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MORALITY BEFORE KNOWLEDGE

Influence of mangrove ecosystem quality degradation on long-tailed monkey population in Muara Angke wildlife sanctuary Jakarta

ADE RACHMI YULIANTRI[1], ALIN ERLITA NURFATIHA[1]*, FADHELUN[1]
[1] *School of Environmental Science, University of Indonesia, Jakarta, 10430, Indonesia*
*Correspondence: alinerlita@gmail.com

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ABSTRACT
Background: One of the problems that occurs in the Muara Angke Wildlife Reserve (SMMA) is the generation of rubbish. This research aims to explain the decline in mangrove quality that occurred in SMMA and its effect on the long-tailed monkey population. **Methods**: This research methodologically combines qualitative and quantitative methods, namely interviews, observation and air testing in the laboratory. **Results**: The results of this research found that organic pollution in the Angke River exceeded quality standards by two times, which probably also came from high levels of ammonia and detergent contamination. Apart from that, from observations, organizational and business activities cause waste in the Angke River. The decline in the quality of the mangrove ecosystem has an impact on the long-tailed monkey population. Initially there were three populations, but now there are only two populations totaling 65-66 individuals. **Conclusion**: This assumes that there is a possibility that long-tailed monkeys migrate to other places. Therefore, there is an influence between the decline in the quality of the mangrove ecosystem on long-tailed monkeys.

KEYWORDS: ecosystem; long tailed mongkey; mangrove; quality.

1. Introduction

Climate Muara Angke Wildlife Reserve (abbreviated as SMMA) was established as a Nature Reserve for the first time through the decree of the Governor General of the Dutch East Indies No. 24 on June 18, 1939 with an area of 15.40 ha, to protect mangrove forests and swamp forest ecosystems. In 1998, Muara Angke Nature Reserve was converted into SMMA based on the Minister of Forestry and Plantation Decree No. 755/Kpts-II/1998 with an area of 25.02 Ha, because it requires more intensive management to support the flora and fauna in it. The main component of vegetation in the SMMA area is mangrove forest. SMMA actually has many regional roles and functions, including as a determinant of whether or not a water body is productive, because it is a habitat for various animals in it, the mangrove ecosystem also acts as a regulator of hydrological functions, by helping to determine water quality. Also as a deterrent to natural disasters, mangrove ecosystems participate in maintaining the natural systems and processes around them. However, the mangrove ecosystem in SM Muara Angke, which is referred to as an ecoton that is very vulnerable and influenced by the condition of the waters of Jakarta Bay and the mainland of Java Island, especially since this area is directly adjacent to the Angke River.

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One of the problems that occurs is waste generation, which has a negative impact on the regeneration of mangrove ecosystems. The success of mangrove growth in SMMA depends on the ability of mangroves to go through their life cycle, including the production and distribution of mangrove seeds in suitable places that support growth. The ability of mangrove regeneration depends on environmental conditions, tides, and substrate suitability. If during the regeneration phase of the mangrove ecosystem there are disturbances that prevent the growth of production and dispersal of mangrove seeds to grow into mature mangroves, the sustainability of the mangrove ecosystem will be threatened.

The condition of the mangrove ecosystem also greatly affects the lives of other living things. One of the animal populations affected by the disruption of the natural regeneration process of mangrove ecosystems is the population of long-tailed monkeys (Macaca fascicularis). Long-tailed macaques are one of the main animals in the SMMA ecosystem that relies heavily on mangroves as their main food source and breeding ground. If the problem of waste generation is not addressed, it will threaten the sustainability of the long-tailed monkey and mangrove populations. From these problems, this research will answer two questions. First, how is the decline in the quality of mangrove ecosystems due to waste generation? Second, how does the decline in mangrove ecosystem quality affect the long-tailed monkey population? These two questions are related, where the second question can be answered by knowing the form of ecosystem quality degradation that occurs.

2. Methods

This research was conducted to analyze waste generation in the SMMA mangrove ecosystem. The research method was conducted using qualitative and quantitative methods. Qualitatively, interviews with a team of experts from BKSDA and research surveys were conducted from morning to noon on Sunday, October 24, 2021. In addition, direct observations were made in the SMMA ecosystem of the presence of two groups of long-tailed monkeys. Quantitatively, researchers also conducted river water sampling at the SMMA estuary to test the quality of class four river water to compare with the applicable quality standards in PP No.22 of 2021 Appendix VI concerning the Implementation of Environmental Protection and Management. This was done to answer the first question of this research. The parameters used in this quality test can be seen in Table 1 below.

