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Local Knowledge and Vegetation Composition of Boli Fruit (*Xylocarpus granatum* J.Koenig) in Balikpapan Bay, East Kalimantan

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ABSTRACT

Boli fruit (*Xylocarpus granatum* J.Koenig) is one of the mangrove plants used by the Balikpapan Bay surrounding community as sunscreen. The seed part of the Boli fruit is simply processed to make sunscreen powder. Local communities around mangrove forests, especially women who work in gardens or ponds, use this fruit as a cold powder to withstand the heat of the sun which can discolor the skin. The mangrove area is one of the habitats located in Balikpapan Bay. The study aimed to describe the local people knowledge, composition and structure of mangrove vegetation on Balikpapan Bay, East Kalimantan. Vegetation data collection was carried out using the plotted path method (2 paths and 33 plots). Vegetation analysis parameters include relative density, relative frequency, and relative dominance. The results of the study found that there are eight mangrove species consisting of seven clans and five tribes. *Xylocarpus granatum* species is present at every stage of growth. Mangrove trees are found in a diameter distribution between 10 and 20 cm. Trees with a height of more than 15 m dominated the area.

Keywords: Composition, mangrove, structure, *Xylocarpus granatum* J.Koenig

INTRODUCTION

Mangroves are plant communities that can adapt to salinity and tides. Kusmana *et al*. (2003) define a mangrove ecosystem as an ecosystem consisting of organisms (plants and animals) that interact with environmental factors and with others in a mangrove habitat. The existence of this mangrove ecosystem has a very important role for living things and the surrounding environment, both ecologically and economically.

Ecologically, mangrove forests have a role as: 1) coastline guards, breakwaters, protectors of beaches and river cliffs from erosion or abrasion and seawater intrusion; 2) oxygen generators and carbon dioxide absorbers; 3) aquatic nutrition providers and processors of polluting waste materials; 4) a nursery ground for shrimp, fish, and crabs; 5) habitats of various types of animals; and 5) plasma sources. As for economically, mangrove forests have benefits as a provider of firewood, wood charcoal, construction materials/building wood, chips, tannins, nypa roof, medicines, foodstuffs, sources of animal feed and fertilizer, fishing sites, pond manufacturing sites, salt making sites, and locations of ecotourism activities (Inoue *et al*., 1999).

One of the mangrove ecosystem areas in East Kalimantan Province is Balikpapan Bay. Mangroves in Balikpapan Bay include mangrove areas located in the southern part of Tanjung Mangkalihat (Sulistyawati, 2011). In this area, mangroves have a role as a place for local aquaculture and are habitats for various biodiversity such as proboscis monkeys (*Nasalis larvatus*) and other species that have ecological and economic potential (East Kalimantan Coastal Project, 2002).

Boli fruit is one of mangrove species which used by the surrounding community. Boli fruit seeds are processed in such a way as to be used as cold powder or sunscreen when doing activities in the garden or pond. This powder is mostly used by women to avoid the heat of sunlight in mangrove areas or beaches. This plant is very easy to find in mangrove habitats. Boli fruit is large round brownish in color and has a stem that tends to be white or light brown, in contrast to other mangrove plants that tend to be dark in color.

Within the Balikpapan Bay area is dominated by mangrove ecosystems. According to Balikpapan City Regional Regulation Number 5 of 2006, the development of the designation of protected areas indicates the need for efforts to monitor biodiversity in the area. One form of information that can be obtained from monitoring activities is the condition of vegetation. This scientific information is important because it can be used as a consideration or input in formulating management. This study aims to provide information about the structure and vegetation composition of mangrove forests in East Kalimantan.

METHODS

Study Area

This study was conducted on 2018, located in Balikpapan Bay. This area is a semi-closed water area that stretches from Balikpapan to Penajam Paser Utara Regency (116042' - 116050'E and 10 - 1022'S and has an area of up to 120 km^2 (Kalimantan Ecoregion Development Control Center, 2016). This area is a mangrove habitat that is still in good condition in East Kalimantan. Information about the research location is presented in Figure 1.

