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Identification of Damage to the Sirimau Protected Forest on Ambon Island

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ABSTRACT

The research was conducted in the Sirimau Protected Forest area of Ambon Island from June to October 2024. Several forms of damage in the protected forest are Konk, Cancer, Damage to leaf shoots or shoots, Broken or dead branches, Open Wounds, Termite Attacks, Liana, Brum, Moss, Broken Rod, and Leaves Discoloration. The damage to the Sirimau Protected Forest has caused serious ecological impacts, particularly the decline in the forest's ability to serve as a primary water catchment and absorption area for Ambon City. This has implications for increasing the risk of hydrometeorological disasters, such as flash floods and landslides in downstream areas, and threatens the sustainability of clean water supplies for residents.

INTRODUCTION

The condition of Protected Forests on small islands in Maluku in the last ten years has experienced a worrying condition, where Landsat-6 image data shows that there has been a change in protected forest cover in Maluku covering an area of 34,776 ha/year due to forest fires, pest and disease attacks, clearing of forest areas, livestock grazing, illegal logging, low monitoring and evaluation measures, and forest utilization based on individual interests. This condition results in disturbances to biodiversity and the health of protected forests, as a result of which protected forests are unable to function as a life support system to regulate water systems, prevent floods, control erosion, prevent seawater intrusion, maintain soil fertility, and fail to prevent global warming on small islands in Maluku. This condition contrasts with the role of

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protected forests, whose existence must be protected because they serve as guardians of the ecosystem, as determined by Law Number 41 of 1999 concerning Forestry. Therefore, it is considered necessary and very important to know the level of vegetation biodiversity and the health status of protected forests from an early stage (*Early warning*) as a preventive measure for regional protection in the face of the impact of climate change and the provision of food sources from forest areas on small islands. Healthy Protected Forests are formed when biotic and abiotic factors in the forest are not limiting factors in achieving the functions and benefits of forests in this and future periods. Healthy forest conditions are characterized by stable vegetation biodiversity, biomass accumulation, rapid nutrient cycles, and no damage from pest organisms. Biodiversity is one of the key measurement indices in forest health assessments, which can also impact carbon storage in a forest community. Biodiversity is used as one of the indicators of forest health assessment because nearly 99.9% of biodiversity and productivity in protected forests have a significant influence on ecosystem stability and regional health. *Forest Health Monitoring Field Methods Guide. It is known that assessments based on biodiversity parameters are influenced by the health of the constituent trees, which in turn is affected by damage to trees in the forest resulting from the attack of pathogens, pests,* and human activities. Healthy Protected Forests must be able to carry out physiological functions with ecological resilience in the face of various disturbances. Over the last decade, the level of biodiversity and the health of protected forest ecosystems have become the primary focus in the management of the area on the Small Island. This is due to the increasing cases related to Protected Forests in Maluku, where there is a decrease in protected forest cover by 30-35%/year which is characterized by the loss of vegetation biodiversity and other ecosystem disturbances. Starting from the above background, the formulation of the problem presented is how to measure the level of protected forest biodiversity and the assessment of the health of protected forest ecosystems on small islands in Maluku in facing the impact of climate change so that forest health status information can be used as a basis for decision-making and policies in managing Protected Forests for the realization of the concept *green economy,* Where protected forests must be maintained so that people living around protected forests do not experience the impact of damage that can affect the welfare of the community through community economic activities by restricting the use of natural resources in protected forests.

