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Xylocarpus moluccensis in North Moluccas, Indonesia, is Going to Extinct: Role of the Local People

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The purpose of the study is to uncover people's role in the extinction threat of mangrove species especially X. moluccensis. The data of this study are the pattern of the mangrove wood usage by the local people and the wood damage of each species treated. Data of the mangrove wood usage had been collected by interview and had been analyzed descriptively. Data of the wood durability had been collected by experimental research, and had been analyzed qualitatively and quantitatively. The results of the study showed that the woods of X. moluccensis were used to construct various parts of boats. Based on the experimental study, related to the water absorption rate through the wood, X. moluccensis was the most damaged one, compared to R. apiculata, B. gymnorrhiza and O. octodonta. Due to the fragility of X. moluccensis, people tend to cut down more wood. Thus, the role of people on the extinction threat of X. moluccensis are the main agent, beside the great damage of X. moluccensis caused by the marine borer enforcing the people to cut down more X. moluccensis.

Keywords: Mangrove, *X. moluccensis*, North Moluccas, Teredo, Pholad.

INTRODUCTION

Mangrove is a vegetation community of the tropical coastal area dominated by some selected species living and proliferating in high and low tide of muddy coast (Bengen, 2001). Mangrove trees, according to Macnae (cited by Supriharyono, 2000), is a community of vegetation which can endure to live in high salinity habitat. The mangrove forest composition consists of various plantation, such as trees, *epifits and lianas*, having similar physiological adaptation, related to structure, and salinity endurance.

The mangrove forest is the main ecosystem supporting the lives in the coastal area and in the sea. The ecological function of mangrove forest is to provide the nutrient for the aquatic biota, to be the spawning and rearing habitat of various marine biota, to protect against abrasion, to protect the seashore against the typhoon and tsunami, to absorb waste, and to prevent the land from the sea water intrusion, etc. In addition, the mangrove forests have an important economic function like to provide wood and leaves as the ingredients of medicine and alike (Dahuri, 2001).

Irmayeni (2011) reported that most of mangrove forests in some areas in Sumatera and other parts of Indonesia have been damaged by people around the forest. Many people have utilized the mangrove forests to fulfil their daily need without doing the conservation. This condition caused the decrease of several mangrove population, such as those of *Rhizophora* sp., *Nypa futicans*, and *Xylocarpus* sp.

Based on a research carried out in 2011 in one area of North Moluccas Province, namely Jailolo in West Halmahera, using parameters of relative density, relative dominance, relative frequency, and Importance Value Index (IVI) ranging

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from 0-300 (Mueller, *et al*., 1974), it was uncovered that several species of mangroves had a very low IVI. It can be concluded that the mangroves in this area have been badly damaged. Some mangroves having very low IVI are *Rhizophora apiculata, Bruguiera gymnorrhiza, Osbornia octodonta,* and *Xylocarpus moluccensis*. In this connection, a depth discussion is needed to reveal the information related to *X. moluccensis* damage as one of mangrove species confronting highest danger compared to other mangrove species.

The purpose of this study is to obtain some information about the people's roles on the damage of *X. moluccensis* in North Moluccas, related to the usage pattern of the woods by the local people as well as the wood endurance of each mangrove species. People must be revived and other efforts related need to be carried out to preserve *X. moluccencis* from the extinction risk.

LITERATURE REVIEW

Mangrove

Generally, the mangrove vegetation grows in the intertidal and supratidal area attaining enough water current, and sheltered from the waves, as well as the rise and fall of the tides. Thus, the mangroves are mostly found in shallow gulf, estuaries, delta, and seashores (Kusmana, 2000).

The mangrove forest is a unique ecosystem and based on the ecological point of view, it is a potential natural resource. Santoso (2008) suggested that in the mangrove forest area the physical factors, terrestrial biota as well as marine biota are integrated to make a complex ecosystem between land and sea. Moreover, the surrounding environmental characteristics of the mangrove forests which are quite tight following the tidal waters, great salinity changing, muddy water stream, and having dependence on the fresh water stream will cause the growth of the mangrove vegetation be limited (Supriharyono, 2000).

According to (Peter and Sivasothi, 2001), *X. moluccensis* belonged to the family of Meliaceae is well-known as *cedar* wood. It is difficult to be cultivated in a wide range since the growth of *cedar* wood needs warm atmosphere and high humidity such as found in tropical area. The *X. moluccensis* seeds are intolerable to drought. It cannot adapt in a frosty or snowy condition. Therefore, some collectors had tried to cultivate this species by seeds in a limited scale.

