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Mangrove Forest Health Assessment on Small Island in Maluku, Indonesia

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Abstract **— The study aims to assess the health condition of mangrove forests on Ambon Island using the approach of tree damage value, forest damage and tree productivity value. The study was conducted in the Mangrove Forest area at 128014'40.680" N and 3038'6.358 S on Ambon Island. The study at the tree level consisted of 3 clusters of 4 subplots measuring 1 ha. Analysis of mangrove forest health using the forest health monitoring method in three clusters with parameters of tree health, forest health and forest productivity. The study results found the types of *Sonneratia alba*, *Rhizophora stylosa*, *Avicennia marina*, *Aegiceras corniculatum*, and *Bruguiera gymnorrhiza*. The tree damage value (CLI) ranged from 10.680 until 11.901, with the highest damage in cluster 2 being 11,901 and the lowest in cluster 1 being 10,680. The higher the tree damage value (CLI), the higher the damage or unhealthy condition. Mangrove forest damage in Passo Village is due to tree termite attacks (*Prorhinotermes flavus)*, which attack the lower tree trunks, with a high category attack intensity of 65.5%. The health condition of the mangrove forest in cluster 1 is better than other clusters, with a low damage value (CLI) of 10,680. In cluster 1, no inorganic waste was found that could cause damage to young plants. The highest LBDS value in *Sonneratia alba* is 26,689, 27,9070 individuals. The study's findings are crucial for the conservation and management of mangrove forests, engaging the audience in the importance of these efforts.**

Keywords **—Damage; forest health; mangrove; small islands.**

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I. INTRODUCTION

Mangrove forests are situated along the coastline and are profoundly impacted by the fluctuation of seawater. They serve multiple ecological purposes, such as providing feeding and spawning grounds, protecting the coastline, preventing seawater intrusion, serving as nurseries for fish, shrimp, shellfish, and other marine organisms, and serving as nesting grounds for birds and reptiles [1]. According to data from the Food and Agricultural Organization (FAO), Indonesia accounts for 22% of the world's most incredible mangrove growth area out of all mangrove areas worldwide [2]. According to the Indonesian Ministry of Maritime Affairs and Fisheries website, there are around 16,530,000 hectares of mangrove forests worldwide, of which 20%, or around 3,490,000 hectares, are in Indonesia [3]. Data from the Indonesian Forestry Ministry show that 637,624 hectares of mangrove forests are in critical status, and 2,673,548 hectares are in good status. The total area of Mangrove Forests in Maluku reaches 176,592,54 Ha, of which 55.72 ha is in Ambon City, with a very rare density of 2.35 ha [4]. Over the past ten years, there has been a significant 45.6% reduction in mangrove forest coverage on tiny islands in Maluku. This decline can be attributed to erosion, human activities, population growth, and increased demand for land. Mangrove forests on Ambon Island are a defense fortress that protects settlements and other land environments from abrasion, seawater intrusion, strong winds, and storms [5]. The National Research and Innovation Agency (BRIN) Ambon noted that the area of mangroves on Ambon Island in the last three years was 33 hectares, and in the last two decades, it has decreased to 10 hectares. The types of mangroves that dominate in Ambon Bay are *Rhisophora apiculata*, *Soneratia alba*, *Avicenia marina, Excoecaria agallocha, Nypa fruticans* and *Hibiscus tiliaceaus*, spread evenly in the coastal areas of Tawiri, Poka, Waiheru Villages (Teluk Ambon District) and Passo, Halong and Lateri Villages (Baguala District)

They also reduce tsunami waves around Ambon Island, which is surrounded by the ocean. Changes in mangrove cover will impact the health of vitality, productivity, and

