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The density, composition and mangrove forest habitat in coastal areas of Torosiaje Jaya Village, Gorontalo, Indonesia SUKIRMAN RAHIM1, , DEWI WAHYUNI K. BADERAN2, , MARINI SUSANTI HAMIDUN3, 1Department of PGSD, Faculty of Education, Universitas Negeri Gorontalo. Jl. JendralSudirman 6, Kota Gorontalo, Gorontalo, Indonesia. email: sukirmanrahim@yahoo.co.id 2Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo. Jl.

JendralSudirman 06, Kota Gorontalo, Gorontalo, Indonesia. Tel./Fax. +0435-821752, email: dewibaderan14@gmail.com, marinish70@gmail.com Manuscript received: 21 March 2017. Revision accepted: 29 June 2017. Abstract. Rahim S, Baderan DWK, Hamidun MS. 2017. The density, composition and mangrove forest habitat in coastal areas of Torosiaje Jaya Village, Gorontalo, Indonesia. Bonorowo Wetlands 7: 38-42.

The ecosystem of mangrove is a quite good ecosystem which is located in Torosiaje Jaya Village of Popayato Subdistrict, Pohuwato District, Gorontalo Province, Indonesia. This because of the beach in the coastal of Torosiaje Jaya Village is a gently sloping beach. Further, this beach has deposited sediment and it is formed a promontory grave that causes that mangrove in that region grows large and relatively fertile.

In addition, the mangrove which is located in Pohuwato has fairly high various species. One of them is found from Avicenniaceae family namely Avicennia marina (Forsk.) Vierh. This study aims to (i) obtain the information about the density of the mangrove; (ii) to determine the composition of mangrove species in coastal areas of Torosiaje Jaya Village; and (iii) to know the habitat of the species which is found in coastal areas Torosiaje Jaya Village.

Besides, the data were collected by purposive sampling. Moreover, for the measurement of density, distribution type, diameter trees, and mangrove vegetation height use a distance method (Point-Centered Quarter Method). Further, the composition types of views are based on the number species are found, and to obtain the data of the habitat conditions of the species which has discovered is using a direct observation in the field by a tree and laboratory test sample originating from soil samples in the study sites.

Moreover, the result of this study finds the four species of tree which dominates the mangrove in Torosiaje Jaya Village. They are Bruguiera gymnorrhiza, Rhizophora mucronata, Rhizophora apiculata, and Rhizophora stylosa with a density value of 51.55 trees/3 ha with an average distance of 581.94 m/tree. B. gymnorrhiza and R.

mucronata are species that dominate in the region due to supply mud as suitable habitat with its growth, besides it is affected by the substrate of mangroves in the Torosiaje Jaya Village it is also affected by salinity and temperature. Further, the data which have obtained, they can be used in a management of mangrove forest which located in the coastal of Torosiaje Jaya Village and they can also be data in mangrove conservation efforts in order to reduce the effects of global warming.

Keywords: Composition, density, habitat, mangrove forests

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INTRODUCTION Mangrove forests have a role in mitigating climate change due to global warming because it can reduce $CO_2$ through the sequestration mechanism that carbon sequestration from the atmosphere and storage in several compartments such as vegetation, litter and soil organic matter (Hairiah and Rahayu 2007).

Through the process of photosynthesis carbon dioxide which is from the atmosphere is absorbed by the mangrove plants and converted into organic carbon that will be distributed to all parts of the body and stored in the biomass plant. According to Nugraha (2011), it is about 50% of tree biomass is carbon. One of the mangrove areas in Indonesia is in the coastal region of Gorontalo Province, Torosiaje Jaya Village of Pohuwato region.

Pohuwato is known as a famous green belt of mangrove and coastal ecosystems where the mangrove as broad enough to stretch from the District of Paguat until Popayato District of West. Mangrove areas have contained in Pohuwato fairly high species diversity. One of the mangrove species found, among others, from family Avicenniaceae namely Avicennia marina (Forsk.) _ Vierh. According to Dharmawan and Siregar (2008), A.

marina is as one of the mangrove species that can absorb and store carbon is greater, because of habitat that is characteristic of wetlands with muddy soil types. Based on the results of interpretation of Landsat imagery which is reported Damanik (2012), that the mangrove area Pohuwato has undergone significant changes, which in 1988 reached the mangrove area of 13243.33 hectares and in 2010 the remaining 7420.73 ha.

