An ethnoecological study on plant conservation in Jering Menduyung Nature Recreational Park of West Bangka (Indonesia)

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Research

Abstract

Background: The communities around Jering Menduyung Nature Recreational Park (NRP) have local wisdom for utilizing and managing natural resources. Nature management, which is done and influenced by the implementation of local wisdom, can be studied through ethnoecological studies. This research aimed to record the plant species protected by local wisdom that supports the conservation of trees in the lowland forest of Jering Menduyung NRP through ethnoecological studies.

Methods: This research was conducted in January-July 2023 in the traditional Jering Menduyung NRP and Air Menduyung Village. Ecological data were collected through vegetation analysis using the quadrat method with 21 plots and analyzed by calculating the Important Value Index. Local wisdom was collected through interviews and observation, which were analyzed descriptively and by calculating the Index of Cultural Significance.

Results: There were 37 tree species found in 24 families. The main uses of these tree species are for building boats and houses, being utilized as traditional ritual materials, and being the source of natural honeycomb. Based on the ICS values, the most important species in the local culture are *Calophyllum lanigerum* Miq., *Dipterocarpus gracilis* Blume, *Ficus sundaica* Blume, and *Dipterocarpus grandiflorus* (Blanco) Blanco. These tree species are protected by the local wisdom in managing landscape units, a ban on cutting trees in the *rimba*, belief in *pulong kayu*, *sapon* honey, the taboo of *melayuk*, and traditional rituals.

Conclusions: Local wisdom of the community around Jering Menduyung NRP supports tree conservation in those areas.

Keywords: *Jerieng* Tribe, Local ecological knowledge, Local wisdom, Traditional ecological knowledge, Tree

Background

Indonesia has designated 63% of its land area, or about 120.5 million hectares of forest area, into three main functions, namely production forest covering 68.8 million hectares; conservation forest covering 22.1 million hectares; and protected forest covering 29.6 million hectares (KLHK 2022). The conservation of forest areas, which protect biodiversity, is usually associated with the presence of local communities with local wisdom values that maintain the area. Local communities have maintained the area long before the conservation area was formed and have developed local wisdom to protect the environment (Indra 2023). This local wisdom can be one of the tools to support the conservation and development of the forest area (Henri *et al.* 2018).

Local wisdom is a human perspective on the environment that is not only limited to the ways of utilizing nature but also includes limitations in its use due to natural constraints (Simbiak 2016). Local wisdom has several forms, namely local knowledge, local skills, local resources, local social processes, local values or norms, and customs (Niman 2019). It plays an essential role in protecting the environment, such as dividing land units by the local wisdom of the Mandailing community in North Sumatra, which shows good environmental management (Nasution *et al*. 2018). In addition, there is local wisdom known as *gawah mali*, or sacred forest of the Sasak community in Mandalika Lombok that supports tree preservation because the community believes that if trees in the sacred forest are cut down, disaster will occur (Rahayu *et al.* 2021). Unfortunately, this vital role is not accompanied by the application of local wisdom of the surrounding community in the management of conservation areas, so actual conservation actions in the field are less than optimal (Iswandono 2016). Local wisdom itself is still under-applied in conservation programs due to mystical values, legends, myths, and customary norms that are difficult to accept logically (Situmorang & Simanjuntak 2015).

One of the conservation areas on Bangka Island associated with the local wisdom of the surrounding community is Jering Menduyung Nature Recreational Park (NRP). Jering Menduyung NRP has a lowland forest consisting of well-preserved tree species. In addition to being a conservation area, the preservation of this forest is emphasized. It is also believed to be related to the local wisdom of the local community, which has been protecting the trees in the area for a long time, even before the area was designated as a nature recreational park in 2016. The local wisdom of environmental management and protection can be examined through an ethnoecological study, which studies the relationship between humans and nature regarding managing natural resources (Nasution *et al*. 2018). Ethnoecology combines the science of ecology and ethnology to study humans and their activities in interacting with nature, thereby demonstrating the role of local wisdom in Indonesia in managing the environment. For example, the local wisdom of the customary Trah Bonokeling community in Banyumas and Cilacap Central Java, which was studied with ethnoecological studies, is known to have ecological values that benefit the environment and show real traditional conservation efforts (Sari *et al*. 2020).

There is a better suggestion that the management of conservation areas is based on a community's local wisdom (Wiratno 2019). However, no research has been conducted on the forms of local wisdom with ethnoecological studies in the Jering Menduyung NRP conservation area. So, applying local wisdom in managing this area has not yet been carried out. Therefore, this research is essential to invent the tree species protected by various forms of local wisdom in Jering Menduyung NRP. This can protect nature and support plant conservation, especially tree species, which have not yet been reported. This research aims to identify the tree species in the area and to understand the forms of local wisdom of the local community that support the sustainability of these trees. Therefore, the results of this research can later be considered by the management of Jering Menduyung NRP, namely the Natural Resources Conservation Agency of South Sumatra (*BKSDA Sumsel*), to determine programs as well as policies and regulations in managing Jering Menduyung NRP area by adopting the local wisdom of the local community.

Materials and Methods

Study area

Ecological data collection was conducted in the traditional lowland forest zone of Jering Menduyung NRP. Jering Menduyung NRP is a conservation area that is administratively located in Simpang Teritip Sub-district, West Bangka Regency, Bangka Belitung Islands Province, and is geographically located at the coordinates of 105°25'59"-105°33'55" East Longitude and 2°07'16"-2°03'58" South Latitude. The elevation range in Jering Menduyung NRP is from 0-44 meters above sea level. According to the Natural Resources Conservation Agency of South Sumatra, this park area is divided into four zones: protection, utilization, rehabilitation, and traditional. This area has various ecosystems, such as mangrove forests, lowland forests, freshwater forests, and beaches. The research is focused on the traditional zone, which geographically lies between 105°26'8.501"-105°26'41.414" East Longitude and 2°7'14.538"-2°7'47.859" South Latitude. This is due to considering this

zone's function as an area to maintain the local wisdom of the community related to nature because the vegetation condition in this area is still natural and undisturbed. The lowland forest in the traditional zone of Jering Menduyung NRP has an air temperature range of 25.6-28.9°C, air humidity of 84-93%, and light intensity of 0.12-2.6 Lux.

