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Potential Source of Tree Seeds at Jering Menduyung Nature Tourism Park, West Bangka, Bangka Belitung Islands

Potensi Sumber Benih Pohon di Taman Wisata Alam Jering Menduyung, Bangka Barat, Kepulauan Bangka Belitung

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Abstract. Jering Menduyung Nature Tourism Park (NTP) still has relatively well-preserved natural areas. This area is known as Keruing Forest because of the large number of *keruing hitam* stands with large diameter. This study aims to identify the species that have potential to serve as seed sources in this area. Vegetation data and microclimate measurements were carried out in 21, 20 x 20 m square plots (=0.84 ha). Identification was carried out by matching specimens with the collection of Herbarium Bangka Belitungense. The species found were analyzed in reference to the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.3/MENLHK/SETJEN/KUM.1/1/2020 regarding the Implementation of Forest Plant Seeds. The results show that pules (*Guioa pubescens* (Zoll. & Moritzi) Radlk.) and *keruing hitam* (*Dipterocarpus grandiflorus* (Blanco) Blanco) can be used as source of identifiable seeds stands. Both species have seedlings that grow in clusters near their parent tree. However, due to insufficient spacing between parent trees, they do not meet the utilization requirements outlined in the SNI 8806:2019 Source of forest tree propagules, these two species cannot be used as natural seed sources. Vegetative propagation or a policy review can be considered as alternative solutions.
Key words: Traditional block; Dipterocarpus grandiflorus; Guioa pubescens; lowland forest

Abstrak. *Taman Wisata Alam (TWA) Jering Menduyung memiliki kondisi alam yang relatif terjaga. Kawasan ini dikenal sebagai Hutan Keruing karena banyaknya tegakan keruing hitam berdiameter besar. Penelitian ini bertujuan untuk mengidentifikasi spesies pohon yang berpotensi sebagai sumber benih di kawasan ini. Data vegetasi dan pengukuran mikroklimat dilakukan pada 21 plot kuadrat 20 x 20 m² (=0,84 Ha). Identifikasi dilakukan melalui pencocokan dengan koleksi Herbarium Bangka Belitungense. Spesies yang ditemukan dikaji dengan Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor P.3/MENLHK/SETJEN/KUM.1/1/2020 tentang Penyelenggaraan Perbenihan Tanaman Hutan. Hasil menunjukkan bahwa pules (Guioa pubescens (Zoll. & Moritzi) Radlk.) dan keruing hitam (Dipterocarpus grandiflorus (Blanco) Blanco) berpotensi sebagai sumber benih bagi Tegakan Benih Teridentifikasi (TBT). Semai kedua spesies tumbuh di dekat pohon induk sehingga tumbuh mengelompok. Namun jika mengacu pada Standar Nasional Indonesia SNI 8806:2019 Sumber benih tanaman hutan, kedua spesies pohon ini tidak dapat dijadikan sebagai sumber benih karena tidak memenuhi syarat jarak antar pohon induk minimal 100 m. Perbanyakan secara vegetatif atau peninjauan ulang kebijakan dapat dipilih sebagai upaya alternatif.*
Kata kunci: *Blok tradisional; Dipterocarpus grandiflorus; Guioa pubescens; hutan dataran rendah*

INTRODUCTION

Conservation, protection and production are the three forest functions listed in the Republic of Indonesia Law Number 41 Year 1999 Article 3b. One manifestation of this conservation function is the establishment of some protected forest areas as Nature Tourism Parks (NTP; Indonesian: Taman Wisata Alam), which have the function of protecting life support systems, preserving the diversity of plant and animal species, and sustainable use of biological natural resources and ecosystems. Jering Menduyung NTP in West Bangka Regency is one of two NTPs on Bangka Island.

This area has a small amount of lowland forest which is the traditional forest of the Jering Menduyung community with relatively intact, preserved and undisturbed plants. This can be seen from the many large trees, especially *Dipterocarpus grandiflorus* (Blanco) Blanco with an average diameter of 69 cm (Nurtjahya *et al*., 2019), which are quite easy to find so that the forest, which is part of the traditional block of Jering Menduyung NTP, is nicknamed 'Keruing Forest'. According to IUCN (https://www.iucnredlist.org/ , 2022), this species is listed as *Endangered* from a 2017 assessment based on the criteria A2cd (population decline ≥ 50% due to decreased habitat area, as well as due to exploitation), and requires conservation action by protecting the habitat of the species, as well as conducting *ex-situ* conservation.

Effective conservation of tropical plant species depends on information on species distribution in space, population dynamics, and complex interactions between species in communities (Mueller-Dombois and Ellenbergh, 2016). Understanding these can be obtained through research on the potential of forests as a source of tree seeds. Vegetation analysis can help determine the habitat conditions suitable for the tree species whose seeds will be utilized, and how they are distributed and populated in nature. The results of the study can be used as a reference in *ex-situ* conservation management without disturbing the balance of the ecosystem in the forest.