Table 1. Parameters used in river water quality tests

Mangrove Ecosystem Quality Decline Parameters	Operational Definition	Measurement Tools	Unit
pH	The level of acidity (hydrogen ion concentration) in the water	pH meter	
TDS	Physical parameters of water that shows the organic and inorganic organic and inorganic materials dissolved in water.	Gravimetry	mg/L
TSS	Physical parameters that indicates particles in water with a size more than 2 microns	Gravimetry	mg/L
COD (*Chemical Oxygen Demand*)	The amount of oxygen in water and wastewater required for waste materials to be chemically oxidized	Spectrophotometry	mg/L

BOD (*Biological Oxygen Demand*)	Amount of oxygen required for the biochemical degradation process	*Winkler*	mg/L
N-Amoniac	The amount of compounds (as nitrogen) left over from the metabolic products of aquatic organisms and discharges and/or derived from waste processes that enter water into water and water bodies	Spectrophotometry	mg/L
Salinity	The amount in grams of all solids dissolved in 1 kilo gram of seawater if all bromine and iodine are replaced by an equal amount of chlorine; all carbonates are converted to their oxides and all organic matter is oxidized	Salinometry (*direct reading)*	$^{o}/_{oo}$
Detergent (MBAS)	The amount of detergent/soap compounds as methylene blue alkyl sulfonate which is the residual discharge of human activities and enters water and water bodies	Spectrophotometry	mg/L

Water sampling was carried out using a sampling method, namely the grab sampling method using a jerrycan manually at the mouth of the SMMA river. Jerrycan containing water samples were taken to the PT MEDIALAB INDONESIA environmental laboratory for testing. Water sampling was carried out during the day at around 14:00 WIB.

Furthermore, the data collected must be processed to obtain research results. The data are data on the population of long-tailed monkeys and data on the decline in water quality of the SMMA mangrove ecosystem. Quantitative data processing and analysis in this study was carried out by narrating the results of calculations to compare with previous studies. Qualitative data processing in this study was carried out by conducting descriptive analysis of the results of interview studies with resource persons and processing by comparing and complementing it with secondary data derived from previous studies and existing policies and regulations. The environmental quality standard used as a comparison is class 4 (four) quality standards because at the SMMA location, river water is only used as a mangrove living location or used to irrigate mangrove plants and other plants that live in the SMMA mangrove ecosystem and is not used as raw water and freshwater aquaculture or recreational facilities, in line with the quality standards in DKI Governor Decree No. 582 of 1995, the Angke River (up to Muara Angke) is categorized into class D (urban business) not for raw / drinking water, recreation or freshwater fisheries. The analysis of river water quality in SMMA was carried out by comparing several chemical and physical parameters from laboratory testing results with river water quality standards in Government Regulation (PP) No. 22 of 2021 appendix VI as listed in the following river water quality requirements in Table 2.

Data that have been processed through calculation techniques and data analysis are then presented in the form of tables and narratives. The long-tailed macaque population is presented in the form of a map of the current long-tailed macaque population in the SMMA mangrove ecosystem. River water quality data in SMMA is presented using comparison data between the test results of several test parameters and the quality standards of PP No. 22 of 2021. After that, the results of the table presentation are narrated to clarify the presentation of data and facilitate the explanation of the research data.

3. Results and Discussion

SMMA is administratively located at 106° 43"-106° 48" East and 6° 06"-6° 10" N-S. While administratively included in the Kelurahan Kapuk Muara and Pluit, Penjaringan District, North Jakarta City, DKI Jakarta. The water in the Muara Angke ecosystem is the Angke river estuary which ends in Jakarta Bay. The mangrove ecosystem in SMMA managed by BKSDA KLHK is directly adjacent to the Protected Forest Area managed by the DKI Jakarta Government. The current condition of pollution in the waters of the SMMA mangrove ecosystem comes from waste carried by the current along the Angke river, North Jakarta, from garbage carried by waves in the waters north of Jakarta and the waste of domestic activities of fishermen who build illegal settlements that are seasonal and semi-permanent around the mouth of the Angke river in the SMMA area. A photo of the illegal settlements can be seen in fig 1 below.