The collection of local wisdom data was carried out in Air Menduyung Village, which is one of the villages surrounding the Jering Menduyung NRP area. Air Menduyung Village is known to have a high-intensity direct connection with Jering Menduyung NRP. This is due to the very close distance of the village and its easy accessibility to the Jering Menduyung NRP area (BKSDA Sumsel 2020). Based on these facts and field observations, it is known that the community of Air Menduyung Village is the one that most frequently enters the Jering Menduyung NRP area and utilizes the existing forest products. The community of Air Menduyung Village is part of the traditional community of Kundi Bersatu Village, which is a descendant of the Jerieng Tribe traditionally led by *dukun* (shamans). There are eight *dukun* (shamans), each with different duties and responsibilities: the *dukun kampung* (village shaman), *dukun laut* (sea shaman), *dukun gunung* (mountain shaman), *dukun hutan* (forest shaman), *dukun air* (water shaman), *dukun tanah air* (homeland shaman), *dukun padi* (rice shaman), and *dukun api* (fire shaman). Each shaman has a working area called *rimba* and has followers who prepare traditional rituals. The research location can be seen on the map in Figure 1.

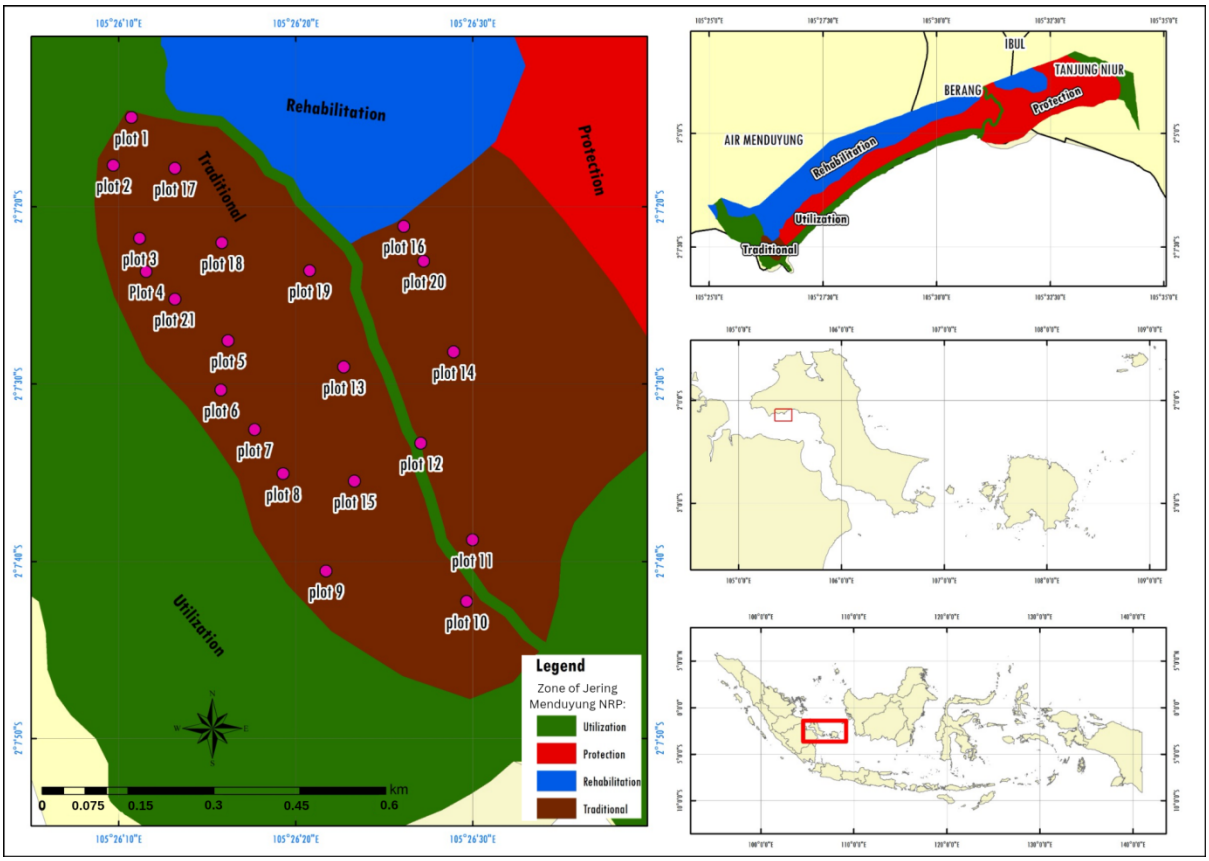

Figure 1. Map of observation plot placement (plots 1-21) in the traditional zone of Jering Menduyung NRP on the western part of Bangka Island, showing the study area

Data collection

Ecological data collection in the form of tree species records in the lowland forest area of the traditional zone of Jering Menduyung NRP was carried out using the square method, applying 21 plots measuring 20 m x 20 m each. The number of plots was determined based on the minimum mapping area from the result of the species-area curve of the lowland forest of Jering Menduyung NRP, which is 0.82 ha (Risyda *et al*. 2017), so the sample plot area in this study was 0.84 ha. The placement of plots used a purposive sampling technique that prioritized locations with the presence of tree species. Data collection on each plot included all growth stages, covering tree species, the number of each species, and the diameter of trees at the tree and pole levels. Identifying the tree species found was carried out and documented directly in the field. Species that were difficult to identify were made into herbariums for later matching with the Herbarium Bangka Belitungense collection, Universitas Bangka Belitung, and Herbarium Bogoriense, BRIN. Scientific name validation was carried out on the

website POWO. Identification was also assisted by BRIN researchers and the PictureThis, PlanNet, and iNaturalist applications. Meanwhile, the conservation status was identified using the International Union for Conservation of Nature (IUCN) data.

The collection of local wisdom data from the community around the Jering Menduyung NRP area was carried out using in-depth (open-ended) interview techniques with informants and structured interviews with respondents who are the local community of Air Menduyung Village, as well as participatory observation in the traditional ritual of *Ceriak Nerang*. The interviews were conducted directly without a questionnaire for both informants and respondents. Informants and respondents were determined using the snowball sampling technique, with the initial informant being the village head. In this study, the total number of informants and respondents was 26, consisting of 1 woman and 25 men, with an age range of 37-69 years. The informants consisted of the Head of Air Menduyung Village, customary leaders (*dukun kampung* and *dukun laut*), and descendants and followers of the *dukun*, who are considered to understand local culture and customs better. The number of respondents was determined using the Slovin method, consisting of community members who work as fishermen, farmers, boat makers, and natural honey seekers who know the names of trees and often utilize forest products from Jering Menduyung NRP.