The Extinction Threat of Mangrove Trees due to Humans' Utilization

According to Dahdouh-Guebas, *et al*.'s (2000) based on surveys and interviews with 116 families in Mida Creek-Kenya, it was revealed that the lives of 100 of them depend mainly on the mangrove resource. The survey result showed that the mangrove trees were the main wood source to construct houses and boats, firewood, and to make charcoal for the local people. The product of mangrove woods could also be made for the need for medication, tanner materials, and furniture. Some of mangrove woods, mostly used for constructing houses and firewood as the main materials were *R. mucronata, Ceriops tagal,* and *B. gymnorrhiza*. While, mangrove woods of *Sonneratia alba* and *X. moluccensis* are used to construct boats and make medicines. Further more, people tend to choose specific mangrove woods to build their houses. These phenomena caused the decrease of theamount of mangrove trees. Moreover, there was no policy ruling the mangrove deforestation by the local people.

The results of some studies showed that the area of mangrove forest in Indonesia continued to disappear each year. The Wetland International data revealed that the mangrove forest occupies only 1.5 million hectares in 2005. Whereas, the total area of mangrove forest in 1982 covered 4.25 million hectares along the Indonesian coastal areas. The decrease of the mangrove forest areas indicates that the mangrove forests along the Indonesian coastal areas are critically endangered. It is possible that in the next couple of years, the mangrove community, which is a very important part of the coastal ecosystem and is very useful in the lives of various marine biota as well as of human, will totally extinct. The worst condition of mangrove forest is found in the coastal area of North Nangroe Aceh Darussalam, gulf of Lampung, Tanjung Pasir (Tangerang), Mahakam delta (East Borneo), West Lombok, gulf of Saleh (NTB), and Moluccas. Generally, there are three factors (anthropogenis factor, nature factor, and biology factor) causing the damage of mangrove ecosystems.

The greatest cause factor is the anthropogenic factor, in which human are the main agent. The unplanned exploitation of mangrove forest, illegal logging, mangrove forest felling for fish ponds, farm field, salt pan, and settlement, also the unawareness of the society on the advantage of mangrove forest and negative thought of the society of the existence of mangrove forest are some of the concrete examples proving that man-made pressure is the biggest problem with the damage and the threatened existence of mangrove communities (Rison, 2010).

The Damage of Mangrove Woods Caused by the Marine Borers

The damage of the mangrove forest is also caused by marine borers. The damage level depends on the species and the population size as well as the intensity of boring; it is also influenced by the amount of the food supplies contained in the wood substrate. Rao, *et al*. (1991) explained that marine borers mostly attack the vertical wood fibre, forming a longitudinal tunnel inside the wood. The marine borers mostly cause irregular damage, causing the degradation of the wood structure, strength and the wood become frail.

There are two groups of Molluscs which often destruct the wood in the sea; they belong to Teredinidae and Pholadidae. The most destructive group of Teredinidae is called shipworm or Teredo. Shipworm or Teredo usually lives and grow quickly inside the submerged wood. It will create a tunnel, and live inside it by attaching calcareous cement alongside the tunnel wall. The marine borers usually bore into the wood until the structure of the wood broke and become fragmented, even it is invisible from the outside. The marine borers body of Pholadidae especially of Martesia genus is covered with lime. This marine borer damage the wood like the worm of ship. This animal keeps boring the wood once it enters the wood to get some space to grow (Castagna, 2004).

According to Distel *et al* (1991) Kohlmeyer (1995) stated that the shipworms of *Teredo bartschi* can break-down the cellulose of wood, producing nitrogen which facilitate the work of bacteria. In this situation, the bacteria build a unique symbiosis with the shipworms. *T. bartschi* grows better in the rich nutrient environments, especially those are rich of bird wastes, called *guano*. The nutrition is obtained directly by the marine borers or indirectly through the mutual interaction with the bacteria.