The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.3/MENLHK/SETJEN/KUM.1/1/2020 concerning the Implementation of Forest Plant Seeds article 21 paragraph (2) reads "Seed sources in nature conservation areas are only intended for identified seed stands (Indonesian: Tegakan Benih Teridentifikasi, TBT)". To date, however, a TBT seed source has not been reported from Jering Menduyung NTP. Therefore, research is required to examine the potential of stands in lowland forests, including in the traditional block of Jering Menduyung NTP, as a source of TBT seeds for conservation in Bangka and other regions of Indonesia, given the alleged heterogeneity of environmental conditions and the well-preserved lowland forests.

MATERIALS AND METHODS

The research was conducted at Jering Menduyung NTP, Air Menduyung Village, Simpang Teritip Sub-district, West Bangka Regency, Bangka Belitung Islands Province. The four blocks in the Jering Menduyung NTP according to the Minister of Environment and Forestry Regulation No. 76 of 2015 is protection (1694.028 Ha), rehabilitation (1271.189 Ha), utilization (723.237 Ha), and traditional block (58.986 Ha). Vegetation analysis was conducted from the end of January to the first week of February 2023 in 21 plots (20 m x 20 m). These observations were made in the traditional block with a total area of 58.986 Ha (BKSDA SUMSEL, 2020). This block was selected because the protection block and rehabilitation block are mostly comprised of mangrove and swamp forests, which are not the focus of this study, and the utilization block was not selected because it is vulnerable to human disturbance and is thought to affect the parent trees of potential seed sources.

A general description of the study site, including aspects such as soil type, is given in BKSDA SUMSEL (2020); climate data, such as rainfall, is available from BMKG (2023) for the period 2018-2022. Quadrat plots were made by purposive sampling at points that were considered representative of lowland forests and had at least one individual with a tree stage. The minimum distance between plots was 20 m, which was determined with the help of Avenza Map via smartphone. Coordinate point mapping from Avenza Map was inputted into ArcGIS version 10.8 and Google Earth Pro to produce a map of the research location (Figure 1).

In each plot, only plants that were trees (dbh ≥20 cm) were recorded. The local names and numbers of individuals at the seedling, sapling, pole and tree stages were recorded, as well as measuring diameter at breast height (dbh), using a roll meter and a vernier caliper, at the pole and mature tree stages, according to the subplots in the quadrats (Figure 1). Growth stage criteria used are adopted from Kasmadi *et al*. (2015) (Figure 2).

Identification of tree species was carried out by photographic documentation of plants in the field and making herbarium specimens. Photos and specimens were identified by matching with the photograph and specimen collections of Herbarium Bangka Belitungense, University of Bangka Belitung (acronym: HBB). Validation of species and family names used Plants of the World Online (POWO; https://powo.science.kew.org/). Data analysis was carried out qualitatively to select potential species based on the TBT (identified seed stand) seed source classification, which requires at least 25 individual parent trees (MENLHK RI, 2020). Species that meet this requirement are then re-identified for eligibility with other general and specific requirements (accessibility, origin of stand, and stand quality) to assess their potential as TBT seed sources.

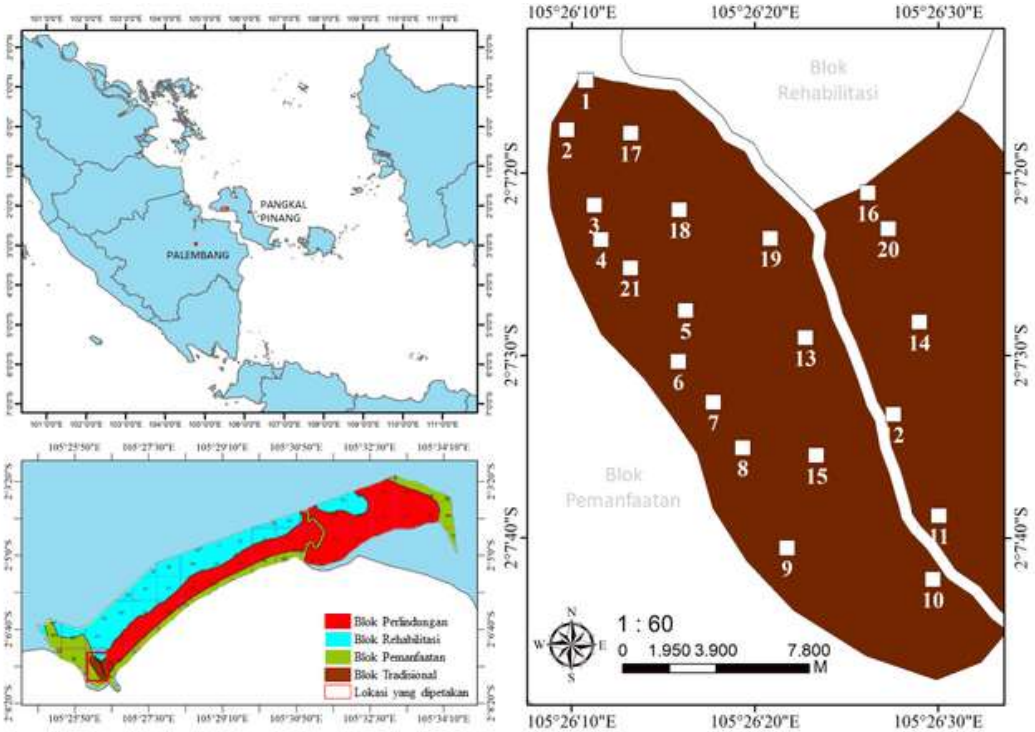
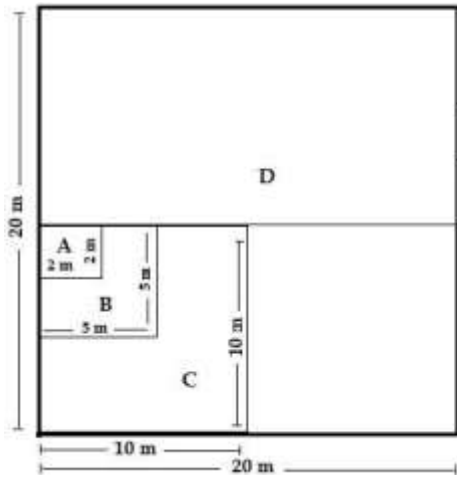