biodiversity [6]. The health of mangrove forests is vital because mangroves play a huge role in the ecosystem and the biota that live in it [7]. Therefore, initial information related to the health conditions of mangrove forests needs to be known, so the study aims to diagnose the health level of mangrove forests on Ambon Island by approaching tree health values and productivity [8]. Trees are said to be healthy if they can perform physiological functions well and will be an indicator of good forest health, where forest health will produce sustainable forests [9]. To effectively monitor the health of mangrove forests, it is necessary to conduct regular and sustainable forest health monitoring using techniques specifically designed for this purpose. This monitoring aims to assess the condition of forest ecosystems, both currently and in the future, as a proactive measure to detect and evaluate the extent of damage. By identifying unhealthy trees early on, appropriate measures can be taken to minimize tree damage [10]. Healthy mangrove forests are established when the biotic and abiotic components within the forest do not impose limitations on attaining sustainable forest management goals, both currently and in the future [11]. Healthy forest conditions are defined by the presence of fertile and productive plants, the accumulation of biomass, rapid nutrient cycling, and the absence of insect damage. The study aims to assess the health conditions of mangrove forests on Ambon Island using two parameters, namely forest damage values and tree productivity values. Research in mangrove forests is essential because researchers want to know the health of the forest ecosystem from a biodiversity perspective, where mangroves are a habitat for various types of flora and fauna. Research can reveal new species, interactions between species, and the ecological role of each organism. The research aims to monitor changes in the mangrove forest environment on Ambon Island due to climate change so that Conservation Strategy Development efforts can be carried out by identifying the main threats to mangrove sustainability, such as land conversion, exploitation of natural resources, and infrastructure development.

II. Materials and Methods

A. Location

The research was conducted in the Mangrove Forest area on Ambon Island, located at 128014'40.680" N and 3038'6.358 S, covering an area of 20 hectares surrounded by the sea. The study employed a rigorous methodology, measuring the density and height of mangrove vegetation classified into the category of trees (Stem diameter at breast height > 10 cm) and seedlings (<2 cm). Observations were made using line and plot methods.

The research was only carried out at the tree level. The sampling was carried out in 3 observation clusters, on a 0.4 ha-wide area, respectively, with each cluster consisting of 4 subplots on a total observation location area of 1.2 ha. The research area is divided into three similar clusters that grow in the sea, so they like to be penetrated. The research was only carried out at tree-level mangroves and only in 3 clusters because the other clusters in the location were of the same type and were difficult to reach because the water was constantly experiencing high tides. The research was conducted in June 2023 in the Mangrove Forest area of Passo Village on Ambon Island, Maluku Province, Indonesia.

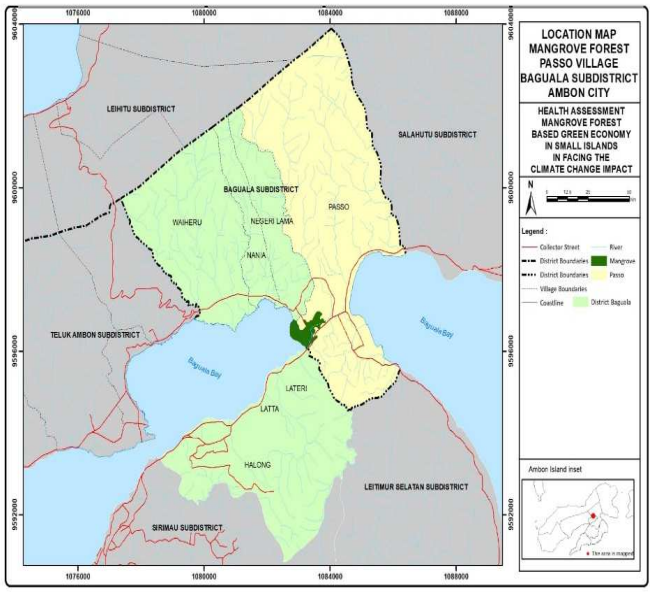

Fig. 1 Research Location Map

B. Data Analysis

Analysis of mangrove forest health using the forest health monitoring method in three clusters with tree health and productivity parameters with a cluster design, as shown in Figure 2 below.

