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Mangrove Zoning Study Using Unmanned AerialVehicle in Mangrove Forest of Nagari Mandeh, West Sumatra

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***Abstracts* – Mangvore has physical and ecological functions that are very influential on coastal ecosystems. Mandeh area is currently one of the ecotourism areas that has a fairly extensive Mangrove forest. However mangrove condition is being threatened due to various reasons. This study to determine the zoning pattern of the Mandeh mangrove forest using two different methods: (a) field survey using belt transect method with determination of plot points determined by purpose sampling (b) method with unmanned aircraft using 3-dimensional visual analysis by utilizing orthophoto data recorded by unmanned aerial vehicles (UAV). Data were presented in tabulation form, then analyzed qualitatively and quantitatively. The results revealed that thezonation pattern of mangrove forests using the field survey method can provide results in the form of a more detailed zonation pattern, the number of individual trees, tree diameters, and the types of species thatdominate. Observation of the zonation pattern of mangrove forests using UAV method providing accurate results in the form of general profiles of mangroves, and individual tree heights. The implication of this research will be useful as a consideration in making policies on mangrove conservation in Nagari Mandeh.**

Keywords – Zoning pattern, Ecotourism, Unmanned Aerial Vehicles, Orthophoto.

I. INTRODUCTION

Indonesia is one of the countries that has the largest mangrove forest in the world. The area of mangroveforests in Indonesia is around 27% of the world's total mangrove forests (KKP, 2018). Mangrove forest is anecosystem that has a different character due to the formation of zoning. The presence of each type ofmangrove that has its own character is thought to be the cause of the formation of zoning (Muhsin &Indrawati, 2008). The zoning formation of each area is different, all depending on the type and growthpattern. Determination of species based on mangrove zoning was proposed by Noer et al., (2006, 2012) whichdivides mangroves into four zoning areas based on their position from the coast. Several previous studiesconducted in the Mandeh area showed that the distribution of mangroves was not evenly distributed from onelocation to another. *Rhizophora apiculata* is the most dominant species found in the mangrove forest area of Nagari Mandeh. The Nagari Mandeh area itself is located on the west coast of Sumatra, Pesisir SelatanRegency, West Sumatra Province. This area consists of 6 villages with an area of about 18,000 ha with typical mangrove vegetation. The Nagari Mandeh area has a mangrove ecosystem area of 896.73 ha with a level of damage of 37.3%. (Mukhtar et al., 2017; Raynaldo et al., 2020).

Given the many benefits of mangrove forests and the effect of zoning formation on mangrove sustainability, further research is needed regarding mangrove zoning. So far, the field survey method is one of the most frequently used methods in observing mangrove zoning in Indonesia. This method can produce detailed datain determining the formation of zoning in a research area. In addition to the field survey method, current technological developments also create new innovations in the observation of mangrove forests, this method utilizes the capabilities of unmanned aircraft or UAV (Unmanned Aerial Vehicle), better known as drones. This method is considered to be able to provide data analysis results similar to the field survey method.

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II. RESEARCH METHODOLOGY

This research was carried out from April to June 2021 in the Nagari Mandeh mangrove forest, Koto XI Tarusan District, Pesisir Selatan Regency, West Sumatra. Data analysis was carried out at the Ecology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, Padang. The method used for field survey data collection is done using the belt transect method (path method)(Kusmana, 1997). Determination of plot points was determined purposively until at most (Mueller-Dombois& Heinz, 1974). Place the transect perpendicular from the shoreline until it reaches the ecoton. Plot measuring 10 mx 10 m for tree level observations, Plot 5 mx 5 m for sapling observations (Bengen, 2004).

As for data retrieval using unmanned aircraft, it will be carried out using 3-dimensional visual analysis of the results of recording unmanned aerial vehicles (UAV). The flight altitude when taking photos is 80 m, with a vertical camera setting of 90º degrees, 75% overlap and an area of 10 hectares. Drone photos are processed through several stages, namely initial processing, point cloud and DSM. Then, orthophoto, DTM and DSM will be exported with geo-TIFF (Tagged Image File Format) format to get CHM (Canopy Hight Model) data. CHM is obtained from the results of subtracting DSM and DTM using the raster calculator in QGIS.