The existence of protected forests on small islands in Maluku has experienced crown damage, biodiversity disturbances, productivity disturbances, decreased site quality, and the emergence of damage as a result of the deterioration of the health of protected forests, which are not functioning optimally. This condition requires serious attention because if the health of the protected forest is disturbed, it will have a significant impact on water systems, leading to flooding and erosion, seawater intrusion, decreased soil fertility, and hydrometric disasters on small islands. Information on the health status of protected forests in Maluku has never been known definitively and comprehensively, so through this study accurate information will be obtained about the health status of protected forests that will be used to maintain the health quality of protected forests in a parmanent manner so that protected forest conservation efforts can be carried out from an early age within the framework of *the green economy* concept especially in efforts to restrict public access to protected forests Information on the health status of protected forests in Maluku has never been known definitively and comprehensively, so that through this research accurate information will be obtained about the health status of protected forests that will be used to maintain the health quality of protected forests in a parmanent manner so that protected forest conservation efforts can be carried out from an early age within the framework of *the green economy* concept especially in an effort to restrict community access to protected forests so that protected forests are maintained and controlled to be used appropriately for the welfare of the community around the area. The approach to solving the research problem is with a *Forest Health Monitoring Field* system using the parameters of crown health, biodiversity level, site quality, damage rate, and productivity assessment, which will determine the level of health of the protected forest ecosystem on small islands in Maluku, so that the existence of protected forests is maintained. The problem identified in protected forest areas on small islands in Maluku over the past decade is the decline in the function and potential of these forests, resulting from flooding, erosion, seawater intrusion, decreased soil fertility, and hydrometric disasters caused by climate change on small islands. Therefore, substantial efforts are needed to ensure the preservation of protected forest ecosystems, thereby maintaining their functions and benefits. One of the criteria for achieving sustainable forests is the value of biodiversity and the health of its forest ecosystems. Therefore, this research is novel, particularly for the protected forest ecosystem in Maluku, and is expected to serve as a policy basis for the conservation movement within the framework of the green economy, addressing the impact of climate change on small islands in Maluku. The protection and health aspects of forests, as integral to a chain of forest maintenance or development, must be an essential part of a forest management unit to protect forests and their components from various factors that cause damage. In the past decade, research assessing the health of protected forest ecosystems has been limited in Maluku. Even in other areas, it has been very limited, primarily focusing on monoculture forest areas, such as Teak Forest and Meranti Forest. This research will be different from previous research based on the parameters used, namely the health of the crown, the level of biodiversity, the quality of the site, the level of damage, and the assessment of productivity in protected forests that are different ecologically and geophysically with varied habitat conditions, as well as the concept of *green economy* Limiting the exploitation of protected forests is also used in this study by looking at community activities around the forest with the final result will produce a healthy protected forest model and will be the basis for the implementation of the sustainable protected forest protection and conservation movement in the face of the impact of climate change on small islands. The purpose of this research is to identify the form of damage in the Sirimau protected forest area, specifically in relation to the impact of climate change on small islands in Maluku.

RESEARCH METHODS

The research was conducted in the Sirimau Protected Forest area of Ambon Island, with plot points located in the forest area of Rutong Country, from June to October 2024, as shown in the map (Figure 1).

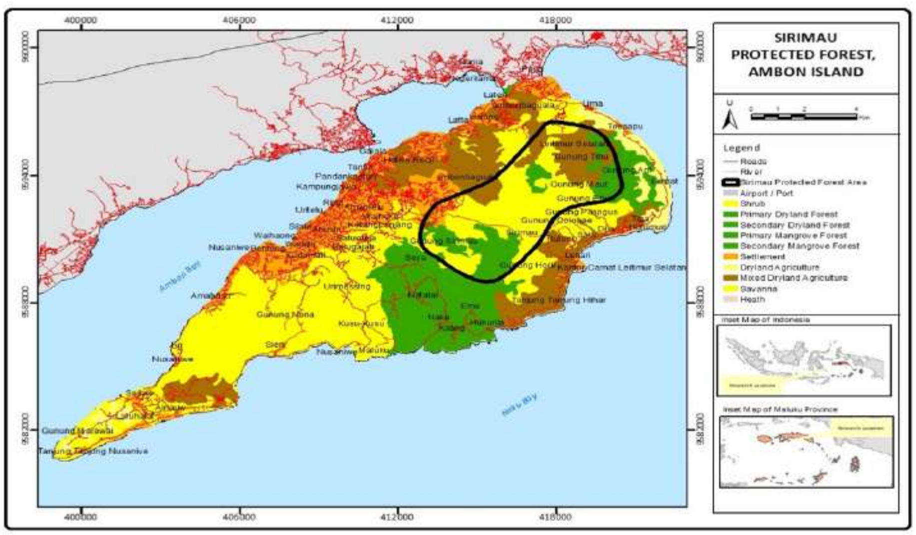


Figure 1. Map of Sirimau Ambon protected forest

The research was conducted in the Sirimau Protected Forest area of Ambon Island, with plot points located in the forest area of Rutong Land, and on Haruku Island, with plot points situated in Haruku Land.