Fig 1. Illegal fishing village in SMMA

Source: Researcher, 2021

Based on secondary data from the analysis of the literature used, namely the Spatial Pattern Plan map in the DKI Jakarta Provincial Spatial Plan 2012 - 2030 is for the Wildlife Sanctuary which is devoted to the only protected function area in DKI Jakarta. As shown in Figure 2 Spatial Pattern Plan Map of North Jakarta Administration City.

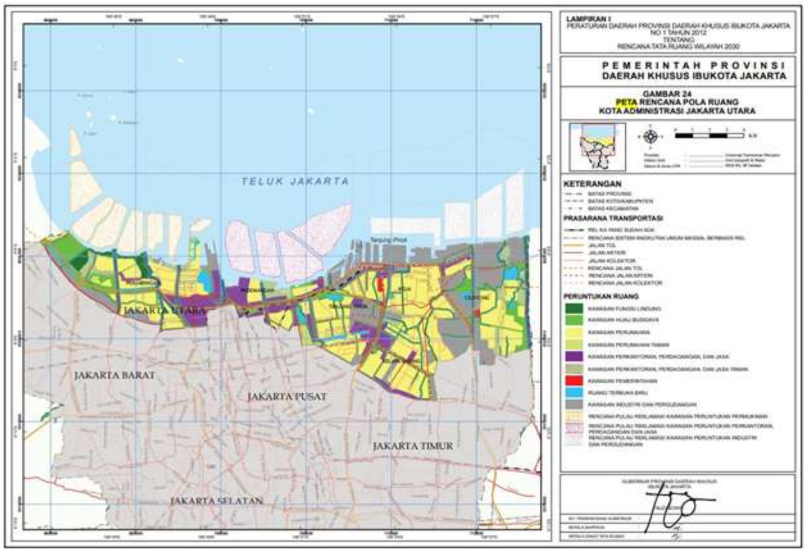

Fig 2. Map of North Jakarta spatial pattern plan

Source: Provincial Government of DKI in 2009

SMMA is one of the mangrove ecosystems that is quite unique and is an ecosystem that is still able to survive in northern DKI Jakarta. Mangrove ecosystems are ecosystems that are able to maintain the sustainability of aquatic biota (Rosyani, 2019). The loss of quality and quantity of mangrove ecosystems can have an impact on the survival of human life and biodiversity. The condition of the mangrove ecosystem is dominated by Sonneratia caseolaris which is the main food of Long-tailed monkeys in SMMA and Nypa fruticans. These two mangrove species can already be an indicator that conditions in SMMA are areas dominated by fresh water mangroves, which are mangrove species that are able to survive in areas with low salinity values. From the secondary data describing the first level image observation analysis in Figure 3 divides the land cover into 2 (two) plant classes, namely mangrove and non-mangrove.

Fig 3. Land cover map in SMMA
(Source: Muara Angke Wildlife Sanctuary, 2018)

Further classification was carried out to distinguish non-mangrove land cover classes which were further divided into 7 classes namely Open Land, Built-up Land, Water Hyacinth, Moss, Other Vegetation, Shrubs, and Water Bodies.

Table 2. Classification of mangrove and non-mangrove land cover

No	Class	Area (Ha)
1	Open Land	0,22
2	Built-up Land	0,02
3	Water Hyacinth	1,03
4	Moss	0,72
5	Other Vegetation	0,02
6	Shrubs	6,66

7	Water	7,39
8	Nypa fruticans	2,47
9	Rhizophora sp.	0,08
10	Sonneratia sp.	9,68
11	Excoecaria agallocha	0,07
	SMMA Total Area	28,36

The shrub class has the largest area of the non-mangrove class category, namely 6.66 Ha. Meanwhile, the mangrove class is further divided into 4 classes to the species level, namely Nypa fruticans, Rhizophora sp., Sonneratia caseolaris, and Excoecaria agallocha. The total area of the mangrove class is 12.30 ha or 43% of the total SMMA area. Sonneratia caseolaris has the largest area of 9.68 ha. Land plants associated with mangroves were even found in the SMMA mangrove ecosystem health monitoring plots, such as Ficus benjamina and Thespesia populnea. This shows that land plants are also able to grow and adapt in the SMMA area.

