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# TREE SPECIES COMPOSITION IN PULAU BIDONG AND PULAU REDANG

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**Abstract:** Island is a landmass surrounded by water and occupied by extensive stands of forest with diverse tree species. Tree is a critical plant formation because it is the major component that made up the forest canopy. The availability of extensive forest canopy is crucial for most animals such as birds, mammals, insects, and reptiles mainly for food, shield and shelter. However, information on the composition and distribution on the tree taxa in the off-coast islands of Terengganu are scarce. Therefore, a study was carried out to provide taxonomic lists of tree species in the islands of Terengganu that covers Pulau Bidong and Pulau Redang. Forest plot of 50m x 50m was used to analyze the floristic composition of tree taxa. The plot was divided into four equal square subplots of 25m x 25m. All trees with 5cm dbh and above were tagged, measured in terms for dbh size and height, recorded and identified. Voucher specimens were taken for further verification purposes. A total of 102 tree species were recorded comprising of 37 families and 66 genera. This finding is relevant in our understanding of the forest ecosystem dynamic for conservation management purposes.

Keywords: Species composition, forest management, dipterocarp, Pulau Bidong, Pulau Redang, tree species composition, South China Sea.

## Introduction

Study on islands have been raised and developed since a long time ago to give way for a better understanding on ecology and evolution. The idea of evolution and speciation by Darwin and Wallace is once designed through studies on islands (Vitousek *et al.*, 1996). An island is a landmass that is surrounded by the ocean and occupied by extensive stands of forest with diverse tree species and faunas. Together, they made up the land and sea ecosystem of the universe. According to Zimmer (2012), there is significant bonding between the life on the land and life on the ocean, by means whenever the links are shattered the ecosystem would experience a big effects or major changes mainly on communities or species level.

The island is useful in ecological studies due to its geographic isolation from the source populations on the mainland. The populations, communities and ecosystems are resistance entities that tolerate through a geographical limitation with vital processes, properties and interactions occur in a simpler way (Vitousek *et al.*, 1996). However, in order to know more on such complex interactions require understanding on one of their basic biotic elements of the ecosystems such as trees. According to Suratman (2012), trees provide resources and habitat structure for almost other species of plants and animals and they are responsible for various processes that affect ecosystem dynamics (McGuire, 2002). For example, trees obtained carbon dioxide from the atmosphere through photosynthesis; some herbivores obtain carbon by feeding on the plants in the atmosphere, carnivores acquire carbon through hunting of other animals and decomposers gain carbon from the dead organisms. In addition, the leaching of dissolved organic compound requires the flow of carbon from the terrestrial ecosystem to the aquatic ecosystem (McGuire, 2002) providing vital relationship between the land and ocean.

Today, the islands of Malaysia are occupied with sizeable patches of primary forests and extensive stands of secondary forests. For example, Pulau Redang that was declared as

Marine Park in Malaysia consists of several types of vegetation that consists of lowland, coastal and mangrove forest (Khairil *et al.*, 2012). Meanwhile, another island such as Pulau Bidong was well-known for its historical site, providing a temporary home for the Vietnamese boat people during 1970s and 1980s (Vu, 2007). In addition, Pulau Perhentian is famous for its white sandy beaches and tourism activities. Therefore, the forests bring about ecological and socio-economics importance in terms of goods and services (such as, forestry and fisheries resources; recreation and ecotourism) (Khairil *et al.*, 2012). As the islands are part of the Terengganu State Park, a lot of baseline data are required to manage and conserve these areas. Presently, data on the diversity of flora in the off-coast islands of Terengganu are scarce.

In this paper, the forest management operation through inventories on tree species diversity was done. As a dominant plant forms, trees are easy to locate precisely and to count (Khairil *et al.*, 2012). Moreover, tree is the dominant plant forms that made up the forest canopy that supports good shading and shelter to the shade specific plants and animals especially wildlife. Therefore, the objective of this study is to provide taxonomic lists of plant species and their composition in two off-coast islands of Terengganu. The distribution and abundance data are absolutely applicable in our understanding of the forest ecosystem dynamic for conservation management purposes.