Data analysis

The local wisdom data of the surrounding community of the lowland forest area of Jering Menduyung NRP were analyzed descriptively to reconstruct the pattern of local community knowledge. The ecological data were analyzed by determining the ecological value through the Important Value Index or IVI (Fachrul 2007), and the data on the utilization of tree species were analyzed with the calculation of ICS or Index of Cultural Significance (Turner 1988), in the following ways:

$$\text{Important Value Index (IVI)} = RA + RD + RF$$

Where IVI = the ecological values of each species; RA = relative abundance calculated as the number of individuals per species per hectare; RD = relative dominance defined as the basal area per species per hectare; RF = relative frequency (per ha) estimated as the proportion of where the species found at least once.

$$\text{Index of Cultural Significance (ICS)} = \sum_{i=1}^{n} (qi \times ii \times ei)ni$$

Where qi = the value of quality; ii = intensity value; ei = exclusivity value.

Results

The tree species in the lowland forest of the traditional zone

The trees at the research site consist of 37 species and belong to 24 families (see Table 1). The number of tree species found at the seedling stage is as many as 848 trees. At the sapling stage, there are as many as 284 trees, at the pole stage, there are as many as 63 trees, and at the tree stage as many as 227 trees. Some tree species found have a diameter of ≥100 cm, especially the *Dipterocarpus grandiflorus* species, which has 12 individuals. One individual of this species even reaches a diameter of ≥200 cm.

Table 1. IVI, ICS, and Red List IUCN Status of tree species in the lowland forest of the traditional zone of Jering Menduyung Nature Recreational Park.

Family	Species	Local Name	IVI (%)				ICS	IUCN Status
			Se	Sa	P	T		
Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr.	*Nyatoh laot*	6.8	10.3	12.1	6.1	38.0	NE
Anisophyllaceae	*Anisophyllea disticha* (Jack) Baill.	*Mensiding*	1.5	2.8	-	-	29.0	LC
Calophyllaceae	*Calophyllum lanigerum* Miq.	*Mentangor*	6.1	10.3	-	3.1	54.0	DD
Clusiaceae	*Garcinia celebica* L.	*Beruas*	-	1.2	-	-	45.0	NE
Dipterocarpaceae	*Dipterocarpus gracilis* Blume	*Kayu Ara hitam*	-	-	-	19.3	33.0	VU
	Dipterocarpus grandiflorus (Blanco) Blanco	*Keruing hitam*	18.2	4.6	-	73.9	53.5	EN
	Vatica rassak (Korth.) Blume	*Resak*	-	-	-	1.5	30.0	LC
Ebenaceae	*Diospyros buxifolia* (Blume) Hiern	*Mempisang*	47.8	1.2	17.8	6.2	44.0	NE
Fabaceae	*Archidendron jiringa* (Jack) I.C.Nielsen	*Jengkol*	-	-	4.8	6.3	37.0	NE
Fagaceae	*Lithocarpus blumeanus* (Korth.) Rehder	*Mengkunyit*	-	-	4.4	-	0	NE
Hypericaceae	*Cratoxylum arborescens* (Vahl) Blume	*Gerunggang*	-	1.6	5.2	3.5	40.0	LC
Lamiaceae	*Vitex pinnata* L.	*Leben*	-	4.3	4.5	3.2	42.0	LC

Family	Species	Local Name	IVI (%)				ICS	IUCN Status
			Se	Sa	P	T		
Lauraceae	*Cinnamomum parthenoxylon* (Jack) Meisn.	*Medang belembang*	1.7	1.2	4.8	2.1	16.0	LC
	Dehaasia firma Blume.	*Medang puser*	-	-	-	1.6	24.0	LC
Lecythidaceae	*Barringtonia macrostachya* (Jack) Kurz	*Medang tanah*	3.3	18.5	20.4	6.8	24.0	NE
Melastomataceae	*Memecylon edule* Roxb.	*Mempadi*	-	3.6	18.4	3.5	34.0	NE
Meliaceae	*Aglaia tomentosa* Teijsm. & Binn	*Ranggung*	5.0	14.2	5.4	1.9	40.0	LC
	Lansium domesticum Corrêa	*Langsat*	-	-	-	1.5	20.0	NE
	Sandoricum koetjape (Burm.f.) Merr	*Sentol*	4.9	4.5	14.0	11.4	36.0	LC
Moraceae	*Artocarpus integer* var. *integer*	*Cempedak*	-	-	-	6.1	28.0	NE
	Artocarpus lanceifolius Roxb.	*Kelidang*	-	-	11.9	3.1	32.0	NE
	Artocarpus rigidus Blume	*Puren*	-	1.2	6.5	14.8	40.0	NE
	Ficus caulocarpa (Miq.) Miq.	*Jeluteh*	-	-	-	4.3	43.0	LC
	Ficus nervosa Roth.	*Mergatel*	-	-	4.5	11.6	16.0	LC
	Ficus sundaica Blume	*Kayu ara putih*	-	-	-	2.9	33.0	LC
Myrtaceae	*Syzygium pycnanthum* Merr. & L.M.Perry	*Kerbancui*	13.4	11.9	-	1,5	24.0	DD
	Syzygium rostratum (Blume) DC.	*Selampit*	3.3	3.6	10.5	7.6	20.0	NE
	Syzygium urceolatum subsp. *palembanicum* (Miq.)	*Samek* or *uber*	-	1.2	-	6.7	48.0	NE
Ochnaceae	*Brackenridgea palustris* Bartell.	*Kulan*	-	-	-	2.9	36.0	NT
Phylanthaceae	*Aporosa lucida* (Miq.) Airy Shaw	*Pelangas*	1.6	6.7	5.6	1.7	30.0	NE
Rubiaceae	*Discospermum malaccense* (Hook.f.) Kuntze	*Mentulang*	-	-	-	1.5	36.0	NE
Salicaceae	*Flacourtia rukam* Zoil & Morr.	*Rukam*	1.6	7.2	13.9	-	28.0	NE
Sapindaceae	*Guioa pubescens* (Zoll. & Moritzi) Radlk.	*Pules*	53.8	25.7	71.5	44.2	44.0	NE
	Xerospermum noronhianum (Blume) Blume	*Kayu batu*	9.29	29.4	38.1	28.9	24.0	NE
Simaroubaceae	*Eurycoma longifolia* Jack	*Pasak bumi*	21.7	32.6	19.6	-	49.0	NE
Theaceae	*Polyspora excelsa* (Blume) Orel, Peter G. Wilson, Curry & Luu	*Pelempang putih*	-	1.2	5.9	-	45.0	LC
	Schima wallichii (DC.) Korth.	*Seru*	-	-	-	6.1	25.0	LC