RESULTS AND DISCUSSION

Forms of Damage to the Sirimau Protected Forest Area

The results of the damage analysis in the Sirimau protected forest area are presented in Table 1.

Table 1. Forms of damage in the Sirimau protected forest area

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
I	1	Moss	31	76	Roots and lower stems	=  Location of moss on the roots and stems of the lower algae	1 tree 5 forms of damage
		Broken Rod	5	28	Upper trunk	 Broken Rod	

Forms of Tree Damage							
Claster	Plot	Damage Type	Damage Code	Number of Trees	Damage Location	Damage Pictures	Information
		Liana	20	31	Trunk	 Liana	
		Conk, fruit body and other indicators	2	1	Top of the stem	 Conk damage to the top of the stem	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Brum on the roots or stems	12	1	Roots and lower stems	 Brum on the roots and lower trunk	
	2	Moss	31	40	Roots and lower stems	 Moss on the roots and lower stems	1 tree 5 forms of damage

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Brum on the roots or stems	12	2	Lower trunk and upper trunk	 Brum on the rootstock and upper trunk	
		Termite	6	2	Roots and lower stems	 Termites on the roots and lower trunks	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken/dead branches	22	4	Branch	 Broken/dead branches	
		Broken Rod	5	31	Top of the stem	 Broken stem top of the stem	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
	3	Broken Rod	5	43	Top of the stem	 Broken stem at the top of the stem	1 tree 7 forms of damage
		Moss	31	62	Bottom of the stem	 Moss on the trunk of the trunk	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Moss	20	23		 Liana on the upper stem	
		Termite	6	13	Roots and lower stems	 Termites on the roots and lower trunks	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Wounds	3	4	Bottom of the stem	 Open wound on the bottom of the trunk	
		Broken branches	22	5	Branches	 Broken Branches on the branch section	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Brum on the roots or stems	12	2	Bottom of the stem	 Brum on the bottom of the stem	
	4	Moss	31	45	Bottom of the stem	 Moss on the bottom of the stem	1 tree 4 forms of damage

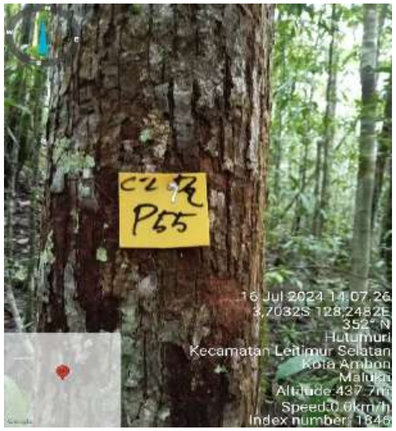
Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Termite	6	4	Roots and lower stems	 Termites on the roots and lower trunks	
		Liana	20	21	Top stem	 Liana on the upper stem	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken/dead branches	22	1	Branch	 Broken/dead branches	
II	**1**	Moss	31	38	Bottom of the stem	 Moss on the bottom of the stem	1 tree 5 forms of damage

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken Rod	5	18	Top of the stem	 Broken stem at the top of the stem	
		Liana	**20**	**13**	**Top of the stem**	 **Liana on the top of the stem**	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Open wounds	3	1	Bottom of the stem	 Open wounds on the bottom of the trunk	
		Brum on the roots or stems	12	4	Bottom of the stem	 Brum on the lower trunk	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
	2	Termite	6	5	Root and lower stem	 Termites on the trunk and lower roots	1 tree 4 forms of poverty
		Liana	20	24	Top of the stem	 Liana on the top of the stem	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken Rod	5	11	Top of the stem	 Broken stem at the top of the stem	
		Cancer	1	2	the top of the stem	 Cancer of the upper part of the trunk	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
	3	Moss	6	14	Lower trunk	 Moss on the lower trunk	1 tree 4 forms of poverty
		Termite	6	11	Roots and lower stems	 Termites on the roots and lower trunks	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken Rod	5	8	Top of the stem	 Broken rod at the top of the rod	
		Liana	20	15	Top of the stem	 Liana on the top of the stem	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
	4	Moss	31	25	Bottom of the stem	 Moss on the bottom of the stem	1 tree 5 forms of keruasakan
		Konk, fruit body and other indicators	2	3	crown	 Kong on the title bar	