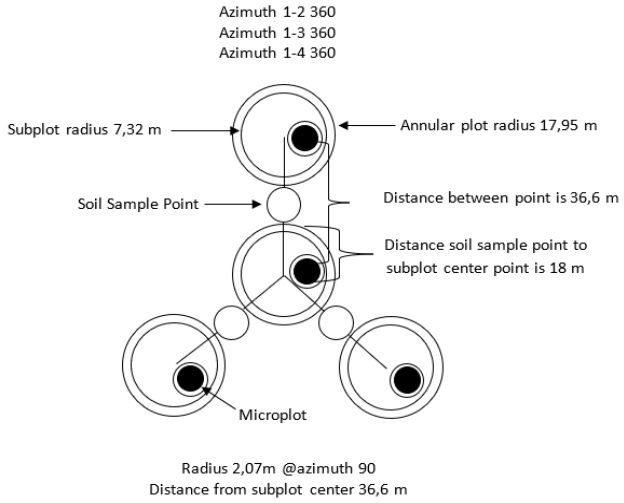

Fig. 2 Cluster Design of Mangrove Forest Health [12]

The assessment of mangrove forest health on Ambon Island was obtained from the species diversity value using the Shannon and Wiener Index, the species richness value using the Margalef index, and the final value of the mangrove forest health condition with the equation:

NKH = NT x NS (1)

Description:

NKH = Final value of forest health condition

NT = Weighted parameter value of productivity indicators

NS = Parameter score value of productivity indicators

The score value (NS) is obtained by transforming the parameter value of each plot cluster with a score range of 1-10. Tree damage conditions are calculated based on the

damage index, which is calculated at two levels, namely at the tree level (Tree et al./TLI) and the cluster level (Cluster Level Index/CLI). The final value of the health condition of the mangrove forest is calculated by multiplying each health indicator. [13]. Calculation of tree damage at the plot cluster level (Cluster Plot Index- CLI) uses the formula:

$$CLI = \sum PLI \sum Plot \quad (2)$$

C. Data Collection

Data collection of mangrove forest productivity uses tree growth parameters (LBDs) obtained by measuring the diameter at a height of 1.3 m above the ground surface, with six cluster plots based on the Minister of Forestry Regulation, which states that the criteria and standards for forest inventory use a sampling intensity of 0.056% and represent the area of mangrove forest studied [14]. Tree productivity values are obtained from field measurements of tree height, crown width, tree diameter, basal area (LBD), tree density (K), frequency (F), species dominance (D), and Important Value Index (INP) [15].

III. Results and Discussion

A. Condition of Mangrove

Tree Damage Assessment of mangrove forest health on Ambon Island using the Forest Health Monitoring (FHM) method for forest health monitoring introduced by the USDA Forest Service to monitor Nation Forest Health designed for temperate regions [16]. The results of forest health measurements will obtain the value of mangrove forest health status based on indicators of tree damage and tree productivity [17]. The study found the types of *Sonneratia alba, Rhizophora stylosa, Avicennia marina, Aegiceras corniculatum*, and *Bruguiera gymnorrhiza*. The zoning pattern in the Passo Village mangrove forest area is influenced by tidal frequency, soil type, soil salinity, drainage, and plant resistance to the environment. Tree damage is assessed visually due to anthropogenic damage, human activities, pest and disease attacks, and climate change. The results of measuring the value of tree damage and productivity in three clusters are in Table 1 below.

TABLE I
TREE DAMAGE VALUE AND PRODUCTIVITY OF MANGROVE FORESTS

Cluster	Tree Damage Value (CLI)	Forest Productivity (LBDs)
1	10.680	12.941
2	11.866	11.404
3	11.901	10.039
Average	11.480	11.462

The table above shows that the tree damage value (CLI) ranges from 10.680 – 11.901 with the highest damage in cluster 2 at 11.901 and the lowest in cluster 1 at 10,680. The higher the tree damage value (CLI), the higher the damage or unhealthy condition. The disruption of mangrove forest damage in Passo Village is generally due to attacks by tree termites (*Prorhinotermes flavus*) which attack the lower tree trunks, with a high category attack intensity of 65.5%. *Prorhinotermes flavus* is like waterlogged areas, making nests in flooded parts of the stems and roots and can rot the wood. Termites make their homes along the trunk to the branches, eating up the stem tissue to form burrow holes measuring 3 – 7 cm. *Prorhinotermes flavus* can adapt to salt water and brackish water and is found in nests along the trunk and branches, eating away at the tissue and leaving the trunk hollow. According to [18], Termites from the Rhinotermitidae family, Rhinotermitinae subfamily, and Prorhinotermes genus have habitats in coastal areas and mangrove swamps.