Notes: (-)=no individuals were found; Se=seedling; Sa=sapling; P=pole; T=tree; IVI=Important Value Index; IVI < 21.96% = low; IVI 21.96 %- 42.66% = medium; IVI > 42.66% = high; ICS=Index of Cultural Significance; ICS>100 = very high; ICS 50-99 = high; ICS 20-49 = medium; ICS 5-19 = low; ICS 1-4 = very low; NE=Not Evaluated; DD=Data Deficient; LC=Least Concern; NT=Near Threatened; VU=Vulnerable, EN= Endangered.

The importance of tree species in the culture of the local community

The local community around Jering Menduyung NRP has local wisdom in using tree species. The local community around Jering Menduyung NRP uses 37 forest plant species, divided into 11 types of uses: building materials, boat construction, gardening tools, food, crafts, medicine, adhesives, ritual materials, cooking spices, basic cloth materials, and clothing dyes. The tree parts used include leaves, roots, stems, fruits, bark, and sap. The most commonly used part is the stems, which are processed into wood boards and beams for making boats and houses. A single tree species can have two or more different uses. Therefore, an ICS calculation was performed to show the level of importance of a plant species in a community's culture. The results of the ICS calculation can be seen in Table 1.

The local wisdom of the local community

The local community around Jering Menduyung NRP still utilizes and depends on nature, especially plants, to meet their living needs. The use of the surrounding nature by the community around Jering Menduyung NRP has formed local wisdom that has been going on for a long time and passed down from one generation to the next in the forms of management of landscape units, ban on cutting trees in the *rimba*, belief in *pulong kayu*, *sapon* honey, taboo of *melayuk*, and the traditional rituals that support the conservation of tree in those area. The relationship and dependence of the community around Jering Menduyung NRP on the surrounding nature influence how the community utilizes nature. Utilization is carried out along with maintaining the sustainability of nature so that it can be used for a long time.

Environmental unit division

The community around Jering Menduyung NRP divides the forest landscape into two units, namely *rimba* (jungle) and *belukar* (shrub). According to local beliefs, *rimba* is a forest area with large trees. It is a dwelling place for supernatural beings, so the area and plants within it should not be disturbed or cut down. *Belukar* is a forest area with small-sized plants and is a land that can be utilized, especially for gardening.

The lowland forest of Jering Menduyung NRP as a customary forest

One of the forests in the Jering Menduyung NRP area is *Rimba Tanjung Tadah*, when mapped, is located in the lowland forest area of Jering Menduyung NRP, especially in the traditional zone. For the local community, this forest is the dwelling place of important spiritual beings in the custom of the *Kundi Bersatu* community, so this area is protected by the custom and is considered a customary forest or a forest protected by the custom. In addition to the community's reluctance to enter the *rimba* due to it being considered haunted, customary rules support the preservation of the lowland forest of Jering Menduyung NRP. As an area that is a customary forest, this region is protected by unwritten customary rules from the *dukun* that almost the entire community obeyed, such as the prohibition of indiscriminate cutting of trees in the forest. No specific tree species are forbidden to be cut down, but if there is only one individual tree of a particular species, it cannot be cut down. Large and tall trees are also not allowed to be cut down because they are protected by supernatural beings inhabiting the forest.

***Pulong kayu* (tree spirit)**

The community around Jering Menduyung NRP believes that in *Rimba Tanjung Tadah*, supernatural beings live in the large trees in the forest, referred to as *pulong kayu* or tree spirits. According to the informants' account, *pulong kayu* resides in trees with a diameter of more than 30 cm (see Figure 2). Based on this criterion, several tree species are believed to be the dwelling places of *pulong kayu*, including *B. palustris*, *C. lanigerum*, *D. glandiflorus*, *D. gracilis*, *F. Caulocarpa*, *F. sundaica*, *G. pubescens*, *S. wallichii*, *V. pinnata*, and *X. noronhianum*. These trees are considered the homes of *pulong kayu*, and conversely, *pulong kayu* is considered the guardian of the trees' lives. If one carelessly cuts down trees in the jungle, it is considered the same as disturbing the homes of *pulong kayu*, which are supernatural beings that live in these trees. This can anger the supernatural beings and cause a disaster for the logger. Although very rare, if the trees are needed for traditional purposes or the general needs of the village community, the trees are cut down by performing a ritual led by a shaman to avoid disturbing *pulong kayu*.

Figure 2. *Dipterocarpus gracilis* tree (A), and *Brackenridgea palustris* tree (B), which are believed to be the home of *pulong kayu*

Sapon honey

Wild honey is one of the seasonal commodities for the community around Jering Menduyung NRP. According to the informants' account, honey-producing bees nest in large trees in the lowland forest of Jering Menduyung NRP, especially in trees of *D. glandiflorus*, *D. gracilis*, and *F. sundaica*. Honey from bee nests *in D. gracilis* and *F. sundaica* trees is called as *sapon* honey. *Sapon*, according to the local community, means home, indicating that the *D. gracilis* tree is a home for honey-producing bees. According to the community, this *sapon* honey is considered rare and high-quality, so its selling price is higher. The existence of honey-producing bee nests is the main reason why the trees in the area are not cut down or disturbed by the community, in addition to the belief in *pulong kayu*. The selling price of honey from this area ranges from IDR 100.000,00 to IDR 300.000,00 per kg (1 US$ = 15,000 IDR). The honey collection process also begins with a prayer reading ritual led by the *dukun laut* before and after the honey collection as a form of communication with *pulong kayu*.

Customary ritual

Jering Menduyung NRP area, or the *Kundi Bersatu* community, has several annual traditional rituals regularly performed as a form of gratitude for the natural resources obtained. The relationship of the *Kundi Bersatu* community with nature is reflected in the use of several plant species as offerings and containers for offerings used in rituals (Figure 3). Each ritual has offerings with different compositions and meanings from one another. The details of the traditional rituals of the *Kundi Bersatu* community can be seen in Table 2.