## Methodology

### *Study Site*

The study was conducted in the off-coast islands of Terengganu that covers Pulau Bidong and Pulau Redang (N 05°48.691' E 103°00.455). According to Khairil *et al.* (2012) on the studies done N 05°37.139", E 103°03.494 in Pulau Redang, the island did experience tropical climate and is affected by the north-east monsoon (November to March) causing heavy rain, strong winds and big waves. Rainfall is reported to be as high as 615 mm in December compared to only 120 m in April after the monsoon periods (Khairil *et al.,* 2012 as in Ridzwan & Sharifah, 1996). The weather was light with some interval of median rate of rains throughout the seven days of sampling period conducted in Pulau Redang on July 2015 while in Pulau Bidong light weather happened throughout the sampling period on June 2015.

Pulau Bidong is covered by the secondary forests with the size of 260 hectare. Plot establishment was done at the coastal forest near to the Universiti Malaysia Terengganu research station. It is the only area that accessible to tourists and visitors with only 4 kilometer hilly trail for hiking. It was believed that the area where the plot was established once was cleared down by the Vietnamese refugees that settled in the island. In addition, general phenology of the forest was observed within and outside of the plot. There was no sign of obvious flowering and fruiting in the plot but some tree species such as *Diospyrus* sp. was seen to bear fruits. A lot of leaf litters seen on the forest floor indicates leaf fall event and promotes the productions of new leaves. However, it differs for the phenology seen outside the plot. Heavy flowering and fruiting were observed around the UMT research station with the trees of *Terminalia catappa* (Ketapang) was in heavy fruiting whilst the *Hibiscus tiliaceus* in heavy flowering.

Meanwhile, in Pulau Redang the study was done at Sea Turtle Research Unit (SEATRU), Universiti Malaysia Terengganu. Pulau Redang with the size of 1,909 hectares are covered with a total of approximately 1,200 hectares forest area) (Khairil *et al.*, 2012). Small patches of primary forest still can be seen at SEATRU due to the fact that the area is being protected for the turtle conservation effort. The panoramic view of the bay decorated by the sandy whitish beach and blue ocean made up the front frame work of the coastal primary forest located just behind the SEATRU cabin. Exploring inside the forest, strong stands of trees with some palms species can be seen covering the forest floor. The forest was in the middle of new leaves production with many trees observed to produce young new leaves often mistaken as flowers if seen from far.

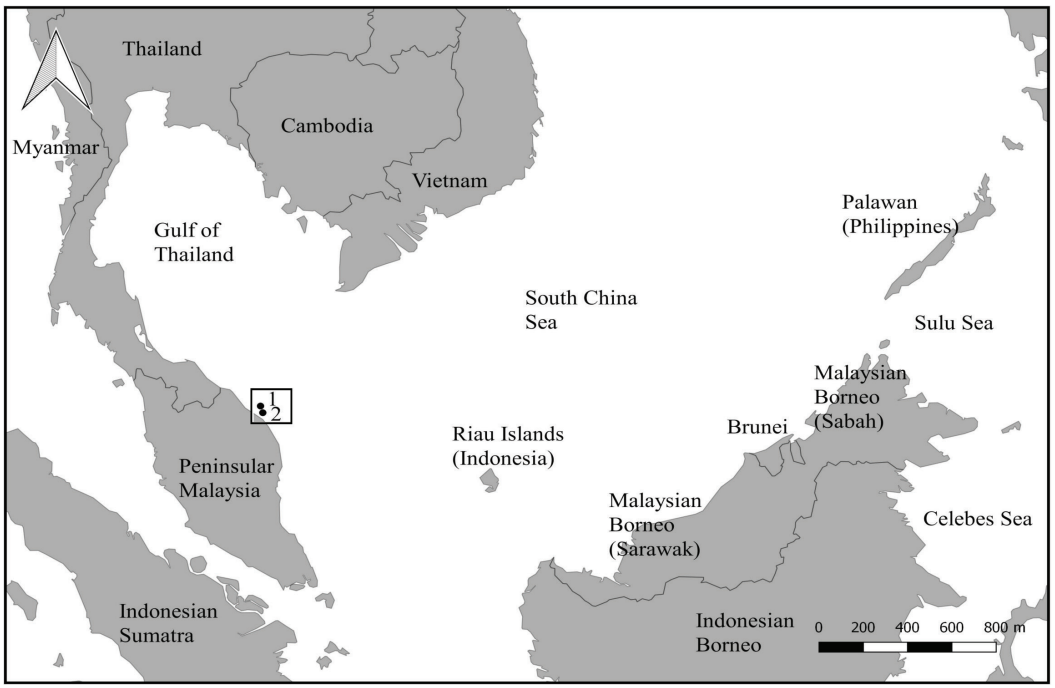


Figure 1: Map showing the location of Pulau Bidong and Pulau Redang, indicated by the rectangular mark

