Sumatran swamp forest. *International Journal of Primatology,* 22(6): 877-911.

Singleton I, Wich SA, Husson S, Stephens S, Atmoko SU, Leighton M, Rosen N, Traylor-Holzer K, Lacy R, Byers O. 2004. Orangutan Population and Habitat Viability Assessment [*final report*]. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.

Siregar DI, Zaitunah A, Patana P. 2015. Pemetaan daerah rawan konflik orangutan sumatera (*Pongo abelii*) dengan manusia di desa sekitar Cagar Alam Dolok Sibual-Buali. *Peronema Forestry Science Journal,* 4(1): 120-133.

Suwandi A. 2000. Karakteristik Tempat bersarang Orangutan (P*ongo pygmaeus pygmaeus* Linne, 1760) di Camp Leakey Taman Nasional Tanjung Puting Kalimantan Tengah. [Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Utami-Atmoko S, Traylor-Holzer K, Rifqi MA, Siregar PG, Achmad B, Priadji A, Husson S, Wich SA, Hadisiswoyo P, Saputra F, *et al.* 2017. Orangutan Population and Viability Assessment [*final report*]. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.

van Schaik CP. 2006. *Diantara Orangutan: Kera Merah dan Bangkitnya Kebudayaan Manusia*. Jakarta (ID): Yayasan Penyelamatan Orangutan Kalimantan (BOS).

van Schaik CP. 2009. Geographic variation in the behavior of wild great apes: is itreally cultural? In: Laland KN, Galef BF, editor. *The Question of Animal Culture*. Cambridge (US): Harvard Univ. Press. page 70–98.

Wich SA, Fredriksson G, Usher G, Kuhl HS, Nowak MG. 2019. The Tapanuli orangutan: Status, threats, and steps for improved conservation. *Conservation Science and Practice,* 2019;e33. DOI:10.1111/csp2.33

Wich SA, Meijaard E, Marshall AJ, Husson S, Ancrenaz M, Lacy RC,van Schaik CP, Sugardjito J, Simorangkir T, Traylor-Holzer K, Doughty M, Supriatna J, Dennis R, Gumal M, Knott CD, Singleton I. 2008. Distribution and conservation status of the orang-utan (Pongo spp.) on Borneo and Sumatra: how many remain? Fauna & Flora International (UK): Oryx. 42(3): 329–339.

Wich SA, Riwan, Jenson J, Refisch J, Nelleman C. 2011. *Orangutan dan Ekonomi Pengelolaan Hutan Lestari di Sumatera*. UNEP/GRASP/PanEco/YEL/ICRAF/GRID-Arenda.

Wich SA, Singleton I, Nowak MG, Utami ASS, Nisam G, Arif SM, Putra RH, Ardi R, Fredriksson G, Usher G, *et al.* 2016. Land-cover changes predict steep declines for the Sumatran orangutan (*Pongo abelii*). *Population Ecology,* 2(3):1-8, DOI: 10.1126/sciadv.1500789.

Wich SA, Singleton I, Utami-Atmoko SS, Geurts ML, Rijksen HD, van Schaik CP. 2003. The status of the Sumatran orang-utan *Pongo abelii*: an update. *Oryx,* I: 49-54.

Wich SA, Usher G, Peters HH, Khakim MFR, Nowak MG, Fredriksson GM. 2014. Preliminary data on the highland sumatran orangutans (*Pongo abelii*) of Batang Toru. Dalam Grow NB, Gursky Doyen S, Krzton A (Editor). New York (US): Springer hal 265-283.

Wijiarti L. 2009. Preferensi habitat bersarang orangutan sumatera (*Pongo abelii* Lesson, 1827) di kawasan hutan Batang Toru Kabupaten Tapanuli Utara – Sumatera Utara. [Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Williams MAJ, Ambrose SH, van der Kaars S, Ruehlemann C, Chattopadhyaya U, Pal J, Chauhan PR. 2009. Environmental impact of the 73 ka Toba super-eruption in South Asia. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 284(34):295–314. DOI:10.1016/j. palaeo.2009. 10.009.