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Liana	20	7	Top of the stem	 Liana on the top of the stem	
		Termite	6	13	Root and lower stem		

Forms of Tree Damage							
Claster	**Plot**	**Damage Type**	**Damage Code**	**Number of Trees**	**Damage Location**	**Damage Pictures**	**Information**
		Broken Rod	5	20	Top of the stem	 Broken stem at the top of the stem	

Source: Primary data, 2024

The results of the recapitulation of damage forms in the Sirimau protected forest area are presented in Table 2.

Table 2. Recapitulation of the form of damage in the Sirimau protected forest area

Number	Damage Type	Damage Code	Sum	Location
1	Broken Rod	5	102	Cluster I
2	Moss	31	216	
3	Liana	20	75	
4	Termite	6	19	
5	Mist	12	5	
6	Broken/dead branches	22	10	
7	Konk, fruit body and other indicators	2	1	
8	Open wounds	3	4	
9	Damaged leaves, shoots or shoots	24	73	
10	Leaves change color	25	60	
1	Broken Rod	5	57	Cluster II
2	Moss	31	77	
3	Liana	20	59	
4	Termite	6	29	
5	Mist	12	4	
6	Cancer	1	2	
7	Konk, fruit body and other indicators	2	3	
8	Open wounds	3	1	
9	Damaged leaves, shoots or shoots	24	89	
10	Leaves change color	25	73	
1	Broken Rod	5	15	Cluster III
2	Moss	31	212	
3	Liana	20	175	
4	Termite	6	8	
5	Mist	12	2	
6	Broken/dead branches	22	2	
7	Konk, fruit body and other indicators	2	12	
8	Open wounds	3	1	
9	Damaged leaves, shoots or shoots	24	86	
10	Leaves change color	22	131	

Source: Primary data, 2024

The forms of damage found in forest areas can be explained as follows:

Konk is characterized by the presence of decay in the infected part of the wood, which can lead to weakening of the plant structure and even death. The characteristics of konk include:

- Discoloration of wood: The part affected by the konk will usually change color to darker or even blacker.
- Soft wood texture: Wood rotten from konk will feel softer when compared to healthy wood.

- The presence of fungal mycelium: Often, we can see fungal mycelium (fine threads) growing in or on rotten wood surfaces.
- Unpleasant odor: Wood that rots due to konk usually emits a characteristic odor, such as a musty or foul odor.

The main cause of the occurrence of konk is fungal infestation. The fungus that causes konk usually gets into plant tissues through wounds on the skin or branches, or through injured roots. Factors that can accelerate the development of konk include:

- High humidity: Humid environmental conditions strongly favor the growth of conk-causing fungi.
- Warm temperatures**:** Warm temperatures are also ideal conditions for fungal growth.
- Plant age: Plants that are old or under stress are more susceptible to conk-causing fungal attacks.

Konk is caused by the infestation of fungi and pests that attack the bark. *Phytophtora palmivora* fungus is a type of fungus that often damages trees. Pest attacks can also cause damage to the bottom of the tree trunk (Arwanda *et al*., 2021; Siregar *et al*., 2023). Symptoms of konk are usually seen as open boils or bark damage. In the early stages, the damage to the snail manifests as small spots on the bark, which then develop into larger wounds. Untreated damage to the snail can lead to the death of the tree (Arwanda *et al*., 2021; Siregar *et al*., 2023). The impact of konk on plants varies greatly, depending on the severity of the damage. Some of the possible impacts. Damage to konk of trees can affect tree health, inhibit growth, and reduce biomass. Other impacts include the loss of the canopy, tree mortality, and changes in the forest's structure. This has a significant impact on the overall destruction of the forest (Arwanda *et al*., 2021; Siregar *et al*., 2023). Pertiwi *et al*. (2019) explained that the type of damage to the konk (fruit body) is characterized by the presence of mushroom/fungal fruit bodies, which are a sign of further weathering on the tree trunk.