Based on the results of the primary data review through testing in the environmental laboratory, the observation data of the salinity parameter results of 7 o/oo and a pH value of 7.24 were obtained. These conditions support the results obtained and justify the initial hypothesis, that the mangroves that dominate in SMMA are indeed mangroves that live in low salinity. This does not indicate damage or poor environmental quality, but indicates the current existing condition of the ecosystem. Based on field observations, part of the SMMA area is inundated by Angke river water. Sufficient water inundation causes mangroves to be able to adapt to these conditions. This is certainly an important note, because with water conditions like this, it will prevent mangrove seedlings from growing and developing to form new individuals.

From the secondary data in 2014, the land cover by mangrove was 7.68 ha for Sonneratia caseolaris mangrove and 2.5 ha for Nypa fruticans mangrove, as illustrated in Figure 4.3. When compared with secondary data in 2019, the increase in mangrove area growth for both types is presented in Table 3.

Table 3. Mangrove land cover of nypa fruticans and sonneratia sp.

No.	Class	2014 Area (Ha)	2019 Area (Ha)	Growth Area (Ha)
1	Nypa fruticans	2,50	2,47	- 0,03
2	Sonneratia sp.	7,68	9,68	2,00
	Total Area	10,18	12,15	1,97

From the comparison of the two secondary data for mangrove cover of Nypa fruticans and Sonneratia sp, an increase in cover area for Sonneratia sp mangrove of 2 Ha and a decrease in cover area for Nypa fruticans mangrove of 0.03 Ha were obtained. This shows that despite the pollution of water quality in the Angke River around SMMA and the large amount of garbage around the SMMA mangrove ecosystem, there was still an increase in mangrove population growth totaling 1.97 Ha for both types of mangroves over a period of 4 years, with an average annual mangrove growth of 0.493 Ha. This shows that mangrove restoration and rehabilitation activities in SMMA by BKSDA have shown results with an increase in mangrove cover area for Sonneratia sp.

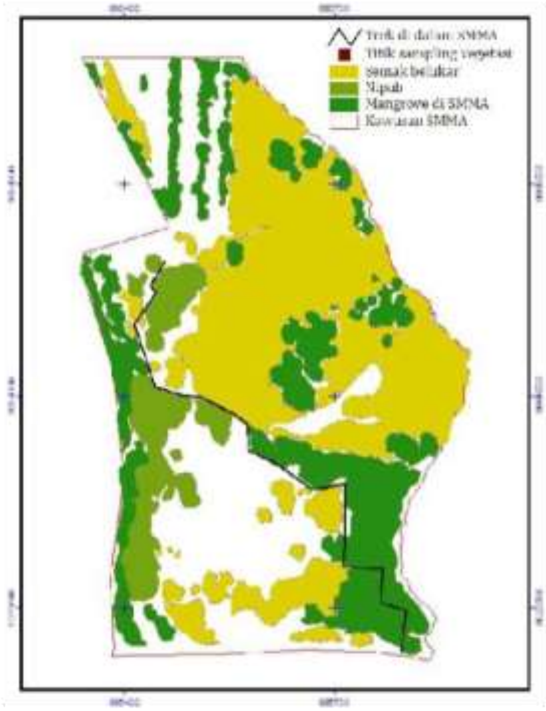

Fig 4. Land cover in SMMA
Source: (Mayalanda et al., 2014)

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3.1 Water quality test research results

From the river water quality test data at the SMMA mangrove ecosystem location, the following data were obtained in table 5.

Table 5. Testing results of Angke River water quality in the SMMA mangrove ecosystem

No	Variable Name	Unit	Test Results	Class 4*)	Description
1	pH	-	7,24	6-9	Not applicable for peat water (based on its natural condition)
2	TDS	mg/L	7.356	2.000	Not applicable to estuaries
3	TSS	mg/L	30,1	400	-
4	COD (*Chemical Oxygen Demand*)	mg/L	66	80	-
5	BOD (*Biological Oxygen Demand*)	mg/L	20	12	-
6	Amoniac (sebagai N)	mg/L	3,8	-	-
7	Salinity	‰	7	-	-
8	Detergent (MBAS)	mg/L	0.37	-	-

*) Quality standard for river water quality according to PP No. 22 of 2021 Appendix VI-1 (class 4)

Based on the data above, it can be concluded that for the parameters pH, TSS and COD in Angke river water in SMMA still meet the quality standards even though for COA the value is almost close to the threshold of class 4 river water quality standards based on PP No. 22 of 2021. The COD value of 66 mg/L (82.5% of the quality standard) indicates that contamination has occurred but has not exceeded the quality standard value of 80 mg/L. While other parameters such as TDS and BOD have exceeded the quality standard where the TDS value is 7,356 mg/L while the quality standard value is 2,000 mg/L. This is likely because there are many dissolved contaminants and high salt levels at the Angke river estuary location. The BOD value reached 20 mg/L while the quality standard value is 12 mg/L, illustrating that organic contamination in the Angke River has exceeded the quality standard almost twice.