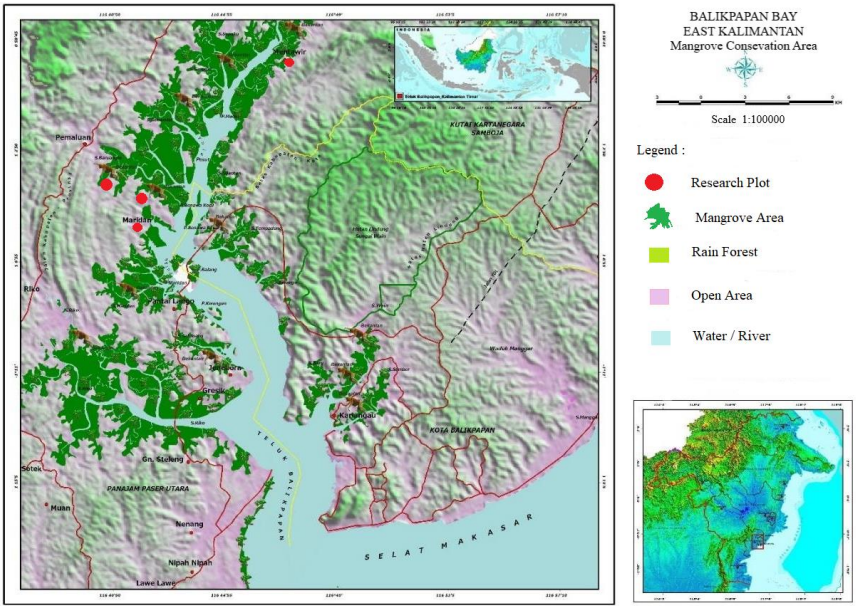

Figure 1. Research location

Data Collection

The local knowledge towards utilization of mangrove plant is important of sustainable mangrove habitat. Open interview used to collect people activities that live surrounding of Balikpapan Bay. The interviews collect about their daily activity, gender and age. Data was collected in 4 villages adjacent to the Balikpapan bay, namely Maridan, Telemow, Binuang, and Mentawir. We used randomly technique to sample respondents for each village. Vegetation data collection is carried out using the banded path method. The observed vegetation levels include tree levels (trunk diameter greater than or equal to 10 cm), saplings (trunk diameter smaller than 10 cm and height more than 1.5 cm), and seedlings (saplings less than 1.5 cm high) (Soerianegara and Indrawan, 1988).

The first path is carried out randomly with a perpendicular position of seawater, while the next path is 50 m away from the first path. The vegetation analysis path is made with a width of 10 m in which it is divided into plots and sub-plots. Observation plots are made with a size of 10 x 10 m for the tree level, while sub-plots are made with a size of 5 x 5 m for the sapling level, and 2 x 2 m for the seedling level. In total, 2 observation lines have been created consisting of 33 plots. The image of placing the path as presented in Figure 2.

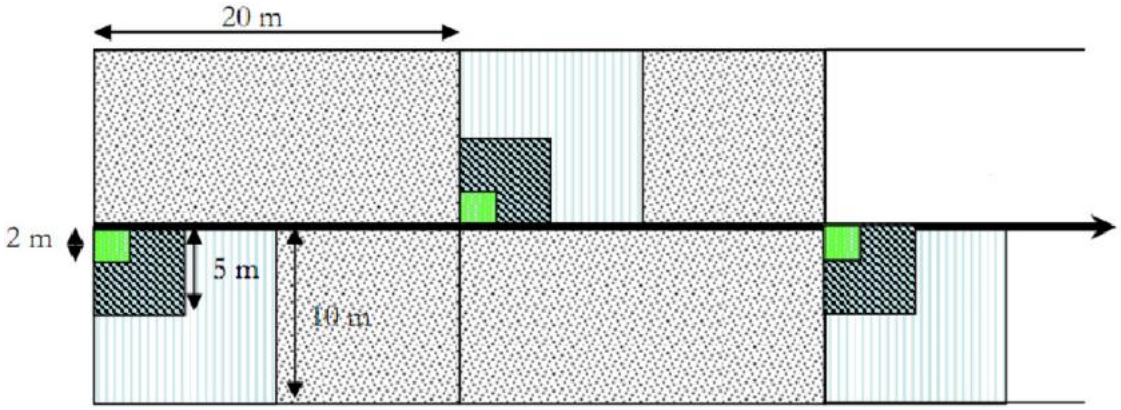

Figure 2. Vegetation plot design

All types of plants at the tree and sapling level are identified, measured in trunk diameter and height, while plants at the seedling level are identified as types and numbers. For identification purposes, the collection of plant specimens, both fertile and non-fertile, is carried out. Furthermore, all specimens were identified at the Wanariset Samboja Herbarium, East Kalimantan.