1. Cancer. Cancer in plants is one of the most serious diseases, causing significant losses in agriculture. Although the name is the same as cancer in humans, the mechanism and causes are different. In plants, cancer is typically caused by pathogenic infections, such as those from fungi, bacteria, or viruses (Surachman, 2023).
2. Damage to leaf shoots or shoots. Damage to leaf shoots is characterized by a change in the color of the leaves, with yellow spots appearing on the leaves, which is caused by the disease of chlorosis in plants attacked by chlorosis. Symptoms and signs observed include yellowing leaves with mosaic patterns, spots, rings, or harlequin patterns. The density of the soil is also a factor that affects root development, which can lead to a lack of nutrient supply, and this in

turn has an impact on leaf yellowing. Damage due to chlorosis shows that mangroves are deficient in nutrients (Sodikin, 2019).

3. Broken or dead branches. The breakage of the branches is caused by strong winds and continuous rain, which weakens the branches and makes them prone to breaking. Broken/dead branches occur due to weak branching conditions or the presence of seasonal/weathered branches (Haikal *et al.,* 2020).
4. Open Wounds. Open wounds are a type of damage that occurs due to biotic or abiotic factors. Open wounds are the main factor in the occurrence of weathering in wood. The weathering of the wood can increase the potential for tree fall or collapse. Wounds on the tree provide access to destructive organisms, including bacteria, viruses, pests, and other pathogens. Wood-destroying fungi found in trees will develop through wounds in trees (Rikto, 2010).
5. Termite Attacks. Termite attacks are characterized by the presence of soil crusts on the trunk that threaten the survival of the tree. The affected parts of the tree are found at the base and trunk of mangrove trees because the base and trunk contain a lot of cellulose substances that are preferred by termites. Termites spread through branches, stems, twigs, or through liana plants found in mangroves (Pertiwi *et al.,* 2019). Termites feed on cellulose in the wood, causing a severe infestation that leaves cavities or holes in the tree trunk, making the tree porous and fragile. This can cause the tree to break easily, especially during strong winds. Wood powder (termite droppings) is found around the base of the tree at the roots, especially the respiratory roots (pneumatophore), where termite attacks can cause structural damage that weakens the tree's ability to breathe and absorb nutrients.
6. Moss. Moss or a climbing plant is a type of plant characteristic of the tropical rainforest ecosystem, and its presence contributes to the diversity of plant types within the forest ecosystem. The most obvious sign of liana infestation is the trunk and branches of mangrove trees entangled by liana tendrils, where these twists can be very strong and pressing, potentially injuring the bark of the tree trunk and disrupting the flow of nutrients. Liana is a formidable competitor; although it does not obtain food from the host tree (as it is not parasitic), it competes fiercely for water and nutrients in the soil, which can be detrimental to the growth of mangrove trees. As the moss grows and wraps, it can cover the tree's crown (canopy), blocking the sunlight that the tree needs to photosynthesize. This can significantly inhibit tree growth. In the case of severe liana infestation, the coiled weight of the liana can add to the heavy load on the mangrove tree, especially when wet. Tight windings can also stifle stem growth, causing the tree to become weak, porous, and eventually die and fall. The presence of the dominant liana can change the composition of mangrove forest vegetation. Fast-

growing lianas can reduce the biomass and carbon sequestration of the forest as a whole, disrupting the ecosystem's balance. To control these attacks, regular cleaning of lianas is highly recommended (Apriani *et al*., 2022).