Although, with resemblance to worms, shipworms belong to the long tender and naked greyish seashells. *Shipworms are* well known for their ability in destructing the wood structure of pole dock, ships, and boats submerged in the sea water. Generally, shipworm is also known as *Teredo* worm. The boring is done to the inside of the woods by using the small shells modified at the anterior edge forming a couple of pallet abrasives, functioning to dig a tunnel inside the wood. The destruction is hard to be found since there are only small holes appear on the wood surface. At the beginning, the larva of *Teredo* sp., start to dig a small tunnel with a diameter of 0.5-3 mm. This marine borer can grow as long as the length of the tunnel. The length of these marine borers varies from 150 mm to 1.8 m with diameter of 25 mm. The tunnel length depends on the attack level, for example, if the borer digs the wood aggressively, the tunnel might be dense, yet the length and diameter might be narrower. The wood particles in the form of cellulose resulted from boring will be their foods supported by the symbiont bacteria. The activity of the borer can transform the wood into something resembles to honey bee hive. Therefore, it can be lower the wood strength, even though the wood looks strong from the outside (Gary, 2010).

T. navalis has inhalant and exhalant siphon which can be immerged through a small hole. When the septum is stimulated the hole will be opened and the siphon appears, but when this animal is in danger, the siphon can be contracted and protected underneath by a pair of calcareous lid. The tunnel is in circular form having calcareous layer made by the molluscs. This animal originally comes from the north east Atlantic ocean, but now it can be found all over the sea and damage the submerged things (Suwignyo, *et al*., 2005).

There are many marine animals found in the mangrove forest, like fish, shrimp, and molluscs. Besides, there is another marine animal group found in the coastal water, called as *Polychaeta*. *Polychaeta* plays an important role in the marine ecosystem as the prey of the bottom animals, such as fish and shrimps (Bruno *et al*., 1998). One sessile group of *Polychaeta* is bright *Sabellastarte indica*. There are also non sessile *Polychaeta*, like *Neriesvirens* and *Marphysa sanguine*.

Polychaeta is a class of annelid worms living in the water, having segmental body and coordinated, so it is called having metameric body. There are three parts of the worm body, namely the head, the segmented trunk, and the terminal end. The segment where the mouth is found is called peristomium, while the segment where the anus is found is called pigidium. The colour of the *Polychaeta* is purplish red. The *Polychaeta* is 5-10 cm long, yet some *Polychaeta* are less 1 mm and some others reach several meters in length. The *Polychaeta* lives by crawling on stones gaps, and coral, or making a hole in sand or mud and hard materials, and wrapping itself. The colour of the male *Polychaeta* and female *Polychaeta* are different; the male's segments are white and the female's segments are orange. The examples of the *Polychaeta* are clam worms, sorong worms, wawo worms, palolo worm, and nipah worms (Jasin, 1982).

Polychaeta belongs to the subclass of Sedentaria which make a burrow in hard material (sediment) as the protection. The tunnels are made from the organic waste, calcium carbonate, the complex protein-polysaccharide, and sand of shells tangled by the *Polychaeta* mucous. The burrows made are mostly straight line-shaped, furcated shape, spiral shape, or U-shaped (Brusca *et al*., 1990)

RESEARCH METHOD

The study is a part of a dissertation research carried out by two methods, namely survey supported by interview technique and experimental method. The survey data had been collected by interview conducted to 40 fishermen as the respondents. The materials being asked by the interview were occupancy, level of education, and the pattern of mangrove usage, especially of *X. moluccensis*. The data obtained from the interview had been analysed qualitatively by describing the percentage of the total response obtained from all interviewed respondents.

The experimental method employed was factorial design of 4 x 2 x 2, consisting of the wood species, the depth of immersion, and the distance of immersion from the beach line. There were four species of mangrove woods, namely *Rhizophora apiculata* (called *soki*), *Bruguiera gymnorrhiza* (called *dao*), *Osbornia octodonta* (called *pos-pos bo*), and *Xylocaprus moluccensis* (called *buah kira-kira*).

The selected mangrove trees cut down for the experimental study were those of ± 200 cm in diameter and had the similar age. The trees were cut into boards of 250 cm in length, 30 cm in width, and 4 cm in thickness. In this case, the study needed 8 boards for each mangrove wood species. The boards were dried for ± a month. After being dried, the boards were sleeked and polished like the body of a boat. Furthermore, 4 bricks were tied on each board and there were also 2 jerry cans tied as the buoy so that the boards would not sink, yet they were still immerged in the water. The boards were, then, submerged 1 and 2 meters in the sea water at the distance of 30 and 50 meter from the seashore based on the factorial randomized design. The boards were observed during a year at an interval of 1,5 months.