Table 2. Annual customary ritual of *Kundi Bersatu* community

Customary Ritual	Time	Place	Purpose	Offering Materials	Guide	Taboo
Ceriak Ngelem	After rice planting time (September), at night	Bukit Terak Village Hall and *Pekal* (customary forest of Bukit Terak Village)	- A form of gratitude for the completion of the rice planting process - Media for the community, shamans and supernatural beings to make an agreement so that the supernatural creatures living in the forest do not disturb rice or other garden plants	Wood and bark of *C. lanigerum* trees, sticky rice (black and white), brown rice, eggs, betel, banana leaves	*Dukun kampung*	- Entering and disturbing the *Pekal* area (customary forest in Bukit Terak Village which is believed to be the starting point of residence and origin of all supernatural creatures in the village of *Kundi Bersatu*) for one week - Had a wedding and divorce for six months after *Ceriak* - Taboo of *melayuk* (not allowed to kill plants and animals) for three days
Ceriak Nerang	After the rice harvest period (February /March), at night	Bukit Terak Village Hall and *Pekal* (customary forest of Bukit Terak Village)	- A form of gratitude for the harvest and natural products obtained - *Mucak kampung* or repairing and cleaning the village from evil influences so that the community is protected from interference by supernatural beings and spirits	Wood and bark of *C. lanigerum* trees, sticky rice (black and white), brown rice, eggs, betel, banana leaves, rice flour, coconut leaves, palm leaf fronds, white cloth	*Dukun kampung*	- Entering and disturbing the *Pekal* area for one week - Taboo of *melayuk* for three days
Naber Laut	The same day as the *Ceriak Nerang* rituals, from morning to noon	House of *dukun laut*	- A form of gratitude for the marine products obtained by the community - Media to clean the sea from evil influences at sea and to ask for safety for people when at sea	*Calophyllum lanigerum* wood, sticky rice (black and white), red rice, eggs, candle	*Dukun laut*	- Work such as going to sea or cutting down trees during rituals - Wandering around while *nuduk* (reciting prayers) - Taboo of *melayuk* for three days
Sedekah Kampung	August, for two days	Bukit Terak Village Hall and at the house of the village community *Kundi Bersatu*	- A form of gratitude - Village cleaning - The turning point for the Jerieng tribe who were not yet religious became followers of Islam through circumcision	There are no offerings	*Dukun kampung* and *dukun laut*	- Hanging around carelessly for newly circumcised children - Cooking *dodol* other than during the Sedekah Kampung

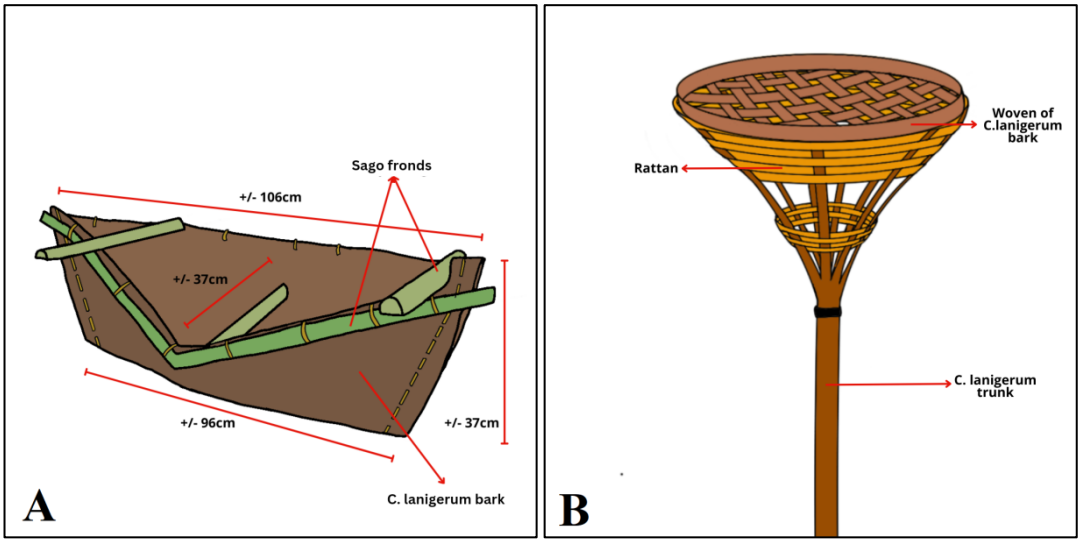

Figure 3. Illustration of offering containers in *Ceriak Nerang* (A) and *Naber Laut* (B) rituals

Discussion

The tree species in the lowland forest of the traditional zone

Based on the calculation of IVI at each growth stage (Table 1), it is known that at the seedling stage, the dominant species with the highest IVI is *Guioa pubescens*. At the sapling stage, no IVI reaches the high category, but overall, the species with the highest IVI is *Eurycoma longifolia,* with an IVI of 32.6%. This value is included in the medium category. In addition to *E. longifolia*, several other species have a medium category, namely *G. pubescens* and *Xerospermum noronhianum*. *Guioa pubescens* is also the dominant species at the pole stage, with the highest IVI value of 71.5%. The species that dominated at the tree stage was *D. grandiflorus*.

The number of tree species found at the research site is less than those found in the traditional zone of Wan Abdul Rachman Great Forest Park of Lampung, which is as many as 43 tree species (Indriyanto 2022). However, it is more than the number of tree species found in the traditional zone of Mt. Halimun Salak National Park, which has nine tree species (Hartoyo *et al*. 2023). The number of tree species at the research site is also greater compared to the number of species found in the Species Area Curve (SAC) of the lowland forest area of Jering Menduyung NRP, with a sample plot size of 0.82 ha. The number of tree species at ≥ 10 cm diameter found in the SAC is 24 tree species (Risyda *et al*. 2017).