Figure 1. Map of the distribution of 21 observation plots in the traditional block (claret colour – 'Blok Tradisional') of Jering Menduyung NTP (Source of block division map: BKSDA, 2020)



Note:

A= seedling stage, height < 1.5 m;

B= sapling stage, height ≥ 1.5 m and diameter < 10 cm;

C= pole stage, diameter 10 cm to < 20 cm; and

D=tree stage, diameter ≥ 20 cm

Figure 2. Quadrat sampling plot

RESULTS

The results of tree species data collection form the 21 plots found 33 tree species from 19 families. The grouping of tree species by family and their scientific names is given in Table 1.

Table 1. List of species with tree habitus

Family	Species	Local Name	Sd	Sp	P	T	*ni*
Calophyllaceae	*Calophyllum lanigerum* Miq.	mentangor	6	17		2	25
Clusiaceae	*Garcinia* sp.	kedemut	2			2	4
Dipterocarpaceae	*Dipterocarpus* sp.	keruing merah				2	2
Dipterocarpaceae	*Dipterocarpus gracilis* Blume	kayu ara hitam				7	7
Dipterocarpaceae	*Dipterocarpus grandiflorus* (Blanco) Blanco	keruing hitam	97	8		42	147
Dipterocarpaceae	*Vatica rassak* (Korth.) Blume	resak biasa				1	1
Ebenaceae	*Diospyros buxifolia* (Blume) Hiern	mempisang	245	1	3	4	253
Fabaceae	*Archidendron jiringa* (Jack)	jengkol			1	6	7

	I.C.Nielsen						
Hypericaceae	*Cratoxylum arborescens* (Vahl) Blume	gerunggang		2	1	3	6
Verbenaceae	*Vitex pinnata* L.	leben/leban		5	1	2	8
Lauraceae	*Cinnamomum parthenoxylon* (Jack) Meisn.	medang belembang	3	1	1	2	7
Lauraceae	*Dehaasia firma* Blume	medang puser				2	2
Lecythidaceae	*Barringtonia macrostachya* (Jack) Kurz	medang tanah	5	21	4	4	34
Melastomataceae	*Memecylon edule* Roxb.	mempadi		3	4	3	10
Meliaceae	*Aglaia tomentosa* Teijsm. & Binn.	ranggung	8	21	1	1	31
Meliaceae	*Lansium domesticum* Corrêa	langsat				1	1
Meliaceae	*Sandoricum koetjape* (Burm.f.) Merr.	sentol	7	8	3	8	26
Moraceae	*Artocarpus integer* (Thunb.) Merr.	cempedak				5	5
Moraceae	*Artocarpus lanceifolius* Roxb.	kelidang				3	3
Moraceae	*Artocarpus rigidus* Blume	puren		1	1	10	12
Moraceae	*Ficus caulocarpa* (Miq.) Miq.	jeluteh				1	1
Moraceae	*Ficus nervosa* Roth.	mergatel			1	8	9
Moraceae	*Ficus sundaica* Blume	kayu ara putih				1	1
Myrtaceae	*Syzygium pycnanthum* Merr. & L.M.Perry	kerbancui	68	12		1	81
Myrtaceae	*Syzygium rostratum* (Blume) DC.	selampit	5	3	2	4	14
Myrtaceae	*Syzygium urceolatum* (Korth.) Merr. & L.M.Perry subsp. *palembanicum* (Miq.) P.S.Ashton	samek/uber		1		7	8
Ochnaceae	*Brackenridgea palustris* Bartell.	kulan				1	1
Phylanthace	*Aporosa lucida* (Miq.) Airy Shaw	pelangas	2	7	1	1	11
Rubiaceae	*Discospermum malaccense* (Hook.f.) Kuntze	mentulang				1	1
Sapindaceae	*Guioa pubescens* (Zoll. & Moritzi) Radlk.	pules	296	44	17	57	414
Sapindaceae	*Xerospermum noronhianum* (Blume) Blume	kayu batu	10	47	8	24	89
Sapotaceae	*Palaquium gutta* (Hook.) Baill.	nyatoh laut	35	22	3	9	69
Theaceae	*Schima wallichii* (DC.) Korth.	seru				5	5

Notes: Sd = seedling, Sp = sapling, P = pole, T = tree, ni = total number of individuals per tree species (=Sd+Sp+P+T)

A specific requirement of TBT seed sources is that they must have at least 25 parent trees, and only *Dipterocarpus grandiflorus* (keruing hitam) and *Guioa pubescens* (pules) meet this requirement. Analysis of the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. P.3/MENLHK/SETJEN/KUM.1/1/2020 on the Implementation of Forest Plant Seedlings, shows that these two tree species meet the general (Table 2) and specific requirements (Table 3).