7. Brum. Brum is the growth of new shoots that occur on roots, stems, or branches. The growth of these shoots is an abnormal event due to excessive shoot growth.   reveals that abnormal growth in plants, such as excessive stem growth based on experience, is caused by genetic abnormalities inherited by the parent and also due to environmental factors in the location where the tree grows, where this growth has a great effect on the reproduction of a tree, because the growth of these shoots causes a lack of optimal distribution of the results of the tree's metabolism (Rikto, 2010).
8. Moss. Moss is a type of plant that often goes unnoticed and can contribute to a dirty environment. Damage caused by moss growth can disrupt metabolic processes in trees. Moss that accumulates on the trunk can also clog air circulation, thereby interfering with the processes of photosynthesis and plant respiration, which can worsen the tree's health condition. According to Sri Winarsih (2008), crustal mosses are formed through a symbiosis of mutualism between fungi and algae that live epiphytically on various substrates (Abimanyu *et al*., 2018).
9. Broken Rod. Damage to broken trunks is one type of rust observed in mangrove trees, which is characterized by the breaking of the trunk to the inside of the wood that is visible through the gaps between the broken mangrove trunks. This type of damage is caused by various factors, including attacks by pests that destroy plants, resulting in holes forming on the plant (Pertiwi *et al*., 2019).
10. Leaves Discoloration. Leaves experience discoloration due to chlorosis, which is characterized by yellowing leaves with mosaic patterns, spots, rings, or haris patterns. The density of the soil also affects the development of mangrove roots, leading to a lack of nutrient supply and resulting in the yellowing of the leaves. Chlorosis indicates that trees lack essential nutrients, which are crucial for the growth and development of mangroves. A lack of nutrients can cause various disorders and symptoms, ultimately leading to death.

CONCLUSION

Based on the analysis and discussion of the damage identified in the Sirimau Protected Forest on Ambon Island, the following conclusions can be drawn. Significant damage has occurred in the Sirimau Protected Forest area, characterized by changes in land cover, primarily due to the impact of pests, diseases, weeds, and lianas. This is compounded by socio-economic pressures on communities living near the forest, coupled with weak monitoring and law enforcement systems. The community's dependence on forest resources for their livelihoods has encouraged encroachment, which has not been accompanied by effective prevention and enforcement efforts. The destruction of the Sirimau Protected Forest has had serious ecological impacts, particularly the reduction in the forest's capacity as a primary water catchment area for Ambon City. This has led to an increased risk of hydrometeorological disasters, such as flash floods and landslides in downstream areas, and threatens the sustainability of clean water supplies for residents.

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REFERENCES

Abimanyu, B., Safe'i, R., & Hidayat, W. (2018). Analysis of tree damage in the urban forest of the Metro City Stadium, Lampung Province.

Apriani, H., Kiswanto, & Marjenah. (2022). Identification of *S. leprosula* Miq tree damage with the forest health monitoring method in KHDTK Sebulu, East Kalimantan. *Journal of Dipterocarp Ecosystem Research*, 8(1), 35–42.

Arwanda, E. R., Safe'i, R., Kaskoyo, H., & Herwanti, S. (2021). Identification of tree damage in Pil people's plantation forest, Bangka Regency, Bangka Belitung Islands Province, Indonesia. *Agro Bali: Agricultural Journal*, 4(3), 351–361.

Erly, H., Wulandari, C., Safe'i, R., Kaskoyo, H., & Winarno, G. D. (2019). Diversity of tree types and carbon stores at Pemiran Resort, Bukit Barisan Selatan National Park. *Jurnal Sylva Lestari*, 7(2), 139–147.

Faizin, R., Ichsan, A. C., & Valentino, N. (2023). Identification of tree damage on the green line of the Mataram City. *Jurnal Biologi Tropis*.

Feriansyah, A., Safe'i, R., Darmawan, A., & Kaskoyo, H. (2022). Comparison of crown health assessment using forest health monitoring and remote sensing techniques (Case study: KTH Lestari Jaya 8, KPHL Kota Agung Utara, Lampung). *IOP Conference Series: Earth and Environmental Science*, 1115.

Fikri, K., Latifah, S., & Aji, I. M. (2023). Identify the type of tree damage in the RTH of the University of Mataram campus. *Journal of Forest Science Avicennia*.

Haris, R., Clark, J., & Matheny, N. (2004). *Arboriculture: Integrated management of landscape trees, shrubs, and vines*. New Jersey: Prentice Hall.

Hartman Jr., & Pirone, T. P. (2000). *Pirone's tree maintenance* (7th ed.). New York: Oxford University Press.