The dominant tree species in the lowland forest of Jering Menduyung NRP is *keruing hitam* (*D. grandiflorus*). This is in line with Widyastuti's research (2010), where the common species found in lowland forests are from the Dipterocarpaceae family, one of which is from the *keruing* (*Dipterocarpus*) genus. At the research site, *D. grandiflorus* was not found at the sapling and pole stages but had numerous seedlings. This could be due to environmental factors that affected the survival of seedlings, one of which was light suitability. At the seedling stage, *keruing* is more tolerant of shading and can survive. However, *keruing* seedlings are generally more light-resistant at the next growth stage, so that they will grow optimally in stands with little shade (Susilowati *et al.* 2021). Other species, such as *D. gracilis* and *F. sundaica*, were not found at the seedling, sapling, or pole stages and were only present at the tree stage. This could be due to various factors, including environmental conditions that did not support the saplings' growth. This aligns with Susilo (2018), who suggested that an absence of young *D. gracilis* trees could be due to the lack of suitable microsites for seed germination and the presence of Dipterocarp seed-eating animals. It is known that *D. gracilis* and *F. sundaica* are intolerant to shade during the seedling phase (Ervina & Wasiq 2018), so these two species cannot grow optimally in lowland forests with dense canopy cover. This factor also limits the growth of *C. lanigerum*, in which, according to Yuliastrin (2016), the low intensity of sunlight is strongly suspected to be a limiting factor for the regeneration of *mentangor* (*Calophyllum* spp.).

Based on the classification results of plant conservation status conducted according to the IUCN Red List, it is known that there are species that are already classified as endangered, namely *D. grandiflorus*, and those that are classified as vulnerable, namely *D. gracilis*. Both of these species are included in the 25 *keruing* species in Indonesia listed in the IUCN Red List. *Keruing* is a wood-producing species widely used in wood industries, thus becoming a target for overexploitation. High levels of exploitation without conservation efforts, with specific habitat needs and a long flowering period, cause the

population of *keruing* in nature to continue declining and become a priority for conservation (Sulistyowati 2021). According to Fatimah & Nisyawati (2020), local wisdom can support biodiversity conservation, such as the local wisdom of the local community in Northern Siberut, which knows the environmental landscape division. Based on ethnoecological studies, it is known to support conservation efforts for the flora and fauna around them. This aligns with the local wisdom of the community around Jering Menduyung NRP, which continues to preserve of *keruing* trees in the lowland forest of Jering Menduyung NRP, thereby supporting the conservation of this species.

The importance of tree species in the culture of the local community

The utilization of trees by the local community around Jering Menduyung NRP is accompanied by local wisdom that indirectly contributes to the preservation of these trees. According to the calculating of the ICS value, several tree species that are important in the local culture, include *C. lanigerum*, *D. gracilis*, *D. grandiflorus*, and *F. sundaica*. The local community indirectly protects these species because they significantly benefit the life and culture of the local community. The community around Jering Menduyung NRP has developed and trusted local wisdom, which the local community practices and indirectly protects and preserves these tree species.

The *mentangor* plant by the local community around Jering Menduyung NRP, is a *C. lanigerum* species. Based on the ICS value, it is known that *C. lanigerum* plays an essential role in the local community's culture around Jering Menduyung NRP. It is primarily used as a material for containers and holders for offerings in *Ceriak* and *Naber Laut* rituals, which are annual traditional rituals expressing gratitude for the natural resources obtained by the local community. This utilization gives *C. lanigerum* a high ICS value, as plant species more frequently used in traditional ceremonies, weddings, culture, and the economy will have a high ICS value (Prasetyo *et al*. 2021). One of the Dipterocarp trees found in the lowland forest of Jering Menduyung NRP is *D. grandiflorus*, which the local community refers to as *keruing hitam* (black *keruing*). For the community around Jering Menduyung NRP, *D. grandiflorus* is an excellent tree species for making boats and houses, making it the primary choice. This makes *D. grandiflorus* an essential species in the life of the community around Jering Menduyung NRP, who work as fishermen. The high ICS value of the *D. grandiflorus* species demonstrates this important role. The local community around Jering Menduyung NRP also refers to two tree species as fig trees, namely *D. gracilis*, a black fig tree, and *F. sundaica,* a white fig tree. According to the local community, the fig trees are special trees that provide non-timber forest products, namely *sapon* honey. Based on the ICS value, in the medium category, these two species are quite crucial in the local culture. They are protected because the *sapon* honey produced has a high economic value and is used in the *Naber Laut* ritual.

As mentioned by Batoro (2012), if a plant species has a high IVI and ICS, it can be said that efforts are being made to preserve that species because of its high prevalence and utilization. This is evident in the presence of the *D. grandiflorus* trees at the research site, which has many benefits in the life and culture of the local community, yet their conservation is still maintained. Conservation efforts are needed if a species has a low IVI with a high or low ICS. The results of the ICS and IVI calculations show that *C. lanigerum*, *D. gracilis*, and *F. sundaica* have high ICS values but low IVI values. Therefore, although the local wisdom of the community around Jering Menduyung NRP indirectly supports the protection of plant species, efforts to propagate or provide other protection for individuals of these species are still needed to ensure the conservation of these species and other plant species.

The local wisdom of the local community

Environmental unit division

Certain areas, both inside and around Jering Menduyung NRP, are considered *rimba* by the local community. One of which is the traditional zone of Jering Menduyung NRP, known as *Rimba Tanjung Tadah*. The status of this area as a *rimba* makes the local community afraid to enter and damage the plants in the area, thus preserving the trees within it. The division of these environmental units supports the preservation of trees in Jering Menduyung NRP because it limits the use of the forest according to the function believed by the local community, namely as a dwelling place for supernatural beings. This local wisdom of the environmental unit division is also owned by other local communities in other conservation areas, such as Talak Mamak Customary Community in Bukit Tigapuluh National Park, Riau. One of the environmental units in the landscape division by the Talang Mamak Customary Community is called *puaka,* which according to their belief, is a sacred forest home to various creatures or supernatural animals in their beliefs. Its preservation is highly maintained, thus supporting conservation (Titisari *et al*. 2019).