APPENDIX

ORANGUTAN RESEARCH RESULT/PUBLICATION IN BATANG TORU LANSCAPE

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
1	2003	Aktivitas Harian Orangutan Liar (*Pongo abelii* Lesson 1827) Di Cagar Alam Dolok Sibual-Buali, Sumatera Utara	Wanda Kuswanda dan Sugiarti	Journal
2	2003	Potensi Habitat Dan Pendugaan Populasi Orangutan (*Pongo abelii* Lesson 1827) Di Cagar Alam Dolok Sibual-Buali, Sumatera Utara	Wanda Kuswanda dan Sugiarti	Journal
3	2005	Strategi Perlindungan Orangutan Liar (*Pongo abelii* Lesson 1827) Di Cagar Alam Dolok Sibual-Buali, Sumatera Utara	Wanda Kuswanda	Journal
4	2005	Survey of Terrestrial Ecology, Air Quality and Noise for the Martabe Project Area, North Sumatra, Indonesia Survey of Terrestrial Ecology, Air Quality and Noise for the Martabe Project Area, North Sumatra, Indonesia	PT Newton Horas Nauli, LIPI, Hatfield	Report
5	2006	Laporan Teknik Mengarustamakan Kebijakan Konservasi Biodiversitas Dan Sistem Penyangga Kehidupan Di Kawasan Hutan Alam Sungai Batang Toru Provinsi Sumatera Utara	Perbatakusuma *et al.*	Report
6	2006	Peraturan Desa Aek Nabara Kecamatan Merancar Kabupaten Tapanuli Selatan	Pemdes	Village regulation
7	2007	Hutan Batang Toru Harta Karun Tapanuli	Mirza Gaby, *et al.*	Book
8	2007	Pengembangan Strategis Konservasi Dan Peran Kelembagaan Dalam Pelestarian Orangutan Sumatera	Wanda Kuswanda dan M. Bismark	Journal
9	2007	Membangun Kolaborasi StrategiKons ervasi Habitat Orangutan Sumatera Di Ekosistem Batang Toru	CII	Report

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
10	2007	A Documentation Strategy to Develop the Potential of NTFPs as a Source of Livelihood Diversification for Local Communities in the Batang Toru Orangutan Conservation Program	Jusupta Tarigan, Endri Martini, James Roshetko and Iwan Kurniawan	Report
11	2007	Daya Dukung Habitat Orangutan (*Pongo abelii* Lesson) Di Cagar Alam Dolok Sibual-Buali, Sumatera Utara	Wanda Kuswanda dan M. Bismark	Journal
12	2007	Development of Collaborative Orangutan Habitat Protection in Batang Toru Watershed, North Sumatra	CII	Book
13	2007	Agroforestry on the Interface of Orangutan Conservation and Sustainable Livelihoods in Batang Toru (North Sumatra)	James M. Roshetko, Endri Martini, Jusupta Tarigan, Gerhard Manurung, Suseno Budidarsono, Kusuma Wijaya, Joel C Tukan, Iwan Kurniawan, Gamma Galudra, Sonya Dewi, Dudy Kurnia Nugroho, Andree Ekadinata, Degi Harja, Betha Lusiana, Meine van Noordwijk and Jonas Purba	Report
14	2008	*Pongo tapanuliensis*, Tapanuli Orangutan	IUCN	Report
15	2008	Buku Ketiga Dokumen Dasar Hutan Batang Blok Barat	OSCP	Book
16	2008	Kesesuaian Jenis Untuk Pengayaan Habitat Orangutan Terdegradasi Di Daerah Penyangga Cagar Alam Dolok Sibualbuali	Wanda Kuswanda dan Asep Sukmana	Journal
17	2008	Orangutan Distribution, Density, Abundance And Impact Of Disturbance	Simon J. Husson, Serge A. Wich, Andrew J. Marshall, Rona D. Dennis, Marc Ancrenaz, Rebecca Brassey, Melvin Gumal, Andrew J. Hearn, Erik Meijaard, Togu Simorangkir and Ian Singleton	Book
18	2008	Distribution and Conservation Status of the Orangutan (*Pongo* spp.) on Borneo and Sumatra: How Many Remain? Oryx, 42, 329–39.	Wich, S.A., Meijaard, E., Marshall, A.J., *et al.*	Journal