The damage to the mangrove forests in the coastal Torosiaje Jaya Village has an impact on other Tomini bay ecosystem conditions such as Togean Islands National Park in Tojo Una-Una, Central Sulawesi Province. By reducing area of coastal mangrove in Torosiaje Jaya Village cause of carbon in the atmosphere cannot be absorbed and stored in plant biomass optimally.

This further confirms the need for a precautionary measure in order to damage that occurred in the coastal mangrove Torosiaje Jaya Village need to be immediately addressed through the information on the density, composition, and habitat, of

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mangrove forests. Findings of this research may serve as a database for mangrove forest conservation management purposes in

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RAHIM et al.

– Mangrove forest of Torosiaje Jaya, Gorontalo _39 _ _

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Torosiaje and other regions as well as for addressing global warming and climate change issues. MATERIALS AND METHODS Study area The study area is located in the coastal areas of mangrove forest Torosiaje Jaya Village, Popayato Subdistrict, Pohuwato District, Gorontalo Province, Indonesia (N 0º 28' 45"E, 121º26' 15"). The geographical position of the study area is presented on the map (Figure 1).

Methods The method used in this research is using the quadrant method or P-CQM (Point Centered Quarter Method). Each plant is contained in the quadrant, recorded the name of the species (as seen by recognition by the research team and mangrove identification books (Tomlinson 1986; Giesen et al. 2006). Measured the diameter of the tree is calculated based on diameter at breast height (dbh) of 1.3

m above the ground or above the buttresses, while the total tree height is calculated from the above buttress without counting the canopy. The stages will be undertaken in this study are: (i) The preparation phase, covering: observation, setting up data collection methods, prepare the equipment that will be used _ for data collection in the field. (ii) The data collection stage, include the determination of the density of vegetation.

To determine the density of the vegetation at the study site, created transect lines perpendicular from the shoreline landward by determining the point of observation or sampling point along the transect. At every point of measurement is made abscissa and ordinate imaginary line, so that at each measurement point there are four quadrants: I, II, III and IV.

Select one of the trees in each quadrant are located closest to the point of a benchmark tree and measure the distance from each tree to tree point benchmark. Each plant is contained in the quadrant, recorded the name of the species. Measured the diameter of the tree is calculated based on diameter at breast height (dbh) of 1.3

m above the ground or above the buttresses, while the total tree height is calculated from the above buttress without counting the canopy. Furthermore, in calculating the density of the wood. Mangrove species that cannot be identified in the field, that it was taken instance leaves, fruits, and flowers to be made herbarium and further identified in

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the Laboratory of Botany, Universitas Negeri Gorontalo, Indonesia. In addition to data mangrove species, also measured the temperature, salinity, soil pH, and moisture.

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Figure 1. The study site in the coastal region of Torosiaje Jaya Village, Gorontalo, Indonesia

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Where: V = volume of trees (m3) p = constant (3.14) d = diameter of tree height chest (cm) t = total height (m), and f = figures tree form (0.6) Composition type Composition kind is calculated based on the number of mangrove species are found.

Habitat The research used descriptive analysis towards the habitat analysis obtained from the soil sample analysis done in the laboratory. The laboratory examination included examining soil texture (sand, silt, and clay). In addition, the examination also covered temperature, humidity and salinity aspects, which are significant factors in the development of mangrove.

RESULTS AND DISCUSSION Result Density, density of all species per hectare, and tree volume Based on the density of trees in the Torosiaje Jaya Village indicates a density value of 51.55 trees/3 ha with an 40 _ _ _ _BONORO WO WETLANDS 7 (1): 38-42, June 2017 _ _ _Data analysis _ _ _ _average distance of 581.94 m/tree. All species density _ _Density _ _ _ _ _ _ _value are presented in (Table 1) _ _ _To calculate the density, calculated the average distance _ _ _ _ _of each individual tree with the following formula _Composition type _ _ _(Indriyanto 2010): _ _ _ _In Table 2, it can be argued that in the mangrove forest _ _The distance the average individual tree to tree point _Torosiaje Jaya Village number of species found little that _ _benchmark (d): _ _ _ _four types i.e.