Data Analysis

Data collection result of local community knowledge was analyzed using descriptive analysis. Vegetation analysis parameters used included relative density, relative frequency, and relative dominance (Cottam and Curtis, 1956). The Important Value Index (INP) of trees and saplings is the result of the sum of the three parameters (Soerianegara and Indrawan, 1988). Especially for vegetation seedling level the important value index is obtained by summing the relative density value with relative frequency.

RESULTS AND DISCUSSION

Local Community Knowledge

Local knowledge is the noble values that apply in the living system of the community to, among others, protect and manage the environment sustainably. Local wisdom is the values, norms, laws and knowledge formed by religious teachings, beliefs, traditional values systems and experiences passed down by ancestors that eventually form a local knowledge system that is used to solve daily problems by the community.

One of the mangrove plants used by the community around Balikpapan Bay is the Boli fruit. From interviews with the community, this fruit is used by the community as a cold powder or sunscreen, especially by women who are active outside. Some of them are active all day in the garden or in the pond. Hot sunlight in the coastal area will cause the skin to burning and crack.

People use Boli fruit as a powder by taking seeds from old fruits. After the fruit seeds are cleaned, then dried by drying. After drying, the fruit is then ground to be smooth and sifted to obtain a fine powder powder. The results of this sifting can be used immediately by adding a little water then smeared all over the face or other parts that will be protected from the heat of the sun. This powder is usually stored in a sealed container and can be used when needed.

All four villages visited, all respondents knew the usefulness of Boli fruit (*Xylocarpus granatum* J.Koenig) can be used as a cold powder or sunscreen. In accordance with Sibarani (2012), local wisdom refers to the nature, roles, and methods of oral tradition, and is the original wisdom or knowledge of a society derived from the noble value of cultural traditions to regulate the order of people's lives. The public knows the use of this Boli fruit from generations that are delivered orally.

The Boli fruit belongs to the trees that can reach a height of 10-20 m. It has board roots that expand to the sides, twisting and forming crevices. The trunk is often hollow, especially in older trees. The bark is light brown-yellowish, thin and flaky, while on young branches, the bark wrinkles. Leaf anatomy rather thick, the arrangement of leaves in pairs (generally 2 pairs of peduncles) and some are solitary, compound and opposite. Form: elliptical - inverted ovoid. Tip: rounding. Size: 4.5 - 17 cm x 2.5 - 9 cm.

Flowers consist of two sexes or females only. Bunches of flowers (2-7 cm long) appear from the base (armpits) of petioles and flower stalks 4-8 mm long. Located: in the armpits. Formation: random swarm (8-20 flowers per swarm). Crown leaves 4; oblong, edges round, greenish-white, 5-7 mm long. Petals: 4 lobes; light yellow, 3 mm long. Stamens: creamy white in color and fused inside the tube.

Fruits are round like a ball (coconut), weight can be 1-2 kg, skinned, brownish-green color. The fruit hangs on a branch that is near the surface of the soil and is somewhat hidden. Inside the fruit there are 6-16 large, woody and tetrahedral-shaped seeds. The arrangement of seeds inside the fruit is as confusing as a puzzle, in English it is referred to as a fruit puzzle. The fruit will crack at the time of drying. Size: fruit: diameter 10-20 cm.

Xylocarpus granatum grows along the outskirts of tidal rivers, the inland margins of mangroves, and other less salty brackish environments, often grown clustering in large quantities. Individuals that have aged are often overgrown with epiphytes. The spread of this tree is found throughout Indonesia, can be found in Java, Madura, Bali, Karimun Islands Java, Sumatra, Sulawesi, Kalimantan, Maluku and Sumba, Irian Jaya.