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
19	2008	Laporan Akhir Pengambilan Data Survei Span di Kawasan Hutan Batang Toru di Sekitar Cagar Alam (CA) Dolok Sipirok, Cagar Alam Sibual-buali dan Cagar Alam Lubuk Raya	Amri Yasin Nasution Anjas M. Nasir Siregar	Report
20	2008	Prosiding Lokakarya Sosialisasi, Sinkronisasi dan Sinergitas Program Konservasi Orangutan Sumatera Dan Habitatnya Di Provinsi Sumatera Utara	Erwin A Perbatakusuma *et al.*	Book
21	2008	Buku Pertama Dokumen Rencana Aksi Konservasi Hutan Batang Toru Blok Barat	CII	Book
22	2008	Buku Kedua Perencanaan Aksi Konservasi dan Dokumentasi Penyusunan Perencanaan Multipihak Hutan Batang Toru Blok Barat	OSCP	Book
23	2009	Karakteristik Pohon Tempat Bersarang Orangutan Sumatera (*Pongo abelii* Lesson, 1827) Di Kawasan Hutan Batang Toru, Kabupaten Tapanuli Utara - Sumatera Utara	Hendri Pujiyani	Thesis
24	2009	Preferensi Habitat Bersarang Orangutan Sumatera (*Pongo abelii* Lesson, 1827) Di Kawasan Hutan Batang Toru Kabupaten Tapanuli Utara –Sumatera Utara	Lanjar Wijiarti	Thesis
25	2009	Kajian Habitat dan Estimasi Populasi Orangutan Sumatera (*Pongo abelii* Lesson, 1827) Di Kawasan Hutan Batang Toru Sumatera Utara	Roland Hotma Simorangkir	Thesis
26	2009	Struktur dan Komposisi Pohon di Habitat Orangutan Liar (*Pongo abelii*), Kawasan Hutan Batang Toru, Sumatera Utara	Roland H. Simorangkir, Sri Supraptini Mansjoer, M. Bismark	Report
27	2009	Orangutan Conservation Services Program Ecotourism Assessment in Batang Toru	OSCP	Report
28	2009	Peraturan Daerah Propinsi Sumatera Utara Tentang Rencana Tata Ruang Wilayah Propinsi Sumatera Utara Tahun 2009 – 2029	Pemda	Local regulation
29	2009	Orangutan Population Biology, Life History, and Conservation Perspectives	Andrew J. Marshall, Robert Lacy, Marc Ancrenaz, Onnie	Book Chapter