Table 2. General requirements for seed source

Article 57	TBT Seed Source Candidates of *Dipterocarpus grandiflorus* (keruing hitam) and *Guioa pubescens* (pules)
Accessibility; the location of the Seed Source is easy to reach and facilitates maintenance, fruit downloading, speeds up transportation time, and to ensure physical-physiological	The parent trees of both *D. grandiflorus* and *G. pubescens* can be accessed from Air Menduyung Village using a motorcycle via a footpath. It is also possible to reach both *D. grandiflorus* and *G. pubescens* stands on foot from the footpath, but it's important to be accompanied by a local elder to prevent any unwanted incidents.
Flowering/fruiting; provided that the stand has flowered and borne fruit, except for pruning gardens	The flowers and fruits of *D. grandiflorus* found in late January 2023 were already quite damaged. According to field assistants, *D. grandiflorus* usually flowers in April and September.
Security; with the provision that stands must be safe from the threat of fire, illegal logging, shifting cultivation, grazing, and looting of the area.	The Jering Menduyang NTP, especially the forest where this stand is located, is a customary forest that is well guarded by the community. To enter the forest, we must be accompanied by a traditional leader who also participates in rituals before cutting down large trees, as they believe that large trees have spirits or

Accessibility; the location of the Seed Source is easy to reach and facilitates maintenance, fruit downloading, speeds up transportation time, and to ensure physical-physiological	The parent trees of both *D. grandiflorus* and *G. pubescens* can be accessed from Air Menduyung Village using a motorcycle via a footpath. It is also possible to reach both *D. grandiflorus* and *G. pubescens* stands on foot from the footpath, but it's important to be accompanied by a local elder to prevent any unwanted incidents. residents.
Stand health; provided that the **stand** must not be attacked by pests and diseases.	Both species have healthy stands.
Area boundaries; provided that the area boundaries must be clear, so that seed collectors know which stands are included as seed sources.	The stands are in traditional blocks which are bordered to the north, northwest, west, southwest, and south by utilization blocks, to the northeast by rehabilitation blocks, and to the east and southeast by protection blocks (BKSDA SUMSEL, 2020).
Well managed; provided that the Seed Source has clear ownership status and has good management indicators, including maintenance, organization and utilization of Seeds	The conservation area is managed by South Sumatra BKSDA which is follows the Decree of the Minister of Environment and Forestry of the Republic of Indonesia Number SK. 580/Menlhk/Setjen/PLA.2/7/2016 dated July 27, 2016 (BKSDA SUMSEL, 2020).

Table 3. TBT Specific Requirements

Article 58 paragraph (2)	**TBT Seed Source Candidates of *Dipterocarpus grandiflorus* (keruing hitam) and *Guioa pubescens* (pules)**
Origin of stand from natural forest or plantation forest	Both species come from natural stands in lowland forests, in the traditional block of Jering Menduyung NTP.
In the case of stands originating from plantation forests, the stands were not originally planned to serve as a seed source.	
The origin of the seed is unknown	Seeds of both species are of unknown parent origin *G. pubescens* and *D. grandiflorus* have several parent trees in close proximity, where more than one parent tree can be found in a 20 m x 20 m plot. This makes it impossible to ascertain which seed came from which parent tree. In addition, there were several cases where seedlings of *G. pubescens* grew in plots that did not have parent trees. This can be seen as the dispersal of seeds in such a way that their origin cannot be determined.
Number of trees at least 25 (twenty five) parent trees	42 *D. grandiflorus* parent trees, and 57 *G. pubescens* parent trees were identified.
Average stand quality or meet productivity standards set by the Head of the Agency.	The diameter range of *D. grandiflorus* stands ranged from 0.34-2.09 m with an average of 0.94 (± 0.33) m, and the diameter range of *G. pubescens* stands ranged from 0.2-1.4 m with an average of 0.35 (± 0.16) m.
Isolation line not required	Both species do not require isolation lines.
Thinning is not done	Both species were not thinned, they are growing naturally.

DISCUSSION

Based on the number of tree stages in Table 1, only individuals of pules (*Guioa pubescens* (Zoll. & Moritzi) Radlk.) and keruing hitam (*Dipterocarpus grandiflorus* (Blanco) Blanco) have potential as natural seed sources. Only members of these two species fulfill the general requirement of seed sources, which is to have at least 25 parent trees, in the Jering Menduyung NTP. A seed source as stated in PERMENLHK RI Number P.3/MENLHK/SETJEN/KUM.1/1/2020 concerning the implementation of Forest Plant Seeds Article 1 paragraph (3) is a stand within the forest area or outside the forest area that is managed to produce quality seeds. Hence, other species with a high number of individuals, like mempisang (*Diospyros buxifolia*), may not be suitable as a seed source because the number of parent trees is less than 25, which does not comply with the regulations.