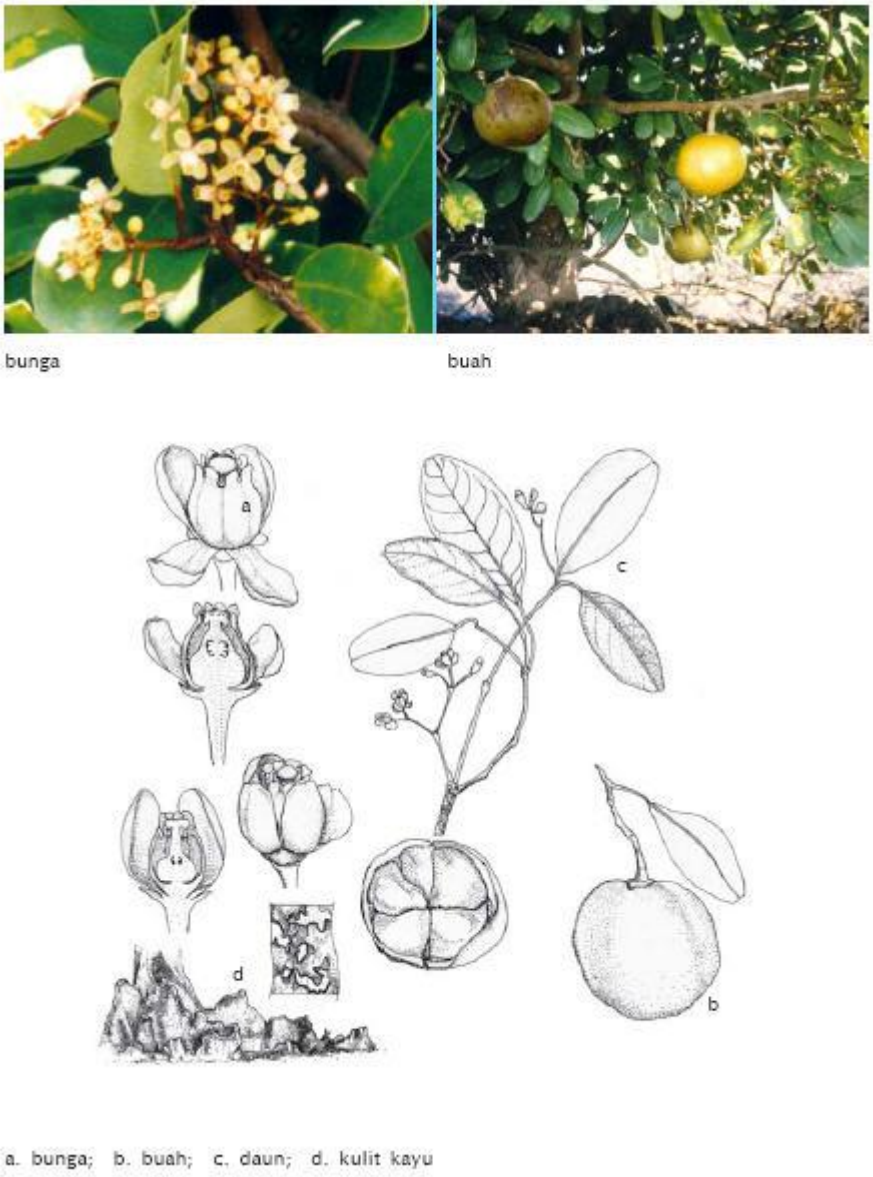

Figure 1. Boli Fruit (*Xylocarpus granatum* J.Koenig)
(Source: http://www.wetlands.or.id/mangrove/mangrove_species.php?id=44)

Vegetation Composition

The mangrove ecosystem on Balikpapan Bay is composed of eight species, seven genus, and five family (Table 1). Among the eight plant species, seven species are mangrove major and one type of plant is included in the minor mangrove. *Rhizophora mucronata*, *Xylocarpus granatum*, and *Ceriops tagal* are found at various levels of growth, i.e., seedlings, saplings, and trees. Mangrove plants with tree species are *Rhizopora mucronata*, *Xylocarpus granatum*, *Ceriops tagal*, *Nypa fruticans*, *Bruguiera parviflora*, *Xylocarpus moluccensis*, while *Acrosticum aureum* is fern. Information of mangrove species in the study area is provided in Table 1.