This division of environmental units also shows that the community around Jering Menduyung NRP has managed the surrounding environment according to the needs and the natural conditions. This is in line with Nasution *et al*. (2018), who

stated that the division of the landscape by the local community indicates that the local community has been able to manage the surrounding environment to meet their needs. This division makes the local community limit the use of land in the lowland forest of Jering Menduyung NRP, which they consider a *rimba*. In addition, according to Wijaya & Oktarina (2014), dividing these environmental units is one of the behavioral patterns of sustainably maintaining, utilizing, and managing nature. Communities in other areas also carry out this practice of dividing the landscape into environmental units. One of the examples is the Baduy community in Kanekes Village, which divides its region into three zones: *dukuh lembur*, meaning village forest, the middle zone as agricultural land, and *leuweung kolot* meaning old or legacy forest that must be preserved (Suparmini *et al*. 2013). Mian Sea-Sea Customary Community in Central Sulawesi also divides the landscape into six environmental units: *basalean* (yard), *lipu* (village), *asi* (field), *laing* (secondary forest), *babono* (jungle), and *balembean* (sacred place) (Amalia *et al.* 2022).

The lowland forest of Jering Menduyung NRP as a customary forest

The local community belief positively impacts the preservation of the lowland forest of Jering Menduyung NRP. The community becomes hesitant to enter and damage the *rimba* (jungle), thus limiting the use of the lowland forest of Jering Menduyung NRP and indirectly supporting the conservation of plants in the forest. This impact is evident in the natural and undisturbed state of the forest. This aligns with Effendi *et al*. (2021), who stated that belief in supernatural things can serve as informal rules that regulate human interaction with nature and improve community compliance better than formal rules. Traditional belief systems and conservation have also been proven to maintain the existence and preservation of forests and ensure the availability of other natural resources (Mulyadi *et al.* 2022). Local wisdom in the form of belief in supernatural beings inhabiting forests is widespread among indigenous communities in Indonesia, supporting the preservation of these forests. Among them is the local wisdom of *Tanah Badewa-Dewa,* believed by the Orang Rimba tribe in Jambi as a forest area inhabited by gods and must be kept intact and not encroached upon or damaged. This belief ensures that the *Tanah Badewa-Dewa* forest is preserved and its sustainability is maintained (Takiddin 2014). In addition, the Tawangsari Village of Malang community also has local wisdom, saying that the *Sengkeran* forest is believed to be a haunted forest inhabited by supernatural beings. This belief has proven to positively impact the preservation of the *Sengkeran* forest (Satiti *et al*. 2016).

The customary rules from the *dukun* limits the local community from indiscriminately and excessively utilizing the lowland forest of Jering Menduyung NRP, thus ensuring the preservation of the trees in the area. This is consistent with Danerek's statement (2014) that customary rules can limit human activities, which will have an indirect impact on environmental protection. The existence of these rules from the *dukun* and the obedience of the local community also demonstrate the efforts and awareness of the local community to protect and preserve the forest. As stated by Awalludin *et al.* (2017), the prohibition against interacting with the forest arises from the awareness of the surrounding community to protect and preserve the surrounding forest. These customary rules are accompanied by sanctions for violators in the form of *basak* or disasters such as getting lost in the forest, illness, and even death. These sanctions reinforce these customary rules and support the conservation of trees in the area because they will deter violators and the local community from breaking them. This was conveyed by the informants, who mentioned that some people from the local community had cut down trees in the area and experienced *basak* in the form of getting lost or severe illness. This incident serves as a deterrent for violators and a lesson for the local community, which then makes the local community increasingly believe that the trees in the area should not be disturbed, indirectly supporting the conservation of these trees. According to Hutapea & Lestarini (2023), a deterrent effect provides a psychological impact that helps build a rule-breaking community's character and also serves as a lesson for other communities, thereby minimizing violations and supporting the effectiveness of local wisdom in nature conservation.

***Pulong kayu* (tree spirit)**

The protection of trees, based on the belief in *pulong kayu*, has led to a prohibition on tree felling and is an effort by the local community to preserve the existence of these trees as a form of respect for *pulong kayu* and to avoid potential disasters. This, in turn, supports the conservation of tree species in the area because the preservation of the trees is well maintained. In line with the statement by Abas *et al*. (2022), plants in the surrounding environment of indigenous communities are considered sacred. Therefore, most indigenous communities respect plants for their sacred value, resulting in wise utilization practices while maintaining the balance of nature. As Darusman (2014) mentioned, several trees are considered sacred because they are believed to have inhabitants behind them, leading to a prohibition on cutting down these trees, which is related to environmental conservation efforts. Belief in the existence of mystical beings also grows in indigenous communities in other areas of Indonesia, such as the farming community in the upstream area of the Ketahun River Basin of Lebong. They believe trees should not be cut down carelessly because trees have spirits that will get angry if trees are fallen indiscriminately (Purwoko *et al*. 2017). *O Hangana Ma Nyawa* Community in Wangongira Village of North Halmahera

believes in *gikiri*, a tree spirit. This belief leads to prohibiting on excessive tree part extraction so as not to disturb the *gikiri*. This prohibition becomes a utilization practice based on conservation principles (Simanjuntak *et al*. 2015).

The belief in the existence of *pulong kayu* is reinforced by the need for a ritual to be performed before felling trees or harvesting honey. This ritual then clarifies that there are limits to using trees in the *rimba* due to the presence of *pulong kayu*, which ensures the preservation of the trees. Local communities in other areas also carry out rituals related to the belief in tree guardians. One is the Muna Ethnic Community in Southeast Sulawesi, who performs a special ritual, known as the *Popanga* ritual before felling a tree. The *Popanga* ritual is performed before felling a *bhake* (banyan) tree because it is believed to have supernatural beings (Hesni *et al*. 2019).

Although very rare, if the trees are needed for traditional purposes or the general needs of the village community, they can be cut down accompanied by a ritual led by a *dukun*. Using trees only for common interests indicates community efforts to protect the trees in Jering Menduyung NRP by limiting tree felling for personal and commercial interests. Moreover, this also becomes a sustainable utilization effort because tree felling will rarely be done as it can only be utilized when there is a common interest, which rarely occurs. This is consistent with Rahmawati (2015), that utilization of forest products, which can only be done for common or communal interests, indicates sustainable utilization because it will limit the use of forest products and prevent exploitation for economic purposes.