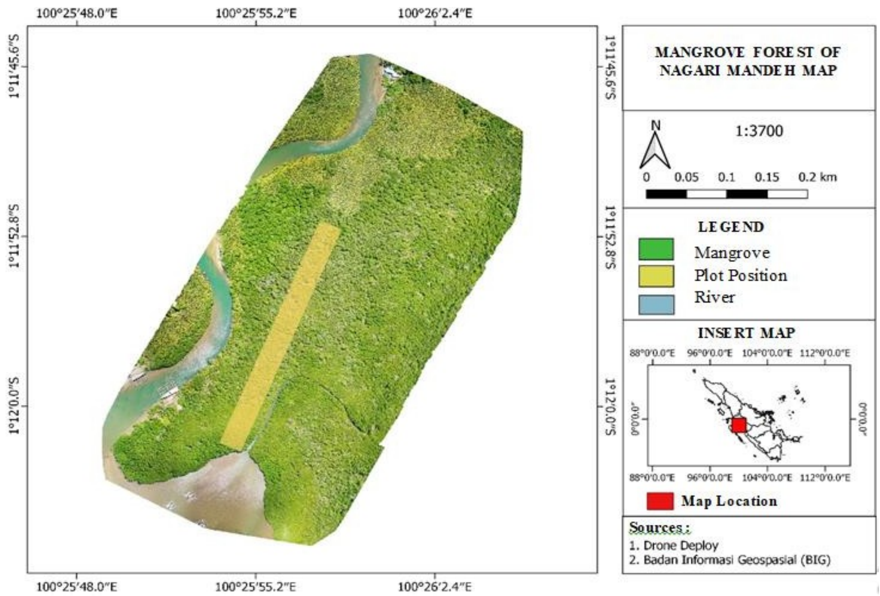


Figure 1. Map of Observation Plot Position, Nagari Mandeh, West Sumatra.

III. DATA ANALYSIS

1. Density

Number of individuals of a species

$$\text{Den} = \frac{\text{number of individuals of a species}}{\text{area of the whole plot}}$$

$$\text{RDen} = \frac{\text{Density a species}}{\text{Density all species}} \text{x } 100\%$$

Information:

Den = Density

RDen = Relative Density

2. Frequency

Number of plot found for a species

$$F = \frac{\text{number of plot found for a species}}{\text{total all plots}}$$

$$FR = \frac{\text{frequency a species}}{\text{frequency all species}} x\ 100\%$$

Information:

F = Frequency

FR = Relative Frequency

3. Dominance

$$D = \frac{\text{basal area}}{\text{total plot area}}$$

$$DR = \frac{\text{value of dominance of a species}}{\text{value of dominance of all species}} x\ 100\%$$

Information:

D = Dominance

DR = Relative Dominance

4. Important Value Index (IVI)

Important Value Index (IVI) = RDen +RF + RDom

5. Diversity Index

To calculate the Diversity Index, the Shannon-Wiener equation is used with the equation:$H'=-\Sigma\{(ni/N) \ln (ni/N)\}$.

IV. Reseult And Discussion

Based on the research that has been carried out, the data obtained for the zoning of the Nagari Mandeh mangrove forest by field surveys and drone surveys are as follows.

1. Zoning Pattern with field survey method

The mangrove forest ecosystem in the Nagari Mandeh area is a natural forest that grows alone and is not the result of planting. Based on observations made in the Nagari Mandeh mangrove forest area, a zoning pattern was obtained with two regional divisions based on seawater inundation conditions. The first zone is the one atthe front, facing the sea directly and is always inundated during high and low tides. The second zone is behindthe first zone and is directly adjacent to the mainland.