Table 1. Information of mangrove species in the study area

No	Species	Family	Habitus	Group Mangrove*
1	*Rhizophora mucronata* Poir	Rhizophoraceae	Tree	Major
2	*Ceriops tagal* (Perr.) C. B. Rob.	Rhizophoraceae	Tree	Major
3	*Bruguiera parviflora* (Roxb.) Wight & Arn. ex Griff.	Rhizophoraceae	Tree	Major
4	*Xylocarpus granatum* J.Koenig	Meliaceae	Tree	Minor
5	*Sonneratia alba* Sm	Sonneratiaceae	Tree	Major
6	*Nypa fruticans* Wurmb.	Arecaceae	Tree	Major
7	*Xylocarpus moluccensis* (Lam.) M.Roem.	Meliaceae	Tree	Minor
8	*Acrostichum aureum* L.	Polipodaceae	Bush	Minor

Abbreviations: Major = a type that is firm as a mangrove, Minor = a type that is not conspicuous and rarely forms pure stands.

The undergrowth species found in the study area is *Acrostichum aureum*, which has a density of 1287 individuals/ha. Bismark (1994) states the cover and frequency of *Acrostichum aureum* on the forest floor affects the density and frequency of mangrove saplings. This type of ferns can reach a height of 2 m and grow very densely to moderately. The growth of mangrove saplings can be disrupted due to lack of light or poor growing position due to obstruction by *Acrostichum aureum*.

Trees Level

Mangrove vegetation in the forest area of Balikpapan Bay at the tree level is composed of six species, six species, five genus, and three family. At the tree level, plants are dominated by *Rhizophora mucronata* which has an important value of 211.65%, followed by *Bruguiera parviflora* (49.00%), *Ceriops tagal* (14.61%), and *Xylocarpus granatum* (11.89%). The composition of types based on the index of important values at the tree level is presented in Table 2.

Table 2. The order of type composition by IVI at the tree level

No.	Species	DnR (%)	RF (%)	DR (%)	IVI (%)
1	*Rhizophora mucronata* Poir	84.07	43.84	83.74	211.65
2	*Bruguiera parviflora (*Roxb.*)* Wight & Arn. ex Griff.	8.50	30.14	10.36	49.00
3	*Ceriops tagal* (Perr.) C. B. Rob.	0.61	13.70	0.30	14.61
4	*Xylocarpus granatum* J.Koenig	2.43	8.22	1.24	11.89
5	*Xylocarpus moluccensis* (Lam.) M.Roem.	4.10	2.74	4.27	11.11
6	*Sonneratia alba* Sm	0.30	1.37	0.10	1.77

Abbreviations: DnR = Relative Density, FR = Relative Frequency, DR = Relative Domination, IVI = Important Value Index.

Sapling Level

The vegetation at the sapling level is composed of six species, five genus, and three family. At this growth rate, vegetation is dominated by *Rhizophora mucronata* (182.79%).

Other species that also have a high IVI include *Xylocarpus granatum* (50.29%) and *Sonneratia alba* (22.37%). The composition of species based on indices of important values at the belta level is presented in Table 3.

Table 3. The order of the composition of types by index of important values at the level of sapling

No.	Species	DnR (%	RF (%)	DR (%)	IVI (%)
1	*Rhizophora mucronata* Poir.	61.76	52.63	68.40	182.79
2	*Xylocarpus granatum* J.Koenig	16.67	26.32	7.30	50.29
3	*Sonneratia alba* Sm	5.88	7.89	8.60	22.37
4	*Ceriops tagal* (Perr.) C.B.Rob.	9.80	5.26	6.40	21.46
5	*Xylocarpus moluccensis* (Lam.) M.Roem.	3.92	2.63	5.40	11.95
6	*Bruguiera parviflora* (Roxb.) W. & A. ex Griff.	1.96	5.26	3.90	11.12

Abbreviations: DnR = Relative Density, FR = Relative Frequency, DR = Relative Domination, IVI = Important Value Index.