The requirement regarding the number of parent trees is related to the role of parent trees as seed producers, because without adequate parent trees, the availability of seeds in nature will

decrease or even become unrecoverable, so that sustainable utilization will become unviable over time. The parent tree requirement for seed source utilization is defined as a mature tree that has reached the full development stage. According to Irawan *et al*. (2020), a parent tree is a tree designated as a tree to produce seeds or vegetative material used to produce new plant seedlings due to its superior characteristics. Although trees can have a diameter at breast height (dbh) of 30 cm, if they cannot produce seeds, they cannot be considered parent trees and cannot be used as seed sources.

Pules and keruing hitam trees included in the tree stage can be regarded as parent trees when they have flowered and produced seeds (Table 2). According to Ulfa et al. (2019), mature trees of Dipterocarpaceae species are determined by having a diameter at breast height (dbh) of 20 cm or more. In addition, research by Widjaya *et al*. (2021) on one species of Dipterocarpaceae, *Vatica venulosa* Blume, which is 15 years old with a height of 8 m, which flowered and 8 years after planting from seed (2005-2013).

The number of potential parent trees of both potential natural seed source species totaled 57 individuals for pules and 42 individuals for keruing hitam, and met the additional requirements as listed in Table 2 and Table 3. However, when referring to the Indonesian National Standard SNI 8806:2019 *Forest plant seed sources,* both species cannot be used as seed sources because they do not meet the general requirement, namely, "*In natural forests, the distance between parent trees is at least 100 m*". In the 21 plots, a distance between individuals of 100 m is not found because the distance between the plots is only 20 m (Figure 3).

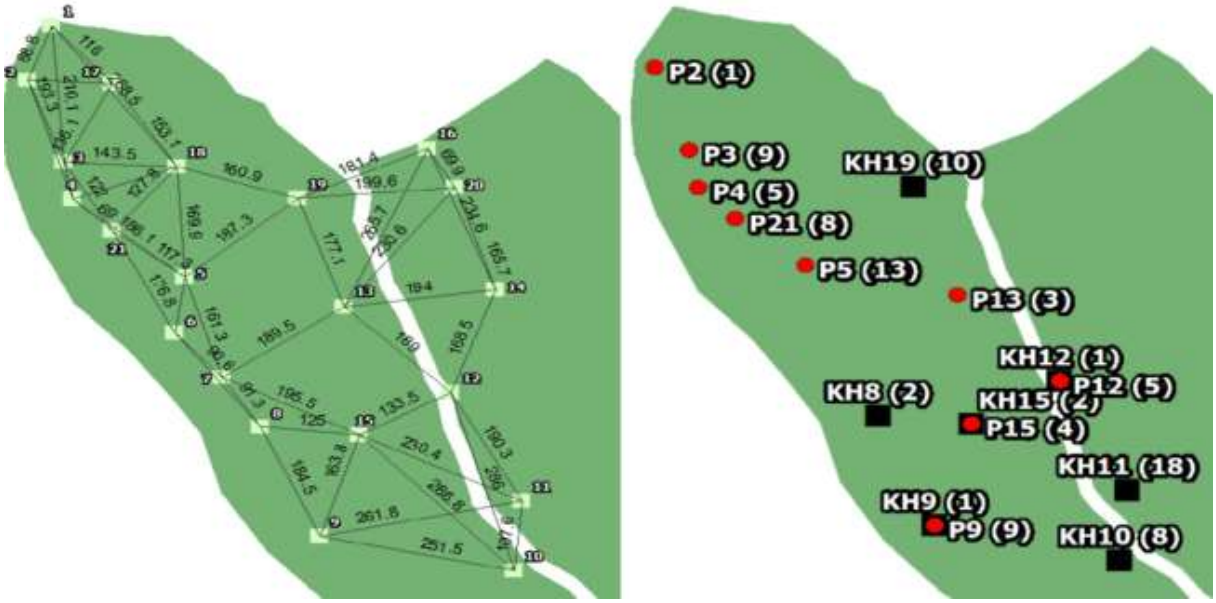


Figure 3. Distance between observation plots (left, units in meters) and distribution of parent trees of potential species (right). Notes: ● = pules (P), ■ = keruing hitam (KH); P2(1) = Plot 2 contains 1 pules parent tree.

The close proximity of parent trees is thought to be caused by environmental conditions that affect the growth and distribution criteria of plant species. Generally, plants have a distribution pattern or distribution that varies, ranging from random, clustered, to some that are spread regularly (Utami and Putra, 2020). The ability of a plant species to arrive and grow in a place is influenced by three factors, namely 1) a special distribution mechanism, 2) the age and level of development, high survival, and reproductive capacity, and 3) the abundance, distance, and position of the seed source (Mueller-Dombois and Ellenbergh, 2016). In this study, it can be said that the accessibility of tree species in the study site has a considerable influence on the distribution mechanism and position of the seed source.