***Plot Establishment and Data Collection***

The forest plot establishment was done following Remi *et al.* (2012) in the checklist of trees in the Crocker Range Park Permanent Research Plot, Sabah Malaysia. Forest plot with a size of 50 metre (m) x 50 metre (m) with (25 m x 25 m subplot) instead of 10 m x 10 m subplot (Remi *et al.,* 2012) was done at both islands. The trees with 5 cm diameter breast height (dbh) and above were measured in terms of dbh and height, tagged with flagging ribbon and identification of trees was done *in-situ*. For the estimation of height, clinometer was used to get the angle in degree and the height was calculated by using trigonometric calculation. There are a total of 963 standing trees for both plots. Therefore only 10 trees at the beginning being measured and the height were then compared to the other trees to give way for tree species identification. However, for the big gigantic tree that reached 40cm dbh and above, the angle and distance was taken for each tree for height calculation. Museum voucher specimen of every tree species were taken for further identification and verification purposes.

**Results**

Based on the inventory, a total of 102 tree species were recorded comprising of 37 families and 66 genera. There were still few species that were unable to be identified. The trees from the genus *Bouea*, *Heritier*a and *Syzygium* could not be identified until the species level. Therefore, the species were named by using numbered morphospecies (e.g., *Syzygium* sp. 1) to give way for the numbering and counting of tree taxa (Senterre *et al.*, 2015). Meanwhile, there were a total of 18 individuals of trees that still could not be identified even at family level and still in the process of identification. The list of tree species and respective composition recorded in Pulau Bidong and Pulau Redang was shown in Table 1. The finding of this study was then compared to the previous studies that focused on some forested island in Peninsular Malaysia as shown in Table 2.

Table 1: List of tree species and compositions at Pulau Bidong and Pulau Redang: **B**, Pulau Bidong; **P,** Pulau Redang

| Family | Species | B | R |
|---|---|---|---|
| Anacardiaceae | *Bouea oppositifolia* (Roxb.) Meisn. | 6 | 3 |
| Anacardiaceae | *Bouea* sp. 1 | nil | 1 |
| Anacardiaceae | *Buchanania arborescens* (Blume) Blume | 21 | nil |
| Anacardiaceae | *Dracontomelon dao* (Blanco) Merr. & Rolfe | 1 | nil |
| Anacardiaceae | *Mangifera macrocarpa* Blume | nil | 2 |
| Anacardiaceae | *Mangifera odorata* Griff. | nil | 1 |
| Anacardiaceae | *Parishia insignis* Hook.f. | nil | 3 |
| Anacardiaceae | *Swintonia floribunda* Griff. | nil | 1 |
| Anacardiaceae | *Swintonia schwenkii* (Teijsm. & Binn.) Teijsm. & Binn. | 3 | nil |
| Annonaceae | *Goniothalamus tenuifolius* King. | nil | 1 |
| Annonaceae | *Polyalthia sumatrana* (Miq.) Kurz. | nil | 1 |
| Burseraceae | *Dacryodes rostrata* (Blume) H.J. Lam. | nil | 3 |
| Burseraceae | *Santiria rubiginosa* Blume. | nil | 1 |
| Burseraceae | *Santiria* sp. | 2 | nil |
| Calophyllaceae | *Mesua ferrea* L. | nil | 3 |
| Calophyllaceae | *Mesua lepidota* T. Anderson . | nil | 1 |
| Calophyllaceae | *Mesua* sp. | 1 | nil |
| Celastraceae | *Kokoona sessilis* Ding Hou | nil | 1 |
| Clusiaceae | *Garcinia eugeniifolia* Wall. ex T. Anderson | 1 | nil |
| Clusiaceae | *Garcinia hombroniana* Pierre | 6 | nil |
| Clusiaceae | *Garcinia nigrolineata* Planch. ex T. Anderson | 21 | nil |
| Clusiaceae | *Garcinia* sp | nil | 3 |
| Dipterocarpaceae | *Dipterocarpus chartaceus* Symington. | 2 | nil |
| Dipterocarpaceae | *Shorea glauca* King. | nil | 41 |
| Dipterocarpaceae | *Shorea materialis* Ridl. | 20 | nil |
| Dipterocarpaceae | *Vatica cinerea* King. | 74 | 1 |
| Dracaenaceae | *Dracaena maingayi* Hook.f. | nil | 1 |
| Ebenaceae | *Diospyros pilosanthera* Blanco . | nil | 25 |
| Ebenaceae | *Diospyros* sp | nil | 27 |
| Ebenaceae | *Diospyros* sp. 1 | nil | 1 |
| Ebenaceae | *Diospyrus* sp. | 4 | nil |
| Erythroxylaceae | *Erythroxylum cuneatum* (Miq.) Kurz | 1 | nil |
| Euphorbiaceae | *Austrobuxus nitidus* Miq. | 32 | nil |
| Euphorbiaceae | *Baccaurea parviflora* (Müll.Arg.) Müll.Arg. | nil | 3 |