Bruguiera gymnorrhiza, Rhizophora _ _ _ _ _ _ _ _ _mucronata, Rhizophora apiculata, dan Rhizophora stylosa, _ _d = _d1+d2+d3+?+dn _ _ _(1) _of trees 36 individual per 300 m2 with an average distance _ _ _ _n _ _ _ _ _of 581,94 (trees/3 ha). Number of trees in sampling points _ _ _ _ _ _ _ _ _ _Where: _ _ _300 m2 in the village of Mangrove Forests Torosiaje Jaya, _ _ _ _ _ _Gorontalo, Indonesia is presented in Table 2 below. _ _ _d1, d2, d3, .........,

dn = distance of each tree to the point _ _ _ _ _of measurement _ _ _ _Habitat for mangrove species _ _ _n = number of trees _ _ _ _ _ _ _ _ _ _ _Texture, detritus and pH are the dominant factors that _ _d = average distance _of individual trees to _the _ _ _ _ _ _affect the development of mangrove. Mangrove soil is _ _ _measuring point _ _ _ _ _ _ _ _ _ _alluvial, which is brought and sedimented by the river and _ _ _ _ _ _ _ _ _ _ _Density all species per hectare (K) _ _the seawater. Alluvial can be classified as sand, silt and _ _ _ _clay.

It is these three components which form soil in _ _ _To calculate the density of all types of trees used the _different composition. Mud is composed by silt and clay _ _following formula (Indriyanto 2010): _ _which are rich in detritus. _ _ _ _ _Area _ _ _ _The analysis _conducted at the Laboratory of _PG _ _ _ _ _ _ _ _Tolangohula and the site investigation revealed that the _ _ _ _ _ _ _ _ _ _ _k = ( )2 _(2) _ _ _ _ _habitat of the species found in Torosiaje for Sampling Point _ _Volume of trees _ _ _ _1, Bruguiera gymnorrhiza is in the habitat which contains _ _ _ _ _ _sand (0%), silt (61.0-62.1%), and clay (38.9-39.0%).

_ _Volume of trees is a content or the magnitude of a _Sampling Point _2, Rhizophora mucronata contains _sand _ _sample obtained from the width and height of the sample. _(0%), silt (62.5-69.7%), and clay (30.8-37.5%). Sampling _ _Tree volume calculated using the formula Brown (1997): _ _ _ _Point 3, the habitat of Rhizophora stylosa contains sand _ _ _ _ _ _ _ _ _ _ _V = ¼.p.d2.t.f

_ _ _(3) _(0%), silt (52.0%), and clay (47.0%). The habitat of _ _ _ _ _ _Rhizophora apiculate contains sand (0%), silt (33.4%), and _ _clay (67.0%). The temperature at the Sampling Point 1 for Bruguiera gymnorrhiza ranges between 31.5-31.80C, its salinity is between 21.6 ppt – 22.1 ppt, and its humidity level is between 84.8-85%. At the Sampling Point 2, the temperature for Rhizophora mucronata ranges between 31-31.50C, its salinity is between 21.8-22.1 ppt, and its humidity level is between 85-86%.

At the Sampling Point 3, the temperature for Rhizophora apiculate ranges between 30-30.50C, its salinity is between 21.2-21.8 ppt, and its humidity level is between 86.5-87%; the temperature for Bruguiera gymnorrhiza is 300C, its salinity is 20.5 ppt, and its humidity level is 87%; the temperature for Rhizophora stylosa is 30.50C, its salinity is 201 ppt, and its humidity level is 86.5%; and the temperature for Rhizophora mucronata is between 30-30.20C, its salinity is between 20-20.5 ppt, and its humidity is 87%.

Discussion Based on the results of data density of trees in the village of Torosiaje Jaya indicate that at the sampling point 3, 2, and 1 has the highest density. This is evidenced, with 36 trees found at sampling points 3, Bruguiera gymnorrhiza is the dominant species, 35 trees for sampling point 2 with dominant species Rhizophora mucronata, and found 34 trees for one sampling point with the dominant species Rhizophora

stylosa.

These species were classified as dominant as they are the dominant species found at the research site and had the widest distribution over the site.