In general, seeds and seedlings of each tree species were found not far from the parent tree, especially for pules (*Guioa pubescens*) and keruing hitam (*Dipterocarpus grandiflorus*) (Figure 4). This is due to the need for shade by the seeds at the beginning of their germination, because direct sunlight can cause death due to drought (Irawan *et al*., 2020). This phenomenon indicates that there is limited seed distribution and dispersion, with the result that the seedlings grow in groups close together. Seed production itself will not occur if it is not preceded by flowering and fertilization, both of which are thought to be triggered by air temperature, rainfall and sunlight. Some tree species flower and fruit at

consistent intervals but not every year. In Dipterocarpaceae for example, members of this family experience annual dry season flowering in everwet forests (Kurten *et al*., 2018) and tend to fruit together at long but not fixed intervals of 5–7 years (Göltenboth *et al*., 2012).

Figure 4. A group of keruing hitam seedlings (A) and a group of pules seeds that have been eaten by animals (B).

However, the distribution of *Guioa pubescens* species is wider and more evenly distributed than *Dipterocarpus grandiflorus*. This is thought to be due to differences in seed size between the two. Large seeds of keruing hitam require dispersal agents in the form of small mammals, such as the squirrels seen in this study. Despite having winged seeds, wind may not be able to disperse seeds of Dipterocarpaceae to distant places, Göltenboth *et al.* (2012) state that wind dispersal is only possible when the wind is strong enough that most seeds will remain near the parent tree. In addition, pules have much smaller seeds than keruing hitam, so these seeds can be dispersed by birds, which is expected to make their dispersal range much wider than that of squirrels. However, it is possible that these animals are fruit/seed eaters and this may reduce the population of seeds that can grow into seedlings. In Figure 5 it can also be seen that biotic factors such as animals can affect the distribution of pules, where seeds are collected in one place and eaten, so they cannot grow into new individuals. Even if there are still some that can grow, the growth of the seedlings will be very dense. In the future, this will lead to competition between individuals for the resources they need.

The availability of nutrients in the soil is influenced by various components including soil pH and water as a nutrient solvent, so soil conditions are not uniform in all locations. According to Kusuma and Yanti (2021), the greater the water content, the higher the C-organic content, so that the soil pH becomes more acidic. Soil acidity is also influenced by water content due to increased H+ concentration (Purba *et al*., 2021). pH at this research location is almost classified as neutral with a range of 5.4 - 7, not too acidic and not alkaline. This is in accordance with the nature of the soil types that make up the Jering Menduyung NTP which are dominated by alluvial soil types, in addition there are also regosol and yellow-red podzolic soil types (Figure 5) found in this research location (BKSDA SUMSEL, 2020).

Alluvial soils have a pH range of 5-6 with moderate to good drainage, this soil is also associated with regosol soil types (Riry, 2023) in plots 16 and 20. Regosol soils themselves generally have the same pH range as alluvial soils, formed from new sedimentary materials, especially those from the coast. According to Yunita *et al*. (2023), low soil pH in alluvial soil types is caused by the large amount of organic matter produced through the decomposition process in the soil. The yellow-red podzolic soil in plot 10 also has an acidic pH because it has low essential nutrients and organic matter, but has a high content of dissolved Al, Fe, and Mn that can poison plants (Tobing *et al*., 2023). Pules trees were found in plots 1, 2, 3, 4, 5, 7, 17, 18, 20, 21, while keruing hitam was found in plots 8, 10, 19, and both could be found together in plots 9, 11, 12, 13, 15 (Table 5). Based on this, it can be said that both can grow well on alluvial soils, where pules can tolerate regosol-type soils better than keruing hitam which is more adapted to yellow-red podzolic soils.

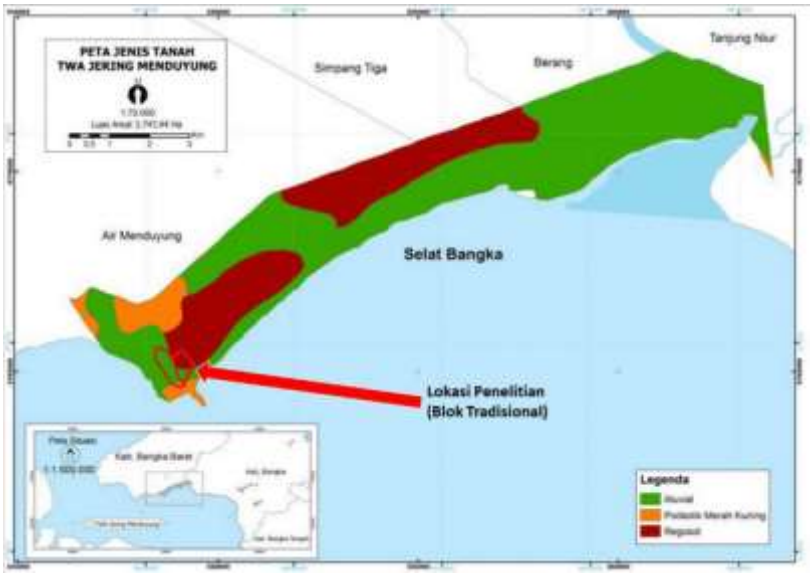


Figure 5. Topographic map of Jering Menduyung NTP (Source: BKSDA SUMSEL, 2020).