Fig. 3 Termite pest attack (*Prorhinotermes flavus*) on mangrove trunks

The attack of *Metopograpsus sp* crabs with an attacking intensity of 24.3% preying on mangrove stems until they break also affects the health of trees in all clusters. This species likes the sweet taste of young mangrove stems in the area. *Aphids (Prociphilus tessellatus*) were also found in the area and preyed on leaves until they were perforated with a high damage intensity of 65.2% and an attack area of 23.5%, as in the picture below.

Fig. 4 Aphid Pest Attack (*Prociphilus tessellatus*)

Aphids belonging to the family Aphididae and order Homoptera are white in color and adhere to the underside of leaves. This destroys twigs and absorbs leaf fluid, causing leaves to dry out, get holey, curl up with white patches, turn yellow, and finally fall off. Mangroves' physiological activity is disturbed by insect infestations, which also lower productivity and diminish the mangroves' ecological role. Mangrove leaves dry out, leaves break, and trees fall due to pest assault [19]. Damage to mangrove forests is also thought to be caused by increased sea traffic operating in the Ambon Bay area and mud, waste, and garbage deposits trapped in the forest area. The above factors disrupt the health of mangrove forests, resulting in a lower seedling density of around 25% compared to a sapling density of 30% and trees of 65%. Indicates that the level of mangrove regeneration in Ambon Bay is shallow due to the disruption of forest health. In the area, inorganic waste, namely cloth, plastic, glass, and paper, was also found due to human activities along the coast of Lateri Village to Passo Village, which was trapped in mangrove roots and covered the seedlings.

The findings of [20] are significant as they highlight the direct health risks that waste poses to the biota living in water and sediment. This risk, in turn, affects the respiration of mangrove roots, leading to mangrove death. The presence of waste also impacts the aesthetic value of the mangrove forest area. The results of the score value show that the higher the score value on the observed indicator, the better the indicator's value in the observed forest. Likewise, a low score on an observation indicator indicates that the indicator value is worsening [21]. The health condition of the mangrove forest in cluster 1 is better than other clusters, with a low damage value (CLI) of 10.680. In cluster 1, no inorganic waste was found that could cause damage to young plants. In cluster 1, the mangrove diversity index value (H') 1,403 is categorized as high.

The finding indicates that the stability of mangrove growth in the cluster is very high because the H' value is the diversity index value that determines the diversity of a species in an area. This shows that the mangroves in cluster 1 are productive, the ecological pressure is moderate, and the ecosystem conditions are relatively balanced. All ecosystem components are in sufficient quantity and function based on the characteristics of a good mangrove ecosystem, especially biotic and abiotic components. The diversity index is a valuable vegetation parameter in comparing communities, studying the impact of environmental or abiotic factor disturbances on communities, and understanding the state of succession and community stability. The size of the number of species determines the high or low diversity. If the number is small, the community is only dominated by one or a few species [22].

The high level of mangrove diversity indicates that the distribution and distribution of mangroves are evenly distributed in the area. The species richness value (R) in cluster 1 is 3,693, which indicates that the richness of mangrove species in this cluster is relatively high because the more species found, the greater the richness index. The Margalef richness index divides the number of species by the natural logarithmic function, which indicates that the increase in species is inversely proportional to the rise in the number of individuals. This shows that an ecosystem with many species will have a small number of individuals in each species [23].

B. Mangrove Forest Health Conditions

The results of determining the health value of mangrove trees are based on the location of damage, type of damage, and severity of the tree [24]. The results of calculating the health value of mangrove forests in Passo Village, Ambon Island, can be seen in Table 2 below.

TABLE II
HEALTH STATUS VALUE OF MANGROVE FORESTS IN PASSO

Cluster	Health Value of Mangrove Forests	Forest Health Status
Cluster 1	29.67	Good
Cluster 2	4.64	Bad
Cluster 3	26.86	Good

The table above shows that the health of mangrove forests on Ambon Island is in poor to good condition. In cluster 2, the forest health status is poor, which is thought to be due to pest attacks, diseases, and human activities in and around the mangrove area. Mud deposits, waste, and garbage trapped in the cluster also impact ecosystem health. The condition of cluster two in a bad category is caused by land conversion into settlements and sedimentation due to erosion on land, causing shallowing and burial of mangrove roots—pollution due to domestic, industrial, and agricultural waste entering the mangrove waters. Clusters one and three are healthy because they have high tree density and many mangrove trees per unit area. Biodiversity is high, mangrove tree growth is good, and there are no signs of damage. Water quality in the mangrove forest cluster is good and not polluted by waste or pollutants. The sediment is considered relatively stable in the cluster, with no excessive erosion and sedimentation. One type of biota that attacks the cluster is *Littoraria scabra*, with a very high attack intensity of 89.5% and an attack area of 76.5%, which significantly impacts the health of the mangrove ecosystem.