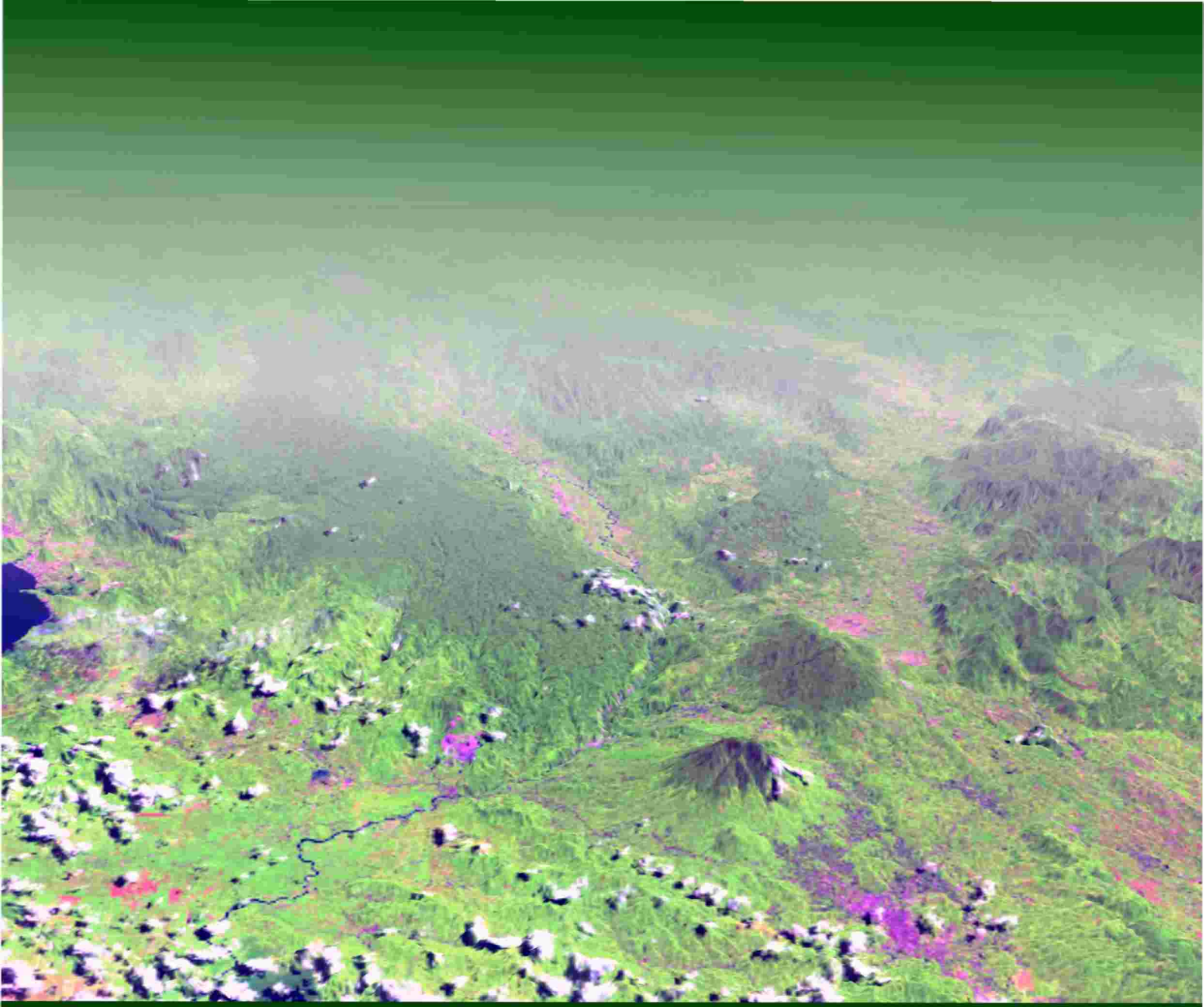
NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
		From Population Viability Analysis Models	Byers, Simon J. Husson, Mark Leighton, Erik Meijaard, Norm Rosen, Ian Singleton, Suzette Stephens, Kathy Traylor-Holzer, S. Suci Utami Atmoko, Carel P. van Schaik and Serge A. Wich	
30	2010	Penilaian Prioritas Dan Tindakan Aksi Konservasi Blok Hutan Sarula Timur – Provinsi Sumatera Utara	CII	Report
31	2010	Non-Timber Forest Products as A Source of Livelihood Diversification For Local Communities in the Batang Toru Orangutan Conservation Program	Jusupta Tarigan, James M. Roshetko, Endri Martini and Andree Ekadinata	Book
32	2010	Strategi Pengelolaan Cagar Alam Dolok Sibual Buali Berbasis Daya Dukung	Fitri Noor Chasanatun	Thesis
33	2010	Lokakarya Konservasi Orangutan Dan Rapat Kerja Forum Konservasi Orangutan Sumatera (Fokus) The Hill Sibolangit, Deli Serdang	Fokus	Report
34	2011	Orangutan Dan Ekonomi Pengelolaan Hutan Lestari Di Sumatera	Wich *et al.* (UNEP)	Report
35	2011	Sugar palm (*Arenga pinnata* (Wurmb) Merr.) for livelihoods and biodiversity conservation in the orangutan habitat of Batang Toru, North Sumatra, Indonesia: mixed prospects for domestication	Endri Martin,James M. Roshetko, Meine van Noordwijk, Arif Rahmanulloh, Elok Mulyoutami, Laxman Joshi, Suseno Budidarsono	Journal
36	2011	Preferensi Dan Kandungan Nutrisi Pakan Orangutan Sumatera (*Pongo abelii* Lesson, 1827) Di Stasiun Penelitian Hutan Lindung Batang Toru, Tapanuli Tengah, Sumatera Utara	Fitrotul Aini	Thesis
37	2011	Pemilihan Habitat Oleh Orangutan Sumatera (*Pongo abelii* Lesson) Di Cagar Alam Sipirok, Sumatera Utara	Wanda Kuswanda	Thesis
38	2012	Seleksi Tipe Habitat Orangutan Sumatera (*Pongo abelii* Lesson 1827) Di Cagar Alam Sipirok, Sumatera Utara	Wanda Kuswanda dan Satyawan Pudyatmoko	Journal