The damage observation on each treated wood species used 50 ml water poured into nine spots of the woods. The water absorption rate then was measured, supported by a stopwatch. The data obtained was analysed both quantitatively and qualitatively. The quantitative analysis was carried out by anova of SPSS 17 program for windows.

The data of the survey study about the usage of the mangrove woods by the local people to construct boats etc. were analysed descriptively including those related to the special quality of *X. moluccensis*. Then the result of the descriptive analysis was linked to the result of the quantitative analysis to answer the question related to the people's role on the extinction risk of *X. moluccensis* in North Moluccas.

FINDINGS AND DISCUSSION

The Results of the Interview Data Analysis related to Usage Pattern of *X. moluccensis*

The results of the interview data analysis related to the usage of the woods of *X. moluccensis* will be explained further. All of the respondents state that they use the woods for their daily needs. There are four types of the mangrove woods used by the local people, namely *R. apiculata*, *B. gymnorrhiza*, *O. octodonta*, and *X. moluccensis*. Most respondents (95%) convey that they use the mangrove woods for firewood, the fence, the house materials, constructing boats, and for the dock pole, while only 5% of the respondents use the mangrove woods for making charcoal, boats fastener and furniture.

Related to the usage of mangrove woods for constructing the fisherman's boat, the results of the interview show that 65% of the respondents use the woods of *X. moluccensis*, to make boats. This kind of mangrove has a wide diameter so

that it produces more boards compared to other species of mangrove. On the often hand about 35% of the respondents use the woods of *B. gymnorrhiza*, and *O. octodonta*, to build boats.

In regard to the usage of the mangrove woods, the branch number of the trees needs to be considered since it influence the quality of the wood. All the respondents stated that the mangrove trees having more branches were *R. apiculata* and *X. moluccensis*. Besides, 67.5% respondents stated that the mangrove trees having many branches were still used. They used such mangrove trees to construct the deck and inner wall of the boats, but 32.5% of the respondents said that even though such the mangrove trees were also used to make the body of the boats.

Related to the physical characteristics, the mangrove woods are difficult to split due to their twisted wood fibres. In this case, 80% of the respondents stated that the woods of *X. moluccensis*, mostly used for making furniture, was difficult to split, but 20% of the respondents said that the woods of *B. gymnorrhiza*, commonly used for constructing house pillars, was the one that is difficult to split.

All the respondents stated that the woods of *X. moluccensis* was the roughest in terms of the wood fibres. They state too that the furniture made from *X. molucensis* were usually good in quality as well as were easily lifted.

All of the respondents said that long time ago, there were many *X. molucensis* grew in their area, yet they never knew that the of *X. molucensis* were native Moluccas. Nowadays, the population of *X. moluccensis* reduces due to the over-usage. Therefore, after knowing the information about the mangrove trees, then they tried to preserve the mangrove trees by forbidding people to use the woods excessively. By doing this, the local people expected that the population of *X. moluccensis* and other mangrove species did not decrease.

The Influence of the Wood On Type Water Absorption Speed in Each Wood Type

The following table presents the results of experimental data analysis using Anova of SPSS 17 program for windows in order to examine the four mangrove wood types damages based on the water absorption rate through the treated woods. The data analysis results presented in Table 1 is related to the Duncan Multiple Range Test (DMRT).

Based on the above DMRT result related to the water absorption rate through the treated woods, it was revealed that the water absorption rate through *X. moluccensis* wood was the lowest (fastest) one and was significantly different from that of *R. apiculata, B. gymnorrhiza*, and *O. octodonta*. Therefore it can be concluded, that the damage of *X. moluccensis* caused by marine borer attack was the most terrible one, followed by *R. apiculata* and *B. gymnorrhiza* at the second place. The result of the survey study had uncovered too that *X. moluccensis* was the most endangered species. On the other hand it can be said that the wood of *O. octodonta* did not undergo any damage, so that the water passed it very slowly.

The following figures of the photographic recording prove the marine borer attack on the four mangrove woods used in the experimental study during a year. The figures were in line with the above statistical test results.

Related to *X. moluccensis* as the most endangered species, the phenomena is related firstly to the survey research result showing that the usage of *X. moluccensis* for the inner wall of boats, so this mangrove wood is protected from the sea water direct contact. In this connection, *X. moluccensis* tree is considered as a strong species of mangrove due to such usage; thus, many local people cut this tree down to fulfill their need, moreover it is supposed too that this mangrove has some special qualities. On the other side, based on the assumption that there is no guarantee that *X. moluccensis* will always be free from the immersion in the sea water, it is presumed that this wood can be also easily damaged by the marine borers, although it is used as the inner part of the boats. It is easily understood too that *X. moluccensis* are cut down more frequently.