Fig. 5 *Littoraria scabra* attacking the bark of the stem

Damaged mangrove leaves in cluster 2 were eaten by *Littoraria scabra* at low tide and could move up to 30 cm above the highest water level. *L. scabra*was is found on the bark and leaves of *Sonneratia alba, Rhizophora stylosa* and *Avicennia marina*. *L. scabra* feeds during low tide, living on bark and following the tide, moving up during high tide and down during low tide. During low tide, some L. scabra can crawl about 30 cm from the ground surface, but 91% of the snails counted were 50-200 cm above the ground surface.

Usually, snails do not migrate far from the trees where they live. At low tide, *L. scabra* crawled into the roots and stems of mangroves about 30 cm from the ground surface and generally did not migrate far from the trees they inhabited. As a result of this pest attack, the leaves became torn. *L. scabra* causes bite wounds on mangrove leaves, which can act as an entry point for pathogens or other organisms. They fell off, reducing the number of effective leaves for photosynthesis and the process of producing energy sources for mangroves in the cluster. The presence of this attached biota can cause a decrease in root growth rates of up to 30% and a reduction of net root production of up to 52 %. [25]. This decrease will force the seedlings to use the available energy to create new roots, reducing the production rate of new shoots or leaves. Two crucial factors in photosynthesis and reproduction [26]. The healthier the mangrove plants are, the greater the number of marine biotas; conversely, if the mangrove plants are damaged, the existence of marine biota will decrease. The high level of damage in cluster 2 impacts the value of the obtained mangrove diversity index, which is only 0.203 and is classified as low. The species richness value is only 0.352 and is classified as low.

This finding indicates that the stability of mangrove growth in the cluster is low. The low level of plant species diversity is caused by the vulnerability of the area where the plants live to various disturbances.[27]. In line with the results of research from BRIN Ambon, which found that the waters of Ambon Bay are prone to tsunami disasters and anthropogenic activities that increase yearly. Healthy forest is formed if the biotic and abiotic factors in the forest are not limiting factors in achieving current or future forest management goals [28]. Healthy forest conditions are characterized by the presence of trees that grow well and productively, biomass accumulation and fast nutrient cycles, no significant damage by plant pests, and forming a unique ecosystem.

The condition of forest health is one factor that can support the principle of sustainable forest management and can be used to control forest functions [29]. The forest is healthy if it functions optimally or at least under the main functions previously determined [30]. The emergence of diseases, weeds, pest attacks, fires, weather, and animals causes forest damage and disrupts tree health in mangrove forests. Damage to a certain threshold can disrupt a forest's health [31]. Symptoms of damage that have been identified are essential information that is considered from the condition of the forest and signs that can result in deviations from the desired condition [32]. All types of tree damage that occur will impact low growth rates, lower canopy conditions, and loss of biomass, especially mortality, and can affect overall forest health. Biotic and abiotic factors can cause this. Tree damage due to biotic and abiotic factors can be seen physically—namely, tree organs are experiencing abnormalities or the presence of pests [10].

Biotic factors are caused by pathogens, namely all organisms that cause disease, including fungi, bacteria, mycoplasma, viruses, parasitic plants, nematodes, and several types of pests, insects, and mammals. Abiotic factors are caused by the physical and chemical factors of the environment around the stand. Environmental factors, human activities, pest disturbances, and disease attacks on trees caused the damage at the research location [33].