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
39	2013	Pendugaan Populasi Orangutan (*Pongo abelii* Lesson 1827) Berdasarkan Sarang Di Cagar Alam Sipirok, Sumatera Utara	Wanda Kuswanda	Journal
40	2013	Seleksi Sumberdaya Habitat Orangutan (*Pongo abelii* Lesson 1827) Di Cagar Alam Sipirok, Sumatera Utara	Wanda Kuswanda	Journal
41	2013	Evaluasi Strategi dan Rencana Aksi Konservasi Orangutan Indonesia 2011-2013	Forina	Report
42	2013	Perilaku Makan Orangutan Sumatera (*Pongo abelii* Lesson, 1827) di Stasiun Penelitian Hutan Batang Toru Bagian Barat Tapanuli Utara	Rahmad Zubeir Harahap	Thesis
43	2014	Orangutan Tapanuli Kritis di Ambang Punah	Wanda Kuswanda	Book
44	2014	Preliminary Data on the Highland Sumatran Orangutan (*Pongo abelii*) of Batang Toru	S. A. Wich, G. Usher, H. H. Peters, Mokhamad Faesal Rakhman Khakim, M.G. Nowak and G.M. Fredriksson	Journal
45	2014	Extractive industries and orangutans	Erik Meijaard and Serge Wich	Report
46	2014	Indentifikasi dan Pemetaan Pohon Sarang Orangutan Sumatera (*Pongo abelii*) di kawasan Penyangga Cagar Alam Dolok Sibual-buali(Studi Kasus : Desa Bulu Mario, Aek Nabara dan Huraba)	Etti Nur Cahyani	Thesis
47	2014	Estimasi Kepadatan Orangutan Sumatera (*Pongo abelii* Lesson, 1827) Berdasarkan Jumlah Sarang di Perbatasan Cagar Alam Dolok Sibual-buali	Ferry Aulia Hawari	Thesis
48	2015	Laporan Badan Pengurus Forum Orangutan Indonesia 2010-2015	Forina	Report
49	2015	Biodiversity Monitoring: Batang Toru river area, PT. North Sumatra Hydro Energy Target Area South Tapanuli, North Sumatra	BP2LHK Aek Nauli dan BBKSDA Sumatera Utara	Report
50	2015	Ekologi Makan Orangutan Sumatera (*Pongo abelii* Lesson 1827) Di Hutan Batang Toru Blok Barat Sumatera Utara.	Mokhamad Faesal Rakhman Khakim	Thesis

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
51	2015	Conservation Genetics of Sumatran Orangutans (*Pongo abelii*)	Puji Rianti	Dissertation
52	2015	Ape Population Abundance Estimates: State of the Apes 2015	Tene Kwetche Sop, Serge Wich, Liz Williamson, Susan Cheyne, Fiona Maisels	Book Chapter
53	2015	Strategic Environmental Assessment for Spatial Planning for North Tapanuli District	PT. Dazya Ina Mandiri	Report
54	2015	Strategi Konservasi Jenis Terancam Punah Sumatera 2015-2020	TFCA Sumatera	Workshop Proceeding
55	2016	Land-cover Changes Predict Steep Declines For the Sumatran Orangutan (*Pongo abelii*)	Serge A. Wich, Ian Singleton, Matthew G. Nowak, Sri Suci Utami Atmoko, Gonda Nisam, Sugesti Mhd. Arif, Rudi H. Putra, Rio Ardi, Gabriella Fredriksson, Graham Usher, David L. A. Gaveau, Hjalmar S. Kühl	Journal
56	2016	Final Report Orangutan Population and Habitat Viability Assessment	Departemen Kehutanan	Report
57	2017	Morphometric, Behavioral, and Genomic Evidence for a New Orangutan Species	Nater *et al*.	Journal
58	2017	A new great ape species	Erik Stokstad	Web Article
59	2017	Broad Conservation: Protect the Unknowns	P. García-Díaz and P. Cassey2	Journal
60	2017	Analisis Populasi Orangutan Dan Satwa Langka Lainnya Pada Wilayah Kerja PT. NSHE, Di Batang Toru	Wanda Kuswanda dan Fitri Noor	Report
61	2017	Studi Populasi Dan Distribusi Orangutan Sumatera (*Pongo abelii*) di Hutan Penyangga dan Potensi Koridor Batang Toru Sumatera Utara	Arfah Nasution	Thesis
62	2017	Memperkenalkan Jenis Primata Baru Khas Sumatera *Pongo tapanuliensis*	www.batangtoru.org/orangutan	Web article
63	2018	Declining Orangutans Population in the Unprotected Forest of Batang Toru	Arfah Nasution, Dyah Perwitasari-Farajallah and Sri Suci Utami-Atmoko	Journal

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
64	2018	Study of Ficus in West Block Batang Toru Forest Region, North Tapanuli District, Indonesia	N Pasaribu, T A Aththorick, E Siswiyati	Journal
65	2018	Genomic Variation of the Great Apes and the Application to Conservation	T. Marques-Bonet& C. Hvilsom	Journal
66	2018	Building Relationships: How Zoos and other Partners can Contribute to the Conservation of Wild Orangutans *Pongo* Spp	M. Ancrenaz, C. Barton, P. o Riger & S. Wich	Journal
67	2018	Orangutan Populations are Certainly Not Increasing in the Wild	Erik Meijaard, Julie Sherman, Marc Ancrenaz, Serge A. Wich, Truly Santika, and Maria Voigt	Journal
68	2018	Newly Discovered Orangutan Species Requires Urgent Habitat Protection	Sean Sloan, Jatna Supriatna, Mason J. Campbell, Mohammed Alamgir, and William F. Laurance	Journal
69	2018	Partisipasi Kelompok Pecinta Alam Forester Tapanuli Bagian Selatan Dalam Pelestarian Orangutan Sumatera (*Pongo abelii*) Di Cagar Alam Dolok Sibual-Buali Kabupaten Tapanuli Selatan	Safran Efendi Pasaribu dan Rizki Efendi Harahap	Journal
70	2018	Dampak Pembangunan PLTA Batang Toru Terhadap Hutan Primer, Habitat dan Populasi Orang Utan, Kekeringan dan Banjir, Emisi Gas Rumah Kaca dan Sosial Ekonomi Masyarakat Sekitar	Yanto Santosa *et al.*	Report
71	2018	Analisis Populasi Orangutan Dan Satwa Langka Lainnya Pada Musim Kering Di Wilayah Kerja PT. NSHE, Tapanuli Selatan	BP2LHK Aek Nauli dan BBKSDA Sumatera Utara	Report
72	2018	Up Date Sebaran Habitat Dan Populasi Orangutan Tapanuli (*Pongo tapanuliensis*)	Wanda Kuswanda	Report

NO	YEAR	TITLE	AUTHORS	TYPE OF PUBLICATION
73	2018	Genomes Reveal Marked Differences in the Adaptive Evolution Between Orangutan Species	Maja P. Mattle-Greminger, Tugce Bilgin Sonay, Alexander Nater, Marc Pybus Tariq Desai, Guillem de Valles, Ferran Casals, Aylwyn Scally, Jaume Bertranpetit, Tomas Marques-Bonet, Carel P. van Schaik, Maria Anisimova and Michael Krützen	Journal
74	2019	Strategi dan Rencana Aksi Konservasi Orangutan Indonesia 2019-2029	Ditjen KSDAE, KLHK	Book
75	2019	Final Report Orangutan Population and Habitat Viability Assessment	Utami-Atmoko, S. Traylor-Holzer, K. Rifqi, M.A., Siregar, P.G., Achmad, B., Priadjati, A., Husson, S., Wich, S., Hadisiswoyo, P., Saputra, F., Campbell-Smith, G., Kuncoro, P., Russon, A., Voigt, M., Santika, T., Nowak, M., Singleton, I., Sapari, I., Meididit, A., Chandradewi, D.S., Ripoll Capilla, B., Ermayanti, Lees, C.M.	Report
76		Dokumen Lengkap Rencana Aksi Konservasi Hutan Batang Toru Blok Barat	OSCP	Action plan
77		Informasi Habitat dan Populasi Orangutan (*Pongo abelii* Lesson 1827) di Kawasan Batang Toru (Studi kasus: Cagar Alam Dolok Sibual-buali)	Wanda Kuswanda	Journal
78		NGO Mapping of PLTA Batang Toru Report for PT North Sumatera Hydro Energy	Joseph Viandrito	Report



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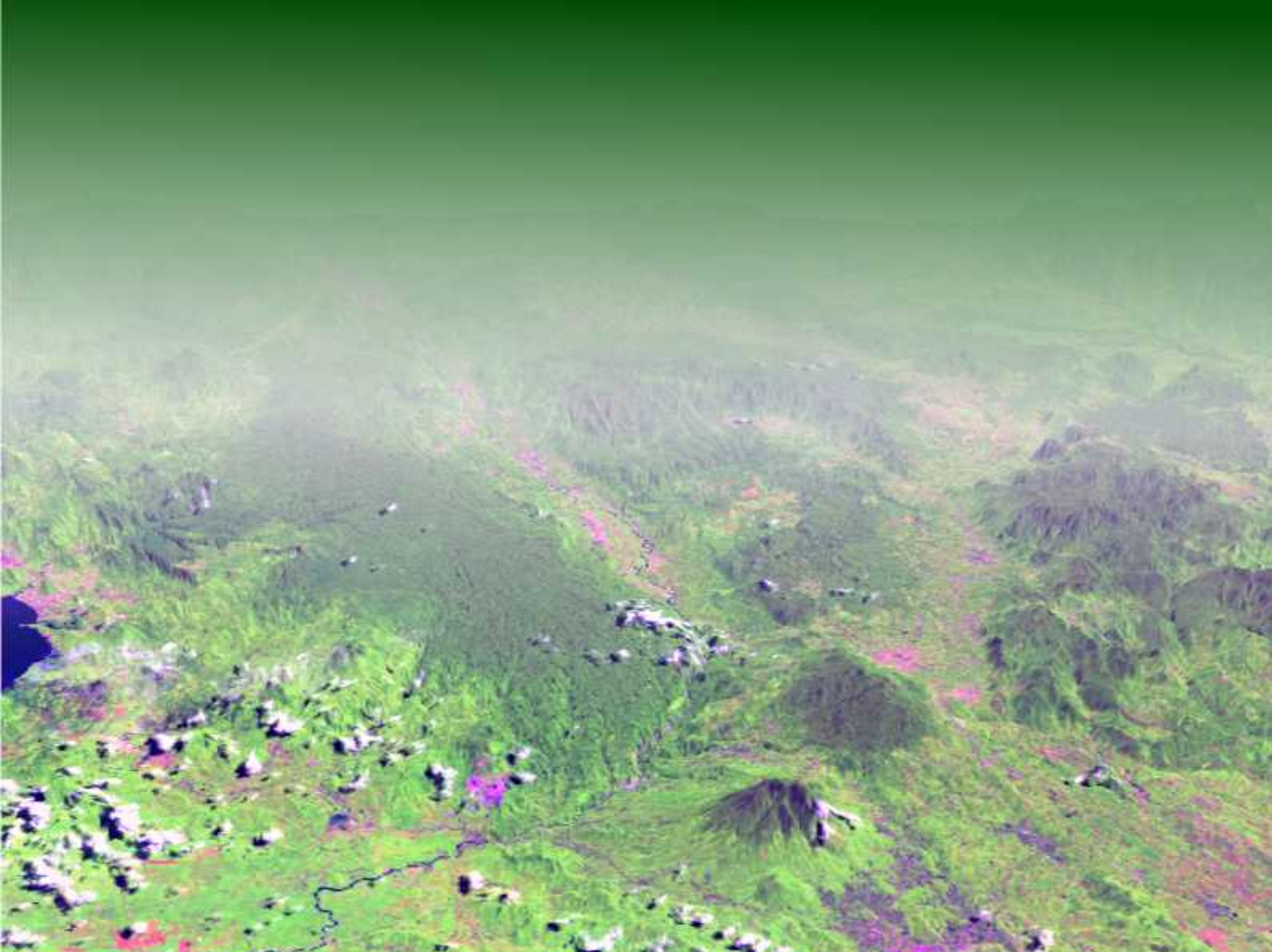

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