| | | | |
|---|---|---|---|
| Euphorbiaceae | *Chaetocarpus castanocarpus* (Roxb.) Thwaites | 6 | nil |
| Euphorbiaceae | *Croton* sp | nil | 7 |
| Euphorbiaceae | *Drypetes* sp. | 3 | nil |
| Euphorbiaceae | *Koilodepes* sp | nil | 9 |
| Euphorbiaceae | *Madhuca sericea* (Miq.) H.J. Lam | nil | 32 |
| Euphorbiaceae | *Madhuca tubulosa* H.J. Lam | nil | 1 |
| Euphorbiaceae | *Suregada multiflora* (Juss.) Baill. var. multiflora. | nil | 1 |
| Fabaceae | *Ormosia sumatrana* (Miq.) Prain | nil | 1 |
| Fagaceae | *Lithocarpus rassa* (Miq.) Rehder | 24 | nil |
| Flacourtiaceae | *Hydnocarpus* sp | nil | 1 |
| Guttiferae | *Calophyllum rupicola* Ridl. | 65 | nil |
| Lauraceae | *Cinnamomum sintoc* Blume. | nil | 1 |
| Lauraceae | *Litsea* sp | nil | 20 |
| Lecythidaceae | *Barringtonia scortechinii* King. | nil | 12 |
| Leguminosae | *Archidendron contortum* (Martelli) I.C. Nielsen | 21 | nil |
| Loganiaceae | *Norrisia malaccensis* Gardner. | 14 | nil |
| Melastomataceae | *Memecylon* sp | nil | 1 |
| Melastomataceae | *Memeycylon* sp. | 1 | nil |
| Moraceae | *Artocarpus kemando* Miq. | nil | 1 |
| Moraceae | *Artocarpus lanceifolius* Roxb. | nil | 5 |
| Myristicaceae | *Knema glauca* (Blume) Warb. | 1 | 4 |
| Myristicaceae | *Knema globularia* (Lam.) Warb. | nil | 6 |
| Myristicaceae | *Knema laurina* (Blume) Warb. | 1 | nil |
| Myrtaceae | *Rhodamnia cinerea* Jack | 10 | nil |
| Myrtaceae | *Syzygium cerinum* (M.R. Hend.) I.M. Turner. | 30 | nil |
| Myrtaceae | *Syzygium cinereum* (Kurz) P. Chantaranothai & J. Parn. | 49 | nil |
| Myrtaceae | *Syzygium grande* (Wight) Walp. | 12 | 2 |
| Myrtaceae | *Syzygium* sp. 1 | nil | 1 |
| Myrtaceae | *Syzygium* sp. 1 | 4 | nil |
| Myrtaceae | *Syzygium* sp. 2 | 26 | nil |
| Myrtaceae | *Syzygium* sp. 3 | 2 | nil |
| Myrtaceae | *Syzygium* sp. 4 | 2 | nil |
| Myrtaceae | *Syzygium syzygioides* (Miq.) Merr. & L.M. Perry. | 5 | nil |
| Myrtaceae | *Syzygium zeylanicum* (L.) DC. | 3 | 1 |
| Ochnaceae | *Brackenridgea hookeri* (Planch.) A. Gray | 3 | nil |