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Table 1. Density value, density of all species per hectare, and tree volume at the research site Species names _TS _Quadrant _NP _JP _DP (cm) _VP _ _ _ _ _ _(m) _ _(m3) _ _B.gymnorrhiza _1 _I _1 _8 _82 _2,566.68 _ _B.gymnorrhiza _ _ _2 _12 _86 _2,826.5 _ _B.gymnorrhiza _ _ _3 _14 _92 _3,638.98 _ _B.gymnorrhiza _ _ _4 _18 _102 _4,473.06 _ _B.gymnorrhiza _ _ _5 _21 _82 _2,248.47 _ _B.gymnorrhiza _ _ _6 _26 _108 _4,457.58 _ _B.gymnorrhiza _ _ _7 _33 _83 _1,974.55 _ _B.gymnorrhiza _ _ _8 _42 _85 _2,416 _ _B.gymnorrhiza _ _ _9 _49 _74 _1,831.15 _ _B.gymnorrhiza _ _II _10 _8 _72 _1,485.86 _ _B.gymnorrhiza _ _ _11 _10 _68 _1,104.46 _ _B.gymnorrhiza _ _ _12 _16 _82 _1,927.26 _ _B.gymnorrhiza _ _ _13 _21 _86 _2,826.5 _ _B.gymnorrhiza _ _ _14 _26 _72 _1,485.86 _ _B.gymnorrhiza _ _ _15 _35 _92 _2,830.32 _ _B.gymnorrhiza _ _ _16 _47 _68 _1,104.46 _ _B.gymnorrhiza _ _III _17 _5 _72 _1,485.86 _ _B.gymnorrhiza _ _ _18 _7 _82 _2,248.47 _ _B.gymnorrhiza _ _ _19 _12 _85 _2,761.15 _ _B.gymnorrhiza _ _ _20 _18 _65 _1,009.16 _ _B.gymnorrhiza _ _ _21 _22 _82 _2,248.47 _ _B.gymnorrhiza _ _ _22 _29 _93 _3,305.35 _ _B.gymnorrhiza _ _ _23 _35 _100 _3,821.66 _ _B.gymnorrhiza _ _ _24 _44 _120 _6,191.08 _ _B.gymnorrhiza _ _IV _25 _6 _75 _1,612.26 _ _B.gymnorrhiza _ _ _26 _11 _72 _1,485.86 _ _B.gymnorrhiza _ _ _27 _17 _82 _2,248.47 _ _B.gymnorrhiza _ _ _28 _23 _65 _1,009.16 _ _B.gymnorrhiza _ _ _29 _32 _83 _2,303.65 _ _B.gymnorrhiza _ _ _30 _34 _68 _1,104.46 _ _B.gymnorrhiza _ _ _31 _37 _72 _1,485.86 _ _B.gymnorrhiza _ _ _32 _40 _64 _978.34 _ _B.gymnorrhiza _ _ _33 _43 _89 _2,648.74 _ _B.gymnorrhiza _ _ _34 _49 _93 _3,305.35 _ _R. mucronata _2 _I _1 _5 _68 _1,104.46 _ _R.

mucronata _ _ _2 _8 _84 _2,022.42 _ _R. mucronata _ _ _3 _16 _82 _1,927.26 _ _R. mucronata _ _ _4 _19 _65 _1,009.16 _ _R. mucronata _ _ _5 _21 _98 _3,670.32 _ _R. mucronata _ _ _6 _35 _74 _1,569.55 _ _R. mucronata _ _ _7 _48 _95 _3,880.18 _ _R. mucronata _ _II _8 _6 _68 _1,325.35 _ _R. mucronata _ _ _9 _9 _75 _1,880.97 _ _R. mucronata _ _ _10 _12 _81 _2,193.96 _ _R. mucronata _ _ _11 _17 _72 _1,485.86 _ _R. mucronata _ _ _12 _22 _103 _4,054.39 _ _R. mucronata _ _ _13 _28 _102 _4,473.06 _ _R. mucronata _ _ _14 _30 _82 _1,927.26 _ _R. mucronata _ _ _15 _33 _96 _3,081.78 _ _R. mucronata _ _ _16 _37 _99 _3,277.4 _ _R. mucronata _ _III _17 _5 _68 _1,104.46 _ _R. mucronata _ _ _18 _9 _69 _1,137.18 _ _R. mucronata _ _ _19 _13 _74 _1,569.55 _ _R. mucronata _ _ _20 _19 _78 _1,743.82 _ _R. mucronata _ _ _21 _24 _68 _1,104.46 _ _R. mucronata _ _ _22 _28 _75 _1,612.26 _ _R. mucronata _ _ _23 _31 _82 _1,927.26 _ _R. mucronata _ _ _24 _42 _86 _2,119.87 _ _R. mucronata _ _ _25 _26 _96 _3,522.04 _ _R. mucronata _ _ _26 _37 _106 _3,757.26 _ _R. mucronata _ _ _27 _45 _116 _5.785.22 _ _R.