Indriani, Y., Safe'i, R., Kaskoyo, H., & Darmawan, A. (2020). Vitality as one of the indicators of conservation forest health. *Perennial*, 16(2), 40–46.

Indriyanto. (2008). *Forest ecology*. Jakarta: The Earth of Scripts.

Indriyanto, Asmarahman, C., & Tsani, M. K. (2019). Identification of forest stand damage in the cultivated area of KPPH Kuyung Bawah farmers in the Tahura Wan Abdul Rachman area. Faculty of Agriculture, University of Lampung.

Iskandar, T. (2018). Health assessment for seedling seed orchard of *Pinus merkusii* using FHM (Forest Health Monitoring) method in KPH Sumedang. *Jurnal Perennial*, 9(2), 99–108.

Karyaningsih, I., & Widiastuti, W. (2019). Identify the types of plant damage in the campus environment I of Kuningan University in an effort to improve campus comfort. Faculty of Forestry, University of Kuningan.

Latifah, S., Mudhofir, M. R. T., Setiawan, B., Lestari, A. T., Idris, M. H., Valentino, N., Hidayati, E., Nuraeni, & Putra, T. Z. (2020). Evaluation of tree risk in RTH Udayana, Mataram City with tree risk assessment. *Journal of Paleocardial Research*, 4(2), 141–160.

Mangold, R. (1997). *Forest health monitoring: Field methods guide*. USDA Forest Service General Technical Report.

Ngatiman. (2014). Termite attack *Coptotermes* sp on red meranti plant (*Shorea leprosula* Miq.) in several planting locations in East Kalimantan. *Journal of Dipterocarp Research*, 8(1), 59–64.

Nuraeni, Y., Latumahina, F. S., Cahyono, T. D., & Nuroniah, H. S. (2020). Caterpillar bag as pests at sengon (*Falcataria moluccana* (Miq.) Barneby and J. W. Grimes) at forest area with special purpose (KHDTK). *Jurnal Perennial*, 9(2), 3884–3887.

Pertiwi, D., Safe'i, R., Kaskoyo, H., & Indriyanto. (2019). Identification of tree damage conditions using the forest health monitoring method in Tahura War, Lampung Province. *Perennial Journal*, 15(1), 1–7.

Prana, N. P. D., Safe'i, R., & Tsani, M. K. (2024). Analysis of the rate of tree damage in green open space, Faculty of Agriculture, University of Lampung. *Journal of Sylva Scienteae*, 7(1).

Pratiwi, L., & Safe'i, R. (2018). Assessment of the vitality of teak trees with forest health monitoring at KPH Balapulang. *Ecogreen*, 4(1), 9–15.

Rikto. (2010). Type of damage to urban forest trees (Case study: Urban forest forming a green path, Bogor City - West Java) [Thesis]. Department of Forest Resources Conservation and Ecotourism, Bogor Agricultural University.

Safe'i, R., & Tsani, M. K. (2016). *Forest health: Forest health assessment using forest health monitoring techniques*. Yogyakarta: Plantaxia.

Siregar, A. F., Arlita, T., & Harnelly, E. (2023). Assessment of tree health by forest health monitoring method in coffee agroforestry protected area of Kekuyang Village, Ketol District, Central Aceh Regency. *Scientific Journal of Agricultural Students*, 8(2).

Surachman, N. A. (2023). Identification of the type and extent of tree damage, as well as the causative factors in the stand in the area cultivated by the Karya Makmur III Forest Farmers Group in Tahura Wan Abdul Rachman. Faculty of Agriculture, University of Lampung.

Stalin, M., Diba, F., & Husni, H. (2013). Analysis of tree damage on Jalan Ahmad Yani, Pontianak City. *Journal of Sustainable Forests*, 1(2), 100–107.

Sodikin, D. (2014). Green line health assessment in Bogor City. Department of Silviculture, Faculty of Forestry, Bogor Agricultural University.

Tsani, M. K., & Safe'i, R. (2017). Identify the level of damage to the stand in the area of the Way Kambas National Park Elephant Training Center. *Journal of Tropical Forests*, 5(3).