Table 5. Distribution of potential seed source tree species by growth stage with >50 individuals in all plots

Local Name	Growth Stage	Number of plot (number of individuals)
Pules	Seedling (=296)	1(5), 2(2), 3(76), 4(5), 5(22), 7(2), 9(98), 12(15), 13(38), 15(20), 17(3), 18(2), 20(5), 21(3)
	Sapling (=44)	1(1), 3(3), 4(4), 5(7), 9(1), 11(2), 12(11), 13(1), 15(6), 18(1), 20(1), 21(6)
	Pole (=17)	3(1), 4(1), 5(2), 9(6), 12(1), 13(2), 15(2), 18(1), 21(1)
	Tree (=57)	2(1),3(9),4(5), 5(13), 9(9), 12(5),13(3),15(4), 21(8)
Keruing hitam	Seedling (=97)	9(3), 10(23), 11(47), 12(2), 19(22)
	Sapling (=8)	11(6), 13(1), 19(1)
	Tree (=42)	8(2), 9(1), 10(8), 11(18), 12(1), 15(2), 19(10)

Note: numbers outside brackets represent plot numbers and number in brackets represent number of individuals. For example 1(5) means that in plot 1 there are 5 individuals

The availability of water in the soil is represented by soil moisture, the higher the moisture the more water is available in the soil. Optimal soil moisture is required for germination. Too little water content can cause the germination process to not be completed, while excessive water content can cause oxygen depletion in the soil which can inhibit germination (Nautiyal *et al*., 2023). Soil moisture in this research location is relatively high due to the presence of river flow and the condition of the area close to the coast. In this study, there were also valley-like areas with several streams that had many keruing hitam stands, so it is possible that such environmental conditions are suitable for keruing germination. Observations of environmental factors such as these can be utilized as guidelines in natural maturing and tree selection for planting, by translating them into basic environmental factors that influence tree growth and tree species composition in the studied area.

This regulation regarding the distance between parent trees has a positive impact on the breeding of plant species that will be used for conservation. Sufficient distance between parent trees can minimize disease transmission during pest or disease outbreaks. On the other hand, it can be difficult, especially in natural forests, because the spacing between species and between individuals of the same species depends on the seed dispersal mechanism as well as the suitability of the growing environment. Since seedlings of most trees are clustered and thinning is not possible as a specific requirement of TBT, human-assisted seed dispersal is also not feasible. In addition, Liu *et al*. (2023) stated that many members of the Dipterocarpaceae and Sapindaceae families have recalcitrant seeds. Recalcitrant seeds do not have a dormancy period, so they are easier to germinate, but long-term storage can reduce their viability (Yudiawati *et al*., 2022). This should certainly be a concern because recalcitrant seeds require special handling so that collected seeds can still germinate. Similarly, when it comes to the requirement of having parent trees at least 100 meters apart, if a threatened

species does not meet these criteria, it should not result in those individuals of that species being disregarded as potential seed sources.

Parent trees, such *as Dipterocarpus grandiflorus*, are also at risk of mortality due to their age. As a result, there are less opportunities for regeneration to replace the dead parent trees and less seed production overall. Vegetative propagation may be possible as an alternative effort to maintain the sustainability of such threatened species. A review of the current regulations and standards is needed to clarify the requirements and criteria when consideration the status of plant species for conservation programmes.

CONCLUSION

The lowland forest in the traditional block of Jering Menduyung NTP has two tree species with potential as a source of seed stands identified, namely pules (*Guioa pubescens* (Zoll. & Moritzi) Radlk.) and keruing hitam (*Dipterocarpus grandiflorus (*Blanco) Blanco, which have 57 and 42 individual parent trees respectively. These two potential species are clustered and grow well on alluvial soils. Pules was found in 15 plots (71.43%) and keruing hitam was found in 7 plots (33.33%) of the total 21 observation plots. However, both cannot be utilized as seed sources based on SNI 8806:2019 because they do not meet the minimum distance requirement of 100 m between parent trees. Vegetative propagation can be chosen as an alternative effort to maintain the sustainability of this threatened species. A review of regulations and standards is needed to clarify the requirements and criteria with consideration of the status of plant species.

REFERENCES

[BKSDA SUMSEL] Balai Konservasi Sumber Daya Alam Sumatera Selatan, 2020. *Rencana Pengelolaan Jangka Panjang (RPJP) Taman Wisata Alam Jering Menduyung Kabupaten Bangka Barat Provinsi Kepulauan Bangka Belitung*. Palembang: BKSDA SUMSEL.

[BSN] Badan Standarisasi Nasional, 2019. SNI 8806:2019 *Sumber benih tanaman hutan*. BSN

Göltenboth F, Timotius LH, Milan PP and Margraf J, 2012. *Ekologi Asia Tenggara: Kepulauan Indonesia*. Jakarta: Salemba Teknika

Irawan US, Arbainsyah, Ramlan A, Putranto H and Afifudin S, 2020. *Manual Pembuatan Persemaian dan Pembibitan Tanaman Hutan*. Bogor: Operasi Walacea Terpadu.

[IUCN] International Union for Conservation of Nature and Natural Resources. 2022. The IUCN Red List of Threatened Species Version 2022-1, diakses dari https://www.iucnredlist.org, pada 16 Juli 2023.