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mucronata _ _IV _28 _7 _98 _3,211.53 _ _R.

mucronata _ _ _29 _11 _64 _978.34 _ _R. mucronata _ _ _30 _26 _102 _3,976.05 _ _R.
mucronata _ _ _31 _30 _68 _1,104.46 _ _R. mucronata _ _ _32 _33 _76 _1,655.54 _ _R.
mucronata _ _ _33 _42 _69 _1,364.62 _ _R. mucronata _ _ _34 _22 _74 _1,569.55 _ _R.
mucronata _ _ _35 _35 _82 _1,927.26 _ __ R. mucronata _3 _I _1 _5 _69 _1,364.62 _ _R.
mucronata _ _ _2 _9 _69 _1,137.18 _ _R. mucronata _ _ _3 _13 _72 _1,485.86 _ _R.
mucronata _ _ _4 _17 _74 _1,569.55 _ _R. mucronata _ _ _5 _22 _86 _2,473.18 _
_B.gymnorrhiza _ _ _6 _28 _88 _2,589.55 _ _B.gymnorrhiza _ _ _7 _32 _65 _1,210.99 _ _R.
apiculata _ _ _8 _38 _66 _1,040.45 _ _R. apiculata _ _ _9 _40 _74 _1,569.55 _ _R. apiculata _
_ _10 _45 _96 _3,522.04 _ _R. stylosa _ _II _11 _7 _64 _978.34 _ _R. stylosa _ _ _12 _11 _85
_2,070.86 _ _R. stylosa _ _ _13 _13 _96 _3,522.04 _ _R. stylosa _ _ _14 _20 _103 _4,054.39 _
_R. stylosa _ _ _15 _23 _112 _5,393.12 _ _R. stylosa _ _ _16 _42 _96 _3,522.04 _ _R.
mucronata _ _ _17 _37 _92 _2,830.32 _ _R. mucronata _ _ _18 _31 _88 _2,219.62 _ _R.
mucronata _ _ _19 _34 _102 _4,473.06 _ _R. apiculata _ _III _20 _5 _72 _1,485.86 _ _R.

apiculata _ _ _21 _11 _68 _1,104.46 _ _R. apiculata _ _ _22 _18 _66 _1,248.54 _ _R. apiculata
_ _ _23 _24 _89 _3,027.13 _ _R. apiculata _ _ _24 _26 _102 _4,473.06 _ _R. stylosa _ _ _25
_21 _115 _5,.685.91 _ _R. stylosa _ _ _26 _31 _92 _3,234.65 _ _R. stylosa _ _ _27 _39 _96
_3,522.04 _ _B.gymnorrhiza _ _IV _28 _6 _65 _1,009.16 _ _B.gymnorrhiza _ _ _29 _10 _86
_2,119.87 _ _B.gymnorrhiza _ _ _30 _15 _72 _1,485.86 _ _R. stylosa _ _ _31 _24 _68
_1,325.35 _ _R. stylosa _ _ _32 _34 _72 _1,485.86 _ _R. stylosa _ _ _33 _38 _86 _2,119.87 _
_R. mucronata _ _ _34 _30 _102 _4,473.06 _ _R. mucronata _ _ _35 _21 _64 _978.34 _ _R.
mucronata _ _ _36 _48 _121 _8.392.93 _ _The mean distance of tree (m2) _ _ _581,94 _ _
_The density of all species/ha _ _ _ _51,55 _ _ _ Notes: TS: Sampling Point, Np: Tree
Number, Jp: Tree Distance, Dp: Tree Distance, Vp: Tree Volume Table 2. Number of trees
in sampling points 300 m2 in the village of Mangrove Forests Torosiaje Jaya, Gorontalo,
Indonesia.