Seedling Level

Unlike the level of trees and sapling, the vegetation at the seedling level is of only four types, four clans, and three tribes. At the seedling level, *Rhizophora mucronata* still dominates which can be seen from the magnitude of the INP value of 149.25%, followed by *Xylocarpus granatum* (36.71%), and *C. tagal* (9.61%). Vegetation at the seedling level has an important role in the plant regeneration system. The composition of types based on indices of importance value at the seedling level is presented in Table 4.

Table 4. The order of the composition of types by index of important values at the seedling level

No.	Species	DnR (%	RF (%)	IVI (%)
1	*Rhizophora mucronata* Poir.	88.72	60.53	149.25
2	*Xylocarpus granatum* J.Koenig	9.18	23.53	36.71
3	*Ceriops tagal* (Perr.) C.B.Rob.	1.72	7.89	9.61
4	*Nypa fruticans* Wurmb.	0.38	7.89	8.27

Abbreviations: DnR = Relative Density, FR = Relative Frequency, IVI = Important Value Index.

Based on the above data, *Xylocarpus granatum*, although does not predominate at any stage of growth. This species can be found in all levels because it is able to obtain nutrients, light, space where it grows. *Xylocarpus granatum* is a species of fast-growing mangrove, the propagule that is stuck into the ground in three months has grown five leaves, and has a larger propagule shape with more food reserves (Setyawan et al., 2005; Suryawan, 2007).

Vegetation Structure

Based on the distribution of diameters, trees in the mangrove forest area are found in a diameter distribution between 10 and 20 cm, namely 398 trees, such as the species *Rhizophora mucronata*, *Sonneratia alba*, and *Xylocarpus granatum*. Trees with a diameter distribution of less than 10 cm were found are 102 trees, a diameter distribution between 20 and 30 cm are

202 trees, a diameter distribution between 30 and 40 cm are 62 trees, and a diameter distribution of more than 40 cm are 2 trees with the largest diameter reaching 45 cm (Figure 2).

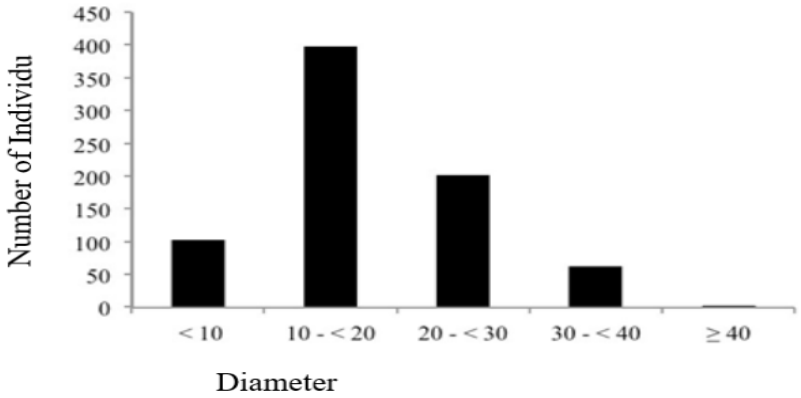

Figure 2. Distribution of individual diameter classes of trees

Based on the figure, it is known that natural youth is less normal because the number of individuals in the diameter class < 10 is lower compared to the diameter class between 10 and 20 cm. But in diameter classes ranging from 10 - < 20 cm to ≥ 40 cm, mangrove natural youth indicates normal natural youth, which is characterized by a smaller number of individuals as the diameter class increases. This condition is thought because trees in the diameter class of < 10 cm are taken from the community for firewood purposes. The mangrove habitat of Balikpapan Bay is dominated by trees with a height of more than 15 m (360 trees), such as *Bruguiera parviflora*, and *Rhizophora mucronata*. Trees less than 10 m high are 125 trees, and as many as 281 trees have heights between 10 and 15 m.

CONCLUSIONS

Boli fruit is used by the community around Balikpapan Bay as a cold powder or sunscreen for generations. The vegetation that makes up mangroves on Balikpapan Bay consists of eight species. *Xylocarpus granatum* is a species that is always present at every level of growth. The natural youth of mangroves is included in the less normal category. It is necessary to carry out efforts to protect, enrich the types of mangroves. The provision of warning boards prohibiting cutting mangrove trees in mangrove areas needs to be done so that their sustainability is maintained.

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