Kasmadi D, Tasirin JS and Sumakud MY, 2015. Komposisi dan Struktur Jenis Pohon di Hutan Produksi Terbatas Ake Oba – Tanjung Wayamli – Ake Kobe. *In COCOS, 6(13):8*

Kurten EL, Bunyavejchewin S, and Davies SJ, 2018. Phenology of a dipterocarp forest with seasonal drought: Insight into the origin of general flowering. *Journal of Ecology, (106): 126-136*.

Kusuma RY and Yanti I, 2021. Pengaruh Kadar Air dalam Tanah Terhadap Kadar C-Organik dan Keasaman (pH) Tanah. *IJCR, 6 (2), 92-97.* https://doi.org/10.20885/ijcr.vol6.iss2.art5

Liu U, Gianella M, Aranda PD, Diazgranados M, Ortiz CMF, Lira-Saade R, Bacci1 S, Mattana E, Milliken W, Mitrovits O, Pritchard HW, Rodríguez-Arévalo I, Way M, Williams C and Ulian T, 2023. Conserving useful plants for a sustainable future: species coverage, spatial distribution, and conservation status within the Millennium Seed Bank collection. *Biodiversity and Conservation, (32): 2791-2839* https://doi.org/10.1007/s10531-023-02631-w

[MENLHK RI] Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia, 2020. PERMENLHK RI Nomor P.3/MENLHK/SETJEN/KUM.1/1/2020 tentang Penyelenggaraan Perbenihan Tanaman Hutan. Jakarta.

Mueller-Dombois D and Ellenbergh H. 2016. *Ekologi Vegetasi: Tujuan dan Metode, Ed. 1* (Terjemahan: Kartawinata K dan Abdulhadi R). Jakarta: LIPI Press.

Nautiyal PC, Sivasubramaniam K and Dadlani M, 2023. *Seed Dormancy and Regulation of Germination*. In: Dadlani, M., Yavada, D.K. (eds) Seed Science and Technology. Singapura: Springer. https://doi.org/10.1007/978-981-19-5888-5_3

Nurtjahya E, Risyda A, Putri CI, Lastri, Risyda A, Putri CI, Saputri LD, Sakila L, Mandasari T and Jepari TW, 2019. Dipterocarps protected by Jering local wisdom in Jering Menduyung Nature Recreational Park, Bangka Island, Indonesia. *Pesquisa Florestal Brasileira. v.39.e201902043, Special issue, 2019*; http://dx.doi.org/10.4336/2019.pfb.39e201902043

Odum EP, 2009. *Dasar-Dasar Ekologi 3rd Ed.* (Terjemahan: Tjahjono Samingan dan B Srigandono). Yogyakarta: Gajah Mada University Press.

Presiden Republik Indonesia, 1999. *Undang-Undang Republik Indonesia Nomor 41 Tahun 1999 tentang Kehutanan*. Jakarta.

Purba T, Ningsih H, Purwaningsih, Junaedi AS, Gunawan B, Junairiah, Figriyanto R and Arsi, 2021. *Tanah dan Nutrisi Tanaman*. Medan: Yayasan Kita Menulis.

[RBG Kew] Royal Botanic Gardens Kews. 2023. Plants of the World Online, diakses dari https://powo.science.kew.org/, pada 18 April 2023.
Riry BR, 2023. Siteplan Pengembangan Objek Wisata Pantai Negeri Hukurila Kota Ambon. *GEOFORUM, Vol. 2 (1): 21-32*. https://ojs3.unpatti.ac.id/index.php/jgse
Tobing L, Gafur S and Abdurrahman T, 2023. Pengaruh Kombinasi Pupuk Organik Sludge, Pupuk N,P,K dan Pupuk Kotoran Ayam terhadap Pertumbuhan dan Hasil Jagung Manis pada Tanah Podsolik Merah Kuning di Kabupaten Sekadau. *Jurnal Pertanian Agros*, *25 (2): 1787-1799*.
Utami I and Putra ILI, 2020. *Ekologi Kuantitatif: Metode Sampling dan Analisis Data Lapangan*. Yogyakarta: Penerbit K-Media.
Ulfa M, Faridah E, Lee SS, Sumardi, Roux Cl, Galiana A, Mansor and Ducousso M, 2019. Multi Inang Fungi Ektomikoriza pada Dipterocarpaceae di Hutan Tropis, *Jurnal Ilmu Kehutanan, 13 (2019) :56-59*.
Widjaya AH, Latifah D, Hardwick KA, Suhartono MR and Palupi ER, 2021. Reproductive biology of Vatica venulosa Blume (Dipterocarpaceae). *BIODIVERSITAS 22(10), 4327–4337*. DOI: 10.13057/biodiv/d22102
Yudiawati E, Sari TL and Setiono, 2022. Pengaruh Lama Penyimpanan Terhadap Viabilitas Benih Kakao (*Theobroma cacao* L.) Varietas Crillo, *BASELANG: Jurnal Ilmu Pertanian Peternakan Perikanan dan Lingkungan, 2 (2): 101-117*.
Yunita Y, Zuraida Z and Jufri Y, 2023. Status Hara Tanah pada Lahan Sawah untuk Pengembangan Padi Organik di Tenggulun Kabupaten Aceh Tamiang. *Jurnal Ilmiah Mahasiswa Pertanian*, *8 (2): 461-467.*

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