| | | | |
|---|---|---|---|
| Ochnaceae | *Campylospermum serratum* (Gaertn.) Bittrich & M.C.E. Amaral | 10 | nil |
| Phyllanthaceae | *Cleistanthus* sp | nil | 1 |
| Phyllanthaceae | *Cleistanthus sumatranus* (Miq.) Müll.Arg. | nil | 9 |
| Polygalaceae | *Xantophyllum* sp. | 3 | nil |
| Rosaceae | *Licania splendens* (Korth.) Prance | 87 | nil |
| Rosaceae | *Maranthes corymbosa* Blume | nil | 1 |
| Rosaceae | *Maranthes* sp. | 1 | nil |
| Rubiaceae | *Aidia densiflora* (Wall.) Masam. | nil | 1 |
| Rubiaceae | *Canthium glabrum* Blume. | nil | 4 |
| Rubiaceae | *Canthium nitidum* | 13 | nil |
| Rubiaceae | *Canthium* sp | nil | 1 |
| Rubiaceae | *Diplospora malaccensis* Hook.f. | 1 | 2 |
| Rubiaceae | *Ixora pendula* Jack var. pendula | nil | 5 |
| Rubiaceae | *Morinda elliptica* (Hook.f.) Ridl. | 2 | nil |
| Rubiaceae | *Psydrax* sp. | 2 | nil |
| Rubiaceae | *Timonius wallichianus* (Korth.) Valeton. | 1 | nil |
| Rutaceae | *Acronychia pedunculata* (L.) Miq | 2 | 6 |
| Rutaceae | *Atalantia monophylla* (L.) DC | nil | 1 |
| Sapindaceae | *Guioa bijuga* (Hiern) Radlk. | 11 | nil |
| Sapotaceae | *Madhuca longistyla* (King & Gamble) H.J. Lam | 3 | nil |
| Sapotaceae | *Palaquium obovatum* (Griff.) Engl. | 4 | nil |
| Sapotaceae | *Pouteria malaccensis* (C.B. Clarke) Baehni. | nil | 2 |
| Sapotaceae | *Pouteria obovata* (R.Br.) Baehni | 14 | 1 |
| Simaroubaceae | *Eurycoma longifolia* Jack | 1 | nil |
| Sterculiaceae | *Heritiera simplicifolia* (Mast.) Kosterm. | nil | 3 |
| Sterculiaceae | *Heritiera* sp. | 1 | nil |
| Sterculiaceae | *Heritiera* sp. 2 | 1 | nil |
| Sterculiaceae | *Sterculia parviflora* Roxb. ex G. Don. | nil | 1 |
| Symplocaceae | *Symplocos adenophylla* Wall. ex G. Don | 36 | nil |
| Ulmaceae | *Gironiera* sp. | 2 | nil |
| Verbenaceae | *Teijsmanniodendron coriaceum* (C.B. Clarke) Kosterm., | 3 | 1 |
| Violaceae | *Rinorea* sp | nil | 1 |
| | Unidentified sp. | 11 | 7 |
| | Total | 686 | 277 |

Table 2:Number of tree species with comparison of the other studies focusing on the island

| Study | Location | Number of tree species recorded |
|---|---|---|
| Presence studies | Pulau Bidong (0.25 ha) | 55 |
| | Pulau Redang (0.25 ha) | 55 |
| Pesiu *et al.* (2015) | Pulau Perhentian (Plot 1, 0.25 ha) | 22 |
| | Pulau Perhentian (Plot 2, 0.25 ha) | 35 |
| Senterre *et al.* (2015) | Pulau Babi Tengah, Johor | 77 |
| Khairil *et al.* (2012) | Pulau Redang (Coastal forest plot, 0.1 ha) | 48 |
| | Pulau Redang (Inland forest plot, 0.1 ha) | 50 |
| Rohaiza (2011) | Pulau Singa Besar, Langkawi (0.5 ha) | 84 |
| | Pulau Timun, Langkawi (0.5 ha) | 75 |
| Raffae (2003) | Bukit Matchinchang Langkawi (2.0 ha) | 117 |

Most of the trees in Pulau Bidong have a dbh size ranging from 5 cm until 44.99 cm dbh and the height of the trees ranging from 3 m until 22.99 m. Meanwhile, in Pulau Redang more dbh size and height class presented. The dbh size of the trees ranging from 5 until 124.99 cm while the tree height ranging from 3 m until 52.99 m. The comparison of dbh size and height of the trees in Pulau Bidong and Pulau Redang were shown in Table 3 and Table 4 respectively.

Following the above information, there are 15 species listed in the IUCN Red List of Threatened Species out of 102 species recorded in Table 4 (IUCN, 2015).

Apart from that, the island tree species also have economic value and some potential uses. Listed in Table 6, were the tree species name with simple descriptions of their uses in daily life. It was found out that 34 out of 102 tree species recorded have the economic value because of their potential uses either as a timber, food, medicine and others.

## Discussion

### *Tree Species Composition and Distribution*

The results of this study show that Pulau Bidong and Pulau Redang are occupied by a variety of tree species that is vital for ecosystem dynamics.