The less-than-optimal efforts to manage the mangrove ecosystem have caused the degradation of the mangrove community in Ambon Bay, even though the mangrove ecosystem in Passo Village has been designated as one of the biological resource protection areas regulated in the Ambon City Spatial Plan since 2012. Even though this status has been socialized to the community, there are still activities to build settlements, shophouses, and the Mall in Passo by utilizing mangrove land. The habitat of *Nypa fruticans*, *Avicennia sp*. and *Bruguiera sp*. Has been converted for the development of trade centres so that the area of the mangrove community is decreasing, and the mangrove forest area becomes narrower. It has affected the balance of the mangrove ecosystem, which is one of the ecosystems that play an essential role in the coastal area of Ambon Bay.

The results of a study by the Indonesian Institute of Sciences in 2015 showed that the area of the Passo mangrove ecosystem was ± 49 Ha. Until now, it has continued to experience degradation due to the use of space for development. According to [34], the area of the Passo mangrove community changed from 2010 to 2012 by 3,482 ha, or 10.76%, and from 2009 to 2014 by 5.71 ha, or 19.65%. The decrease in area due to the degradation (drought) of mangrove vegetation is suspected to have occurred due to an oil spill through a leaking oil pipe. The rate of sediment runoff entering the Passo mangrove ecosystem during the three months of the rainy season was 205,207.5 kg.

The process of soil erosion in the upper land during the rainy season will bring soil particles into the seawater. Large particles will settle and get trapped in the mangrove roots and change the primary substrate type of the mangrove community. The continued impact of the reduction in mangrove area and sedimentation, one of which is changes in species composition, zoning and mangrove density. [35]. This is because each species has specific habitat preferences. Thus, if there is a change in the character of the natural habitat, it will affect the presence and growth of mangrove species on Ambon Island.

C. Tree Productivity Value

The level of mangrove tree productivity is known by measuring tree growth.[30]. Tree growth is calculated as the basal area (LBDs). [36]. *Tree productivity value* is a broad term encompassing various aspects of a tree's contribution to an ecosystem or economic system.[8]. Tree species, different species with varying growth rates, wood quality, and ecological roles influence it. It depends on environmental conditions such as climate, soil, and topography, which significantly impact tree growth. Some critical aspects of tree productivity value in small islands are biomass production, Carbon sequestration, nutrient cycling, and habitat provision.[35]. LBDs are known from the tree diameter value because tree diameter growth is easy to measure with a high level of consistency. The results of calculating the area's productivity value of mangrove forests are shown in the table below.

TABLE III
MANGROVE FOREST PRODUCTIVITY VALUE

No	Types of Mangrove	Basic Surface Area (BSD)	Species Density	Species Frequency (F)
1	*Rhizophora stylosa*	2.754	1450	27.907
2	*Avicennia marina*	0.831	250	18.604
3	*Aegiceras corniculatum*	0.007	10	2.325
4	*Bruguiera gymnorrhiza*	3.480	1570	18.6047
5	*Rhyzophora apiculata*	0.024	10	2.3256
6	*Bruguiera parviflora*	0.601	160	2.3256
7	*Sonneratia alba*	26.689	4290	27.9070
Total		**34.386**	**7740**	**100**

Table 3 shows *Aegiceras corniculatum* has low density of the Corniculatum species in mangrove forests in Ambon could be attributed to several factors. Habitat Preferences are high salinity levels typically characterize salinity mangrove forests. While some *Aegiceras corniculatum* may tolerate saline conditions, others may have specific salinity preferences not met in mangrove environments. Mangrove forests often experience waterlogging, which can limit the availability of oxygen for plant roots. *Aegiceras corniculatum* species may require better aerated conditions for optimal growth.

Mangrove forests can have a dense canopy, limiting sunlight penetration to the forest floor. *Aegiceras corniculatum* may need more sunlight for photosynthesis and growth. Nutrients where mangrove soils can be nutrient-poor, especially in the understory. *Aegiceras corniculatum* may have specific nutrient requirements that must be more readily met in mangrove environments. The highest productivity value marked by the LBDS value found in the *Sonneratia alba* species. Found as many as 27,9070 individuals from seedling to tree level, growing scattered, with a height of 6 - 15 m. The bark is dark white to brown, with fine longitudinal cracks. The roots are in the form of cables underground and appear on the surface as conical, blunt, and 25 cm high respiratory roots. The leaves are leathery and have glands that do not develop at the base of the leaf stalk. The leaf stalk is 6-15 mm long. The shape of the leaves is inverted oval with rounded tips measuring 5 -12.5 x 3 - 9 cm.