The Pattern of *X. moluccensis* Wood Usage as the Cause of the Extinction (Based on the Survey Result)

Based on the analysis result of the interview mentioned in the previous part, it can be implied that the extinction cause of the *X. moluccensis* wood is the over usage by the local people due to its physical characteristic, related to some special qualities, such as its wide diameter. This type of mangrove wood can produce many boards due to its wide diameter. The boards are mostly used as the inner part of boats, such as wall and deck, which protect them from the direct contact with the sea water. Most people assume that the *X. moluccensis* woods are more durable and less invaded by the marine borers. Therefore, more people tend to use more *X. moluccensis* wood, while its number is decreasing. This is in line with Dahuri's (2001) idea that the main problem in the mangrove forest is the people desire to fulfil their need. This phenomenon causes to the deforestation of the mangrove forest.

The survey finding also is in line with Clough's (2013) research report that the species of mangrove wood, particulary *Xylocarpus* is suitable make made a high quality furniture, such as wooden bowl and any household materials in Serawak East Malaysia. *Xylocarpus* is well known as cedar mangrove since the colour of this type of mangrove wood looks like cedar's. Considering the over exploitation of *Xylocarpus* for the commercial business and the difficulty of the cultivation on a large scale, this species is almost extinct in North Mollucas.

The Effect of Wood Species on The Water Absorption Rate through the Treated Woods

The results of anova test related to the effect of the water absorption rate through the treated woods showed a significant effect. The DMRT test revealed that *X. moluccensis* underwent the greatest damage, and it was significantly different from the damage of *R. apiculata* and *B. gymnorrhiza*. The least damage was found at *O. octodonta*.

The different invasion of the marine borers of the several mangrove woods species is caused by the nutrients contained in the experimented mangrove woods and their wood fibre structure. Based on the previous researches, it was revealed that the *R. apiculata*, *B. gymnorrhiza*, and *X. moluccensis* woods were categorized as heavy, solid, and tough log. These characteristics show the relative size of the wood cells. There are rough wood fibres inside the cells, but the degree of the phenol compound of these woods is low so that the three treated wood species are easily damaged. The mangrove species of *O. octodonta* cannot be easily damaged by the marine borer attack because the degree of the phenol compound of this wood is high. This phenomenon is in line with Kathiseran (2001) statement that the mangrove woods were used for charcoal due to its high heat value. Besides, the mangrove woods were rich in a phenol compound making them durable and could be used for various construction. The explanation of the heaviness, toughness, strength, and durability of *O. octodonta* was revealed in The Plant List

Table 1. Duncan Multiple Range Test (DMRT) related to the difference of Water Absorption Rate through Woods among the four species treated.

Mangrove Wood Species	Water Velocity	DMRT Notation
3=*Xylocarpus moluccensis*	5,698	a
1=*Rhizopora apiculata*	16,523	b
2=*Bruguiera gymnorrhiza*	24,418	c
4=*Osbornia octodonta*	90,668	d

Figure 1. The invasion of the marine borers on *R. apiculata* wood

Figure 2. The invasion of the marine borers on *B. gymnorrhiza* wood

Figure 3. The invasion of the marine borers on *O. octodonta* wood

Figure 4. The invasion of the marine borers on *X. moluccensis* wood

(2010). This species of mangrove wood is difficult to be processed, but once it is used, the result is good. Thus, it is commonly used for house construction, pillars, and railway bolsters; while the bark is mostly used for mending the broken boat wall.

The result of statistical analysis was in line with the photographic record showing the wood damages caused by the marine borer attack. Regarding the statistic analysis results and the photographic record, it could be seen that the highest wood damage level caused by marine borer attack was found on *X. moluccensis*, and it was significantly different from the wood damage level found on *R. apiculata*, *B. gymnorrhiza*, and *O. octodonta*. In this connection *O.octodonta* underwent the least damage that was significantly different compared to the three other species. The findings of the experimental research are supported by Helsing (2006) saying that the young shipworms dug small holes on the surface of wood and entered the wood, which later, the young shipworms grew. As the body of the shipworm grew longer, the tunnels would also get longer and bigger; the diameter of the tunnel might reach a quarter inch. The body of shipworms would grow longer yet the entrance hole would not get bigger. The wall of the tunnel was mostly covered by calcareous materials produced by the mantle tissue in order to maintain the tunnels. When the tunnels git broken and their respiration interfered, these animals would die.