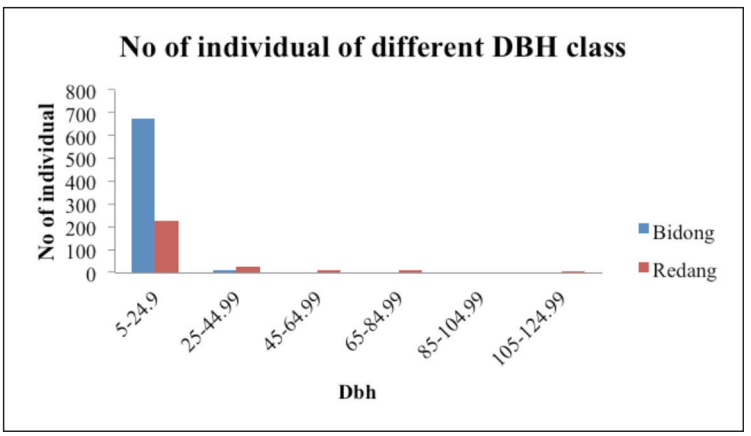


Table 3: No of individuals of different DBH class in Pulau Bidong and Pulau Redang

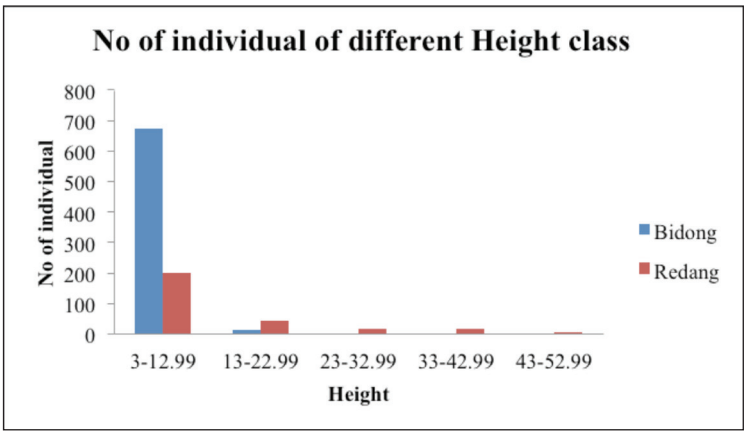


Table 4: No of individuals of different height class in Pulau Bidong and Pulau Redang

Table 5: The IUCN Red List of Threatened Species: The IUCN status were indicated as **LC**, Least Concern/ Lower Risk; **NR**, Near Threatened**; VU**, Vulnerable; **EN**, Endangered; **CR**, Critically Endangered; **EW**, Extinct in the Wild; **EX**, Extinct. The location or island were indicated as **B**, Pulau Bidong; **R**, Pulau Redang

| Family | Species | Status | Location |
|---|---|---|---|
| Dipterocarpaceae | *Dipterocarpus chartaceus* Symington. | CR | B |
| Dipterocarpaceae | *Shorea materialis* Ridl. | CR | B |
| Dipterocarpaceae | *Vatica cinerea* King. | EN | B, R |
| Dipterocarpaceae | *Shorea glauca* King. | EN | R |
| Celastraceae | *Kokoona sessilis* Ding Hou | VU | R |
| Sapotaceae | *Madhuca longistyla* (King & Gamble) H.J. Lam | VU | R |
| Anacardiaceae | *Mangifera macrocarpa* Blume | VU | R |
| Sterculiaceae | *Sterculia parviflora* Roxb. ex G. Don. | LC | R |
| Rosaceae | *Maranthes corymbosa* Blume. | LC | R |
| Rosaceae | *Licania splendens* (Korth.) Prance | LC | B |
| Ochnaceae | *Brackenridgea hookeri* (Planch.) A. Gray | LC | B |
| Myristicaceae | *Knema globularia* (Lam.) Warb. | LC | R |
| Euphorbiaceae | *Madhuca tubulosa* H.J. Lam | LC | R |
| Burseraceae | *Dacryodes rostrata* (Blume) H.J. Lam. | LC | R |
| Annonaceae | *Goniothalamus tenuifolius* King. | LC | R |