The productivity of mangrove forests increases along with the tree's age. The older the tree, the higher its growth will be. The magnitude of the growth rate will correlate with the health of the teak community forest. [37]. The difference in LBD values between types in the area is due to the tree's growth rate; namely, the height and diameter of the tree are higher. The value of the health status of the mangrove forest, combined with the calculation of the final value of the forest health condition, is the result of scoring against the LBDs value obtained. [35]. The value is obtained by subtracting the maximum value from the minimum value and dividing it by three categories. Then, the health condition of the mangrove forest on Ambon Island will be known. The degree to which each variety of tree can adapt to changes in the environment, seed dispersal, and seedling growth all impact the productive value of the mangrove forest.

An ecosystem's presence of a particular type of vegetation suggests that the type is naturally thought to be appropriate for the local vegetation environment. Water quality criteria also influence mangrove density. Salinity, pH, and water temperature are three limited water quality criteria. The magnitude of the micro temperature value in the area of 30^0C also supports the productivity of the mangrove forest. Environmental ecology, such as temperature, is essential for the survival of trees and marine biota. [25]. The salinity of the water in the area also supports mangrove productivity; the recorded water salinity value in the area is 15.5%. The salinity value of mangrove forests in the location still supports the growth of mangrove plants.

Mangrove plants thrive with a salinity of 10% -30%, even some species grow in high salinity conditions and can affect the growth of mangroves, namely salinity conditions. According to [38] salinity is the salt content of water expressed in per mil (%) or salt per thousand water. Mangroves generally live in salty or brackish areas ranging from 11-25%. Salinity is an essential factor in mangrove species' growth, endurance and zones. The results of measuring the pH value in the area range from 7.07 - 7.20; this condition is still within the range of seawater quality standards for biota and tourism activities. The oceanographic and geomorphological characteristics of the area greatly influence the pH value. Open waters tend to have higher pH values than closed waters, small islands have alkaline pH values, and large islands with many rivers tend to lower the pH value to acidic. Mangroves will grow and develop well in the pH range of 6.2 - 8.0.

pH variations can have an impact on physiological processes, particularly those connected to plant respiration, which in turn affect mangrove productivity in the area, the acidity of the waters is also a crucial component for organisms. The examination of the three plot clusters led to the conclusion that clusters that don't fit into the right category require comprehensive treatment. This includes measures like rehabilitation, pest and disease management, and preventing community activities in and around the region.

IV. CONCLUSION

The results of the assessment of mangrove forest health on Ambon Island using the forest health monitoring method in three clusters show that the tree damage value (CLI) ranges from 10,680 - 11,901, where the higher the tree damage value (CLI), the greater the damage or unhealthy condition. Health disorders that occur on Ambon Island due to attacks by tree termites (*Prorhinotermes flavus*), *Metopograpsus sp*, *Littoraria scabra* and Aphids (*Prociphilus tessellatus*), human presence, mud deposits, waste and garbage trapped in the cluster. The disturbances that occur impact forest health and overall mangrove forest productivity.

Preserving the health of mangrove forests in Ambon is crucial for maintaining coastal ecosystems and the livelihoods of local communities. Here are some practical solutions: implement strict regulations to limit development in mangrove areas, especially for aquaculture, tourism, and industrial development. Encourage sustainable farming and fishing practices that minimize pollution and habitat destruction. Establish protected areas and nature reserves to safeguard critical mangrove ecosystems. Enhance wastewater treatment facilities to reduce pollution from domestic and industrial sources. Implement sustainable agricultural practices to minimize nutrients and pesticide runoff into mangrove ecosystems.

Conduct mangrove reforestation programs to restore degraded areas. For this reason, intensive action is taken against clusters with a poor category through rehabilitation measures, pest and disease control, and prohibition of community activities in the mangrove forest area. *Tree productivity value* is a broad term encompassing various aspects of a tree's contribution to an ecosystem or economic system. It has been influenced by factors such as tree species, different species with varying growth rates, wood quality, and ecological roles. It depends on environmental conditions such as climate, soil, and topography, which significantly impact tree growth. Some critical aspects of tree productivity value in small islands are biomass production, Carbon sequestration, nutrient cycling, and habitat provision.

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