There is another mollusc family called Pholadidae, or pholad having a habit too to make a hole in their substrate. According to Helsing (2006) Pholad was capable of making a hole in wood and stone, so affected the damage of the pillar structure happened in Hawaii and Mexico. This marine borer is similar to clam because its body can be covered by a pair of shells. *Pholads*, like Shipworms, form tunnels and live inside woods until the woods get damaged.

Considering the damaged level of the mangrove woods, it can be seen that the most durable wood is *O. octodonta*. This is in line with The Plant List's (2010) opinion that the *O. octodonta* wood is categorized as a tough, sturdy, and durable wood. It can hardly be processed due to its toughness. Thus, this kind of wood is commonly used for the railway bolsters as well as pillars. On the other side the wood of *X. moluccensis* is the mangrove wood species which is most easily damaged by marine borer. The result of the survey study shows that the *X. moluccensis* wood is used as the inner parts of boats, such as deck, mast, and inner wall so that it does not immerge in the sea water directly. However, there is no absolute guarantee that this wood cannot contact the sea water forever. When this wood is immerged in the seawater at a time, the wood will be attacked by the marine borers. Therefore, in relation to the damage risk of *X. moluccensis*, the possibility invasion of the marine borers is still high and it will lead to the high frequency of the mangrove deforestation.

The threat to the existence of *X. moluccensis* is getting higher in relation to the other facts. According to Peter and Sivasothi (2001) the species of *X. moluccensis*, well known as *cedar* wood, was difficult to be cultivated in a large scale. This species needed warm atmosphere and high moisture to grow well, as in tropical area. Besides, the seeds were intolerable to the dry weather and could not adapt well in cold condition. This condition would be the limiting factors for the growth of *X. moluccensis*.

CONCLUSIONS

In the following part, there will be stated some conclusions based on the before-mentioned discussions.

a) The usage pattern of the mangrove wood of *X. moluccensis* is to construct boats and the parts of the boats, for example inner wall, deck, and mast. Related to the usage of *X. moluccensis* for constructing the inner parts of the boats, these woods are are not submarged in sea water, so it is supposed that the woods are more durable and tougher.

b) The result of the experimental study related to the effect of the wood types on the water absorption rate through woods showed a significant impact. *X. moluccensis* underwent the greatest damage that was significantly different compared to *R. apiculata, B. gymnorrhiza*, and even more compared to *O. octodonta*. The photographic records related to the marine borer attack were also in line with the statistic analysis results.

c) The deforestation of *X. moluccensis*, is the worst one compared to the there other mangrove species studied. This phenomenon is caused by the superiority of *X. moluccensis*, due to it's wider bark diameter, so that it can produces more boards compared to other mangrove woods, to construct the inner parts of boats. Due to it's unmerged status in the sea water, *X. moluccensis* is supposed durable and tougher so that many local people cut the trees down. This condition is getting worst since, in fact, in the long run there is no guarantee that *X. moluccensis* are really always not submerged in the sea water although the wood is used to make the inner parts of boats. The possibility of the immersion is still high, thus the damag risk is also still high. In the long run, the population of *X. moluccensis* in North Moluccas is

endangered seriously because local people might still keep deforesting the mangrove trees. The potential threat of the *X. moluccensis* is getting higher considering that the cultivation of the *X. moluccensis* is difficult compared to other species of mangrove trees.

Base on the three conclusions before it seems clear that the damage cause of the *X. moluccensis* in North Mollucas is related to the result of people's activity, wood durability, and the low growth rate of saplings. People prefer to use *X. moluccensis* due to it's large stem diameter supported by the people's misperception about the strength of wood. The wood strength of *X. moluccensis* is the most vulnerable due to marine borer attack; this fact causes the logging frequency is very high. This condition then became very severe as *X. moluccensis* seedling growth rate is very low.

SUGGESTIONS/ RECOMMENDATIONS

Based on the explanation above, there are some suggestions given as follows:

a) The government needs to inform every local people about the role and function of the mangrove forest for the seashore water and many others. Thus, it is expected that there will be an effort of mangrove reforestation.

b) The government needs also to involve the local people to preserve the mangrove forest so that the deforestation and the over exploitation can be minimized. Thus, it is expected that the population of the mangrove forest will not lost.

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