Location _Number of _Number of _ _ _species _trees _ _ _ _ _ _Side point 1 _1 _34 _ _Side
point 2 _1 _35 _ _Side point 3 _4 _36 _ _ Data showed that the dominant species found in
each Sampling Point possessed the highest skills of adaptation towards their habitats for
survival purposes. The species composition of coastal mangrove forests Torosiaje Jaya
Village found four species of Bruguiera gymnorrhiza namely, Rhizophora mucronata,

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Rhizophora apiculata, Rhizophora stylosa. Salinity, substrate, and temperature affect mangrove density and species composition.

Salinity affects the growth and density of mangrove, which is based on the results of further research towards the sea, the salinity or salt content of the higher places. Mangrove is not a plant that needed salt but mangrove is a plant that is tolerant of salt. This is in line with the opinions by Hutahaean et al. (1999), which examined the mineral elements needed for the growth of mangrove plants are the macro elements such

as N, P, S, K, Ca and Mg and micro elements consisting of Zn, Mn, and Cu.

Based on these results the elements Na and Cl are not needed for the growth of mangrove plants. If the salt content on the site is too high then the growth will be stunted mangrove. According Hutahaean et al. (1999) that the range of salinity for Rhizophora mucronata is 12-30 ppt.

based on the results of research that salinity in coastal areas Torosiaje Jaya Village for 21.5 to 22 ppt of Rhizophora mucronata. species, a species that is from 21.5 to 22 ppt of Bruguiera gymnorrhiza, Rhizophora stylosa species are 20 to 21.5 ppt. Therefore, The coastal of Torosiaje Jaya Village is a coastal region that can support the growth of three species of mangrove dominant.

Various types of mangroves overcome salinity levels in different ways. Rhizophora, for instance, secretes excess salt through the glands under its leaves to overcome high salinity. The absorbed water has almost become fresh water, with 90-97% of salt content in seawater were unable to pass through this root filter.

Salt from the plant body was accumulated in the old leaves and wasted along with fall leaves. Mangrove vegetation should seek to maintain water because of the difficulty in obtaining fresh water. In addition to salinity, density substrate also affects the mangroves. The substrate is generally composed of sand, clay, and dust.

Based on the results of laboratory analysis, soil dominant mangrove species Bruguiera gymnorrhiza is a land that has a <5% sand, dust from 61.1 to 75.3%, and 17.1 to 47.9% clay. According to Indah et al. (2008), this ground including clayey loam soil which is dominated by a blend of silt and clay that causes the formation of good texture.

That is why the substrate in this region is classified as good and supports the growth of various mangrove species found in the research site. Based on observations of air temperature that is at the study site ranged from 30-31.8°C. At the point of observation that high temperature caused by sunlight is still hindered by the mangrove canopy cover so that the temperature becomes lower.

Temperatures in the coastal mangrove forests Torosiaje Jaya Village is the range of temperature that supports the growth of mangrove. This is confirmed by Kusmana (2010) states that if the temperature is higher than 35ºC, it will give unfavorable influence on the process of photosynthesis so that the process of mangrove growth will be hampered.

In conclusion, the value density types of mangrove forests in the coastal regions of Torosiaje Jaya Village for the entire species is 51.55 trees/ha with an average distance _ of 581.94 m/tree. The species composition of coastal mangrove forests of Torosiaje Jaya Village found four species namely Bruguiera gymnorrhiza, Rhizophora mucronata, Rhizophora apiculata, and Rhizophora stylosa. Mangrove density and species composition in an area influenced by several factors among which salinity, substrate, and temperature.

Habitat that affects the growth of mangrove species on the coast of Torosiaje village is mangrove soil which contained sand (<5%), dust (61.1-75.3%), and clay (17.1-47.9%). The soil includes clay because of the combination of dust and clay that forms a good texture. Therefore, the substrate found in this coast is classified as good and can support the growth of various mangrove species found in the research site.

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