***Sapon* honey**

The existence of honey-producing bee nests, especially *sapon* honey, has significant value in the community's economy around Jering Menduyung NRP. Therefore, the community preserves the trees that are the nesting places for these bees, not only because these trees are home to *pulong kayu*. Preserving the tree species that become *sapon* indirectly supports plant conservation. Due to a belief that a particular tree species is a special place for animals, tree protection also develops in local communities in other areas, such as the *Orang Rimba* tribe in Jambi. They believe that the *sialang* tree is a special tree that becomes a nest of bees producing pure honey, which is economically promising because one tree can form up to 200 bee nests. Several tree species that are believed to be *sialang* trees or nesting places for honey-producing bees by the *Orang Rimba* tribe are *Alstonia* sp., *Artocarpus* sp., *Bhesa* sp., *Dipterocarpus* sp., *Ficus* sp., *Koompassia* sp., *Spondias* sp., and *Garcinia tetranda* (Marpaung 2021). This honey becomes a significant source of life for the *Orang Rimba* community, so they significantly preserve the trees considered *sialang* trees (Saleh 2014).

This study found no *sapon* honey nest or honey-producing bees in the lowland forest of Jering Menduyung NRP. However, the species of honey-producing bees at the research site is suspected to be the same as the bee species in other places such as lowlands, mangroves, plantations, and industrial forest plants, namely *Apis dorsata* or giant honey bee, which is one of the wild bee species that have not yet been successfully cultivated. *Apis dorsata* is a bee species that usually builds nests at a height of 3-32 m above ground level, thus preferring to nest in tall trees with large branches with a diameter of 10-60 cm (Neupane *et al*. 2013). The nesting preference of *A. dorsata* matches the vegetation at the research site, which is dominated by tall trees with large branches, making this species potentially one of the honey-producing bees in the area. *Apis dorsata* in the forests of Kampar Regency of Riau is often found nesting in Dipterocarp and fig trees, such as *D. confertus*, and *F. racemosa* (Pribadi 2019). This is similar to the honey-producing bees at the research site, also known to nest in Dipterocarp and fig trees, such as *D. gracilis*, *D. glandiflorus*, and *F. sundaica*.

Customary ritual

The local community around Jering Menduyung NRP carries out several rituals (see Figure 4) related to local beliefs. The rituals performed manifest respect and reverence for the supernatural things believed to exist around them. As stated by Jamilah *et al*. (2019), traditional rituals cannot be separated from a belief system that develops in indigenous communities, where the belief's manifestation is realized through traditional rituals. Rituals also reinforce evidence of the presence of supernatural beings in *rimba*, leading the local community tends to believe in them. This, in turn, makes the community more cautious in interacting with and utilizing the *rimba* resources. In line with Putri *et al.* (2022), traditional rituals are an inseparable part of a culture, where traditional rituals strengthen beliefs that grow within a community and serve as a guide in utilizing nature.

Figure 4. *Ceriak Nerang* rituals in *Pekal* or the customary forest of Bukit Terak Village (A) and in the village hall (B)

Calophyllum lanigerum is used as one of the main materials for making offering containers (Figure 5) in *Ceriak* and *Naber Laut* rituals. The tree used is the one that has reached the tree or pole and sapling stages. Parts of *C. lanigerum* used are bark and trunk still at the sapling stage. The utilization of *C. lanigerum* is done as minimally as possible so that the tree can be used sustainably for subsequent traditional rituals. The wood used does not come from the lowland forest of Jering Menduyung NRP but comes from the forests in the surrounding villages that happen to be cut down for other purposes, such as for building houses in the village. The bark comes from only one tree with a diameter of approximately 30 cm and is intended to meet the needs of the rituals without having to cut down another tree. The practice of utilizing *C. lanigerum* demonstrates sustainable use that supports conservation. Because the rituals carried out by the community around Jering Menduyung NRP continue to be preserved, the existence of *C. lanigerum* must also be continuously preserved. This is because *C. lanigerum* is the main material in the rituals and cannot be replaced. Therefore, the existence of *C. lanigerum* will continue to be maintained to meet the needs of future rituals. This is consistent with the statement by Pramita *et al*. (2013) that the culture within a society will always be preserved and maintained, indirectly conserving plants used in that culture, especially in traditional rituals.

Figure 5. Bark of *Calophyllum lanigerum* (A), which will be made into an offering container for *Ceriak Nerang* rituals (B)

In *Ceriak Ngelem*, *Ceriak Nerang*, and *Naber Laut* rituals, there is a taboo of *melayuk* for three days after the ritual. This taboo is one form of effort to preserve the natural environment around the *Kundi Bersatu* village community because it will limit the community's behavior towards plants and animals for three days. Even though it is only three days, this taboo strengthens the belief in supernatural beings and gentle spirits that inhabit the *rimba* and trees, indirectly supporting the preservation of plants in the lowland forest of Jering Menduyung NRP. As conveyed in Aprilia *et al*. (2023), the existence of taboos renders a community powerless over nature. Due to this powerlessness, the community does not dare to act recklessly towards the forest, thus becoming patient and suppressing the desire to cut down trees, hunt, and fishing. A similar taboo also exists in the indigenous Juhu community in South Kalimantan. For three days and three nights after a *Puja-Puja* ritual, no activities are allowed in the customary Pahumaan forest, including cutting down trees. This taboo makes the Juhu community dare not to act recklessly towards the forest and its contents. A similar taboo also applies in the indigenous communities of Sulawesi, including Mandar, Bugis, and Bajo tribes, which is the taboo of indiscriminately cutting down trees after the implementation of the *Sengkineh* tradition (Al-idrus *et al*. 2021).

Conclusion

The community around Jering Menduyung Nature Recreational Park possesses local wisdom in the form of environmental unit divisions, the prohibition on cutting down trees in *rimba* (jungle), belief in *pulong kayu*, *sapon* honey, the taboo of *melayuk*, and customary *Ceriak* and *Naber Laut* rituals that protect the trees in Jering Menduyung NRP, especially species such as *Calophyllum lanigerum*, *Dipterocarpus gracilis*, *Dipterocarpus grandiflorus*, and *Ficus sundaica*, which play a

significant role in the local culture. All of these kinds of local wisdom of the community around Jering Menduyung Park also support the conservation of *D. grandiflorus*, which has an endangered status, and *D. gracilis*, which has a vulnerable status.

Declarations

List of abbreviations: *BKSDA Sumsel* - South Sumatra Natural Resources Conservation Agency; IVI - Important Value Index; ICS - Index of Cultural Significance; NRP - Nature Recreational Park.

Ethics approval and consent to participate: All informants and respondents have been asked for their consent and have obtained permission before interviews and observations were conducted.

Consent for publication: Not applicable.

Availability of data and materials: All data are only stored by the authors.

Competing interests: The authors declare that there is no competing interest.

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