Tree species from the timber family that is *Shorea glauca* and *Madhuca sericea* dominates the forested land of Redang. Similarly, Khairil *et al.* (2012) on the study of tree species for two forest types at Pulau Redang recorded the species of *Shorea glauca* to be the most important species in the island. This indicates that the forested land of Pulau Redang is still protected beyond of its popular tourism destination status that seeks for more land settlements through years. Meanwhile, little is known on the historical island of Bidong. The findings of this study make known of some dominant tree species that exist in the island such as *Licania splendens*, *Vatica cinerea* and *Syzygium cinereum*. Perhaps the findings of this study would give some

Table 6: Potential uses of island tree species following Burkill, (1966)

| Family | Species | Uses |
|---|---|---|
| Anacardiaceae | *Mangifera odorata* Griff. | Food |
| Anacardiaceae | *Parishia insignis* Hook.f. | Timber |
| Anacardiaceae | *Swintonia floribunda* Griff. | Matches |
| Annonaceae | *Polyalthia sumatrana* (Miq.) Kurz. | Timber |
| Calophyllaceae | *Mesua ferrea* L. | 1. Timber 2. Illuminating oil 3. Varnish 4. Medicine |
| Clusiaceae | *Garcinia hombroniana* Pierre | 1.Edible fruits 2. Medicinal use 3. Timber |
| Clusiaceae | *Garcinia nigrolineata* Planch. ex T. Anderson | Timber |
| Dipterocarpaceae | *Shorea materialis* Ridl. | Timber |
| Dipterocarpaceae | *Vatica cinerea* King. | Timber |
| Dipterocarpaceae | *Shorea glauca* King. | Timber |
| Euphorbiaceae | *Chaetocarpus castanocarpus* (Roxb.) Thwaites | Little timber |
| Euphorbiaceae | *Baccaurea parviflora* (Müll.Arg.) Müll.Arg. | Edible fruits & Timber |
| Fabaceae | *Ormosia sumatrana* (Miq.) Prain | Ornamental & Timber |
| Lauraceae | *Cinnamomum sintoc* Blume. | Medicinal use |
| Loganiaceae | *Norrisia malaccensis* Gardner. | Timber (Constructions) |
| Melastomataceae | *Memecylon* sp. | Timber & Charcoal |
| Moraceae | *Artocarpus kemando* Miq. | Timber (house, boat building), fibre, bird-lime Fruit eaten |
| Moraceae | *Artocarpus lanceifolius* Roxb. | Valuable timber & Fruit eaten |
| Myristicaceae | *Knema laurina* (Blume) Warb. | Timber (Houses & beams) & Food (Edible fruits) |
| Myrtaceae | *Syzygium grande* (Wight) Walp. | Shade trees, Fire breaks & Timber |
| Myrtaceae | *Syzygium zeylanicum* (L.) DC. | Fruit eaten, Timber & Medicine |
| Phyllanthaceae | *Cleistanthus sumatranus* | House building |
| Phyllanthaceae | *Cleistanthus* sp | House building |
| Rubiaceae | *Diplospora malaccensis* Hook.f. | Beverage |
| Rubiaceae | *Morinda elliptica* (Hook.f.) Ridl. | Dye & Medicine |
| Rubiaceae | *Timonius wallichianus* (Korth.) Valeton. | Timber, but little use |
| Rubiaceae | *Ixora pendula* Jack var. pendula | Medicinal |
| Sapindaceae | *Guioa bijuga* (Hiern) Radlk. | Timber |
| Sapotaceae | *Palaquium obovatum* (Griff.) Engl. | Gutta-percha &Timber |
| Sapotaceae | *Pouteria obovata* (R.Br.) Baehni | Food (Edible fruits) |
| Sapotaceae | *Pouteria malaccensis* (C.B. Clarke) Baehni. | Food (Edible fruits) |
| Simaroubaceae | *Eurycoma longifolia* Jack | Medicinal |
| Sterculiaceae | *Sterculia parviflora* Roxb. ex G. Don. | Timber |
| Symplocaceae | *Symplocos adenophylla* Wall. ex G. Don | Charms |

idea of the extensive forest that made up the land of Pulau Bidong and would encourage more studies focusing on the land ecosystem. Based on the comparison with the previous island-based studies (Rohaiza, 2011; Khairil *et al.,* 2012; Raffae 2013; Pesiu *et al.,* 2015), there are similarities in the recorded dominant families. It is found that Dipterocarpaceae and Euphorbiaceae dominate the island forest. This shows that the forested islands of Peninsular Malaysia are of the same in terms of tree taxa distribution due to its general forest formation under the tropical evergreen rainforest.

### *Threatened Tree Species*

The study reveals 15 tree species that were listed in the IUCN Red List of Threatened species (IUCN, 2015). Two species that really need to be brought into attention is the Critically Endangered species, *Dipterocarpus chartaceus* and *Shorea materialis* from the dominant timber family, Dipterocarpaceae. Both of the tree species were spotted in the historical Pulau Bidong. Another tree species, *Vatica cinerea* (spotted in Pulau Bidong and Pulau Redang respectively) and *Shorea glauca* (only spotted in Pulau Redang) categorized as endangered species. In addition, there are three species listed as Vulnerable which means has a high potential to be endangered. The result obtained from the studies can be the gateway of looking at the importance of tree species as a dominant element of the ecosystem in a crucial level. Crucial means to do something or starting a plan that could contribute to the conservation or monitoring of the island tree species. Perhaps a permanent plot can be establish in Pulau Bidong and Pulau Redang to monitor the growth pattern and even the loss of trees every year.

### *Economic Potential*

The economic potential of the island tree species is also highlighted in this study. According to Burkill (1966), there are 34 tree species recorded comprising of 20 families has some economic potential value. Most of the trees have a potential uses generally as timber, medicine and foods. Moving into each one of this general uses, some of the timber can be widely use as constructions material for house and boat building especially the highly valuable dipterocarp family, Dipterocarpaceae. However, the dipterocarp family nowadays is threatened due to their quality. In order to protect those important tree species, maybe some of the lesser known timber species can be used as a backup by the forest industries (Appanah & Ratnam, 1992). Based on the findings, there were 24 timber species recorded in the islands of Bidong, Redang and Perhentian. The importance of research is practical on identifying the tree species suitable for timber production.

Next, the most practical uses of flora that most people hunting for, is the medicine or herbs. In Pulau Bidong, the famously known flora, *Eurycoma longifolia* locally known as Tongkat Ali is scattered through the island. Some small tracks can be seen in Pulau Bidong, mostly to make way for people searching for the plant. Realizing the value of the island tree species, attention should be brought to the local communities to sustainably care about the existence of those useful tree species. Studies done by Kulip (2003), the knowledge on the use of tree species were passed from generation to generation but the practice seems to be vanishing and fade away. Therefore, solutions were needed to instill and enhance that traditional knowledge to young generations. Some possible solutions would be through education and awareness effort. For example, scientific research on plants through classification and recording of plant species was one of the great attempts scientists ever done to maintain the traditional knowledge practiced by local communities.

## Conclusion

The panoramic view of the extensive forests covering the hilly part of the islands is indeed a blooming sanctuary of tree species. However, the islands are somehow exposed to some disturbances due to land settlements mostly for tourism purpose. Therefore, conservation effort through collecting ecological baseline data is

highly recommended to continually sustain those strong stand structures of trees decorating the small scale of island yet a vital element to every creature hidden beneath. If properly managed, the island forests can be sustainable resources both for the local communities and non-consumptive use by the eco-tourists for outdoors recreational activities and appreciation of nature.

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Figure 1: *Vatica cinerea* King

**Description:**

Usually small trees under 4 ft girth, sometimes exceeding 8 ft girth. Leaves usually elliptic-lanceolate and narrowing towards both ends, apex blunt, about 3.5 to 1.7 in., about 9 nerved, the nerves being hardly more prominent on the lower than the upper surface; petioles rather slender, usually slightly less than 0.5 in. in length, sparsely grey tomentose.

Figure 2: *Shorea glauca* King

**Description:**

Trees 80 to 100 ft. tall. Branchlets puberulous. Leaves rather stiff, coriaceous, ovate-lanceolate acuminate, base broad round, above glabrous smooth shining, beneath glaucous when young; nerves slender ascending 7 to 9 pairs about 3.5 to 4.5 in. long, 1.4 to 2 in. wide; petioles 0.45 to 0.6 in. long, wrinkled.

Figure 3: *Syzygium cerinum* (M.R. Hend.) I.M. Turner

**Description:**

Bark orange-rown, rather fissured and fibrous, the old flakes greyish. Leaves elliptic to obovate, blunt or slightly pointed tapered to the base, with many five veins. Common in lowland forest, especially swampy ground and by rivers.

Figure 4: *Buchanania arborescens* (Blume) Blume

**Description:**

An evergreen, glabrous tree, bark pinkish brown, smooth, red internally. Leaves oblong, narrowly obovate, tapered to the base, the sides rather upturned and wavy, shiny, side veins 13-20 pairs, long stalk. Common on sandy and rocky coasts and riverbanks