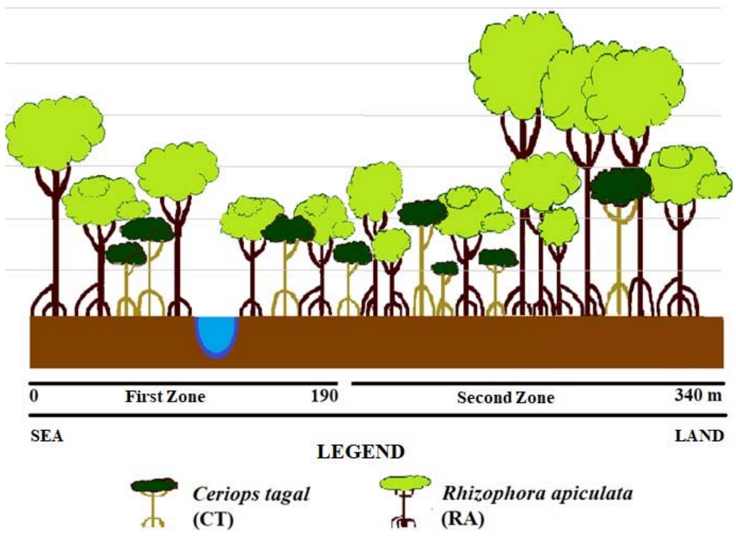
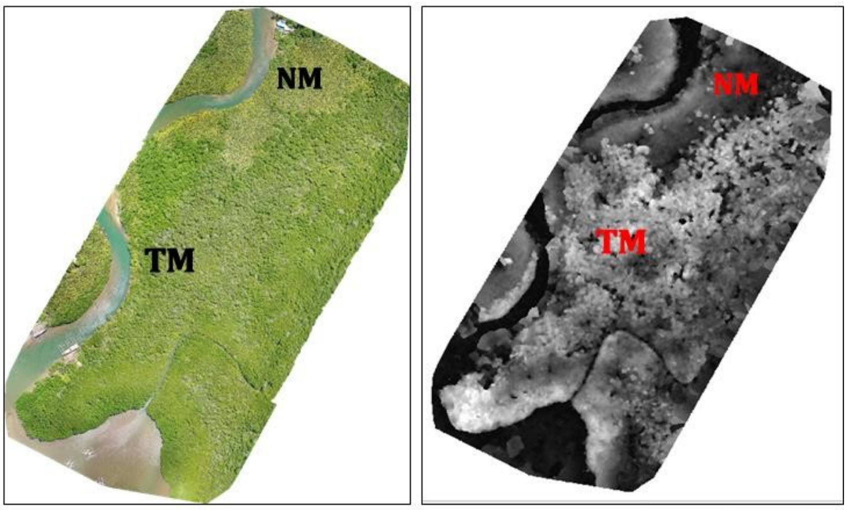


Figure 2. Mangrove zoning sketch of Nagari Mandeh

Observations using the field survey method were carried out by making observation plots from the starting point in the sea and then stopping until the boundaries of the untrue mangroves were found. Throughout the observation plot, only two types of mangrove species were found, *namely Rhizopora apiculata* and *Ceriops tagal*. From the calculations in the field, it was found that there were 279 species of R. *apiculata* with 140 individuals divided into the tree category (which had a DBH of more than 10 cm) and 139 individuals for the sapling category (which had a DBH of less than 10 cm). while for the type of C. *tagal* found as many as 101 individuals with the division of 33 individuals for the tree category and 68 individuals for the sapling category.

2. Zoning pattern with drone survey method

Based on aerial photos captured using drones, it can be seen that the mangrove forest zoning in the Nagari Mandeh area is divided into two zones. The first zone is a zone that contains true mangroves which are at the very front, directly facing the sea. This zone is dominated by Rhizophora species. While the second zone is behind the first zone consisting of mixed mangrove species dominated by Nypha species. The pattern can be seen clearly in the orthomosaic data display, and is strengthened when compared to the DSM data (*digital surface models*) which shows true mangroves with a lighter colored appearance when compared to mixed mangroves.



(a) (b)

Figure 3. Comparison of the appearance of true mangroves (TM) and non-true mangroves (NM) in (a)orthomosaic and (b) dataDSM (*digital surface models*).

V. Conclusion

Based on the results of the study, it was concluded that 1) the zoning pattern of the Nagari Mandeh mangrove forest using the field survey method can be grouped based on two zones, namely the front zone and the back zone. The division of this zone is based on observations of seawater inundation. The with zone is an area that is always flooded and the back zone is only flooded during high tides. While the zoning division using the drone method is divided based on true mangrove groups and mixed mangroves.

Acknowledgment

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