Researchers also included ammonia and detergent values, which although do not have quality standard values based on PP No. 21 of 2021, indicate that organic contamination may also come from high ammonia and detergent contamination. Ammonia and detergents can come from domestic waste discharges that dissolve and pollute the water quality of the Angke River along North Jakarta. Residential and business activities along the Angke River that do not have domestic waste treatment facilities and discharge their waste directly into the Angke River are the main causes of high ammonia content. In addition, waste decomposition and illegal settlement activities around the SMMA mangrove ecosystem also contribute to the decline in river water quality in the SMMA mangrove ecosystem. From field observations, several fishing boats were seen conducting toilet activities in the Angke river within the SMMA mangrove ecosystem and discharging their waste directly into the river.

3.2 Interview results and previous research studies on the long-tailed macaque population in SMMA

From the results of secondary data analysis, there are 12 types of mammals found in the SMMA mangrove ecosystem. Long-tailed macaque (Macaca fascicularis) is one of the mammal species found in the SMMA mangrove ecosystem. Based on the observations of the IAR Indonesia Foundation from 2017-2019 in the SMMA mangrove ecosystem, the number of individuals of long-tailed monkeys (Macaca fascicularis) ranged from 60-80 individuals. Meanwhile, based on observations by YKAN and DKI Jakarta BKSDA in 2019, the number of long-tailed macaque (Macaca fascicularis) individuals was 66. From field observations, long-tailed monkeys were found at several points along the SMMA area, which are part of one of the long-tailed monkey population groups.

Based on interviews with the BKSDA team at the SMMA mangrove ecosystem location, the initial population of Long-tailed monkeys was as many as 3 population groups. While currently there are only 2 populations of Long-tailed monkey groups. The number is around 65-66 Long-tailed monkeys for the total of the two populations. This shows that there has been a decrease in the number of Long-tailed monkey populations in the SMMA ecosystem. The cause of the decline should be investigated further to determine if there is a specific reason for the decline in the population of long-tailed monkeys in the SMMA mangrove ecosystem. Figure 5 below shows a photo of a Long-tailed macaque looking for food around the SMMA mangrove ecosystem.

Fig 5. Long-tailed Monkey (Macaca fulgaris) in the SMMA mangrove ecosystem

Source : researcher, 2021

From BKSDA's secondary data, a map of animal distribution in the SMMA ecosystem was obtained as shown in Figure 6. Currently there are only two populations of long-tailed monkeys that still survive in the SMMA mangrove ecosystem location.

Fig 6. Map of animal distribution in SMMA mangrove ecosystems

Source: SM Muara Angke DKI Jakarta Province

4. Conclusions

The results of this study indicate that there is a decrease in the quality of mangrove ecosystems as seen from the results of water sample testing. This decrease affected the population of long-tailed monkeys, because originally the population of long-tailed monkeys there were 3 groups, when conducting surveys there were only 2 groups. It is assumed that there is a possibility of long-tailed macaques migrating to other places. On the other hand, the area of mangrove land cover from 2014 to 2018 increased.

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Conflicts of Interest

The authors declare no conflict of interest.

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Biographies of Author(s)

ADE RACHMI YULIANTRI, School of Environmental Science, University of Indonesia

- Email:
- ORCID:
- Web of Science ResearcherID:
- Scopus Author ID:
- Homepage:

ALIN ERLITA NURFATIHA, School of Environmental Science, University of Indonesia

- Email: alinerlita@gmail.com
- ORCID:
- Web of Science ResearcherID:
- Scopus Author ID:
- Homepage:

FADHELUN, School of Environmental Science, University of Indonesia

- Email:
- ORCID:
- Web of Science ResearcherID:
- Scopus Author ID:
- Homepage: