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Biodiversity and Conservation of Flora of Carey Island, Malaysia

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ABSTRACT

Floristic surveys were conducted at six sites of Carey Island, Malaysia. From the surveyed sites, 53 species that belong to 48 genera and 30 families had been identified. The common species recorded were *Avicennia alba*, *A. intermedia*, *Bruguiera gymnorhiza*, *Ceriops tagal*, *Nypa fruticans*, *Rhizophora apiculata*, *R. mucronata*, *Scyphiphora hydrophyllacea*, *Sonneratia alba*, *Xylocarpus granatum* and *X. moluccensis*. However, the dominant pteridophytes were *Adiantum flabellulatum*, *Lygodium salicifolium* and *Nephrolepis biserrata*. With special interest to mangrove sites, the majority of the identified species are of economic importance either as a source of food, medicine, wood, ornamentals or for coastal protection. *Xylocarpus* species are considered as important endangered mangrove species in Malaysia. Therefore, propagation of these species through tissue culture, as an approach for conservation, has been initiated.

Keywords: Biodiversity, Carey Island, conservation, Malaysia, mangrove, tissue culture, *Xylocarpus*.

INTRODUCTION

Carey Island is a huge island with a total area of 15,000ha and comprised largely of palm oil estates that belong to Golden Hope Plantations. The island is located at the North-West of Morib, Selangor, across the Port Klang, Malaysia. It is considered as an initial settlement area for woodcarving, using the wood of *Xylocarpus* species. Among woody *Xylocarpus* species, is *X. granatum* which was selected to carry out this study. This species is one of the most important components of the mangrove forest for its vital importance wood quality and other multi-purpose uses. In meantime, this species suffers from extinction due to unavailability of its seeds and the long time needed for plant development. Therefore, mass propagation through different tissue culture systems is in need to conserve and meet the requirement for wood of *Xylocarpus* species.

To date, there have been no previous published records on Carey Island's flora; their composition and distribution, and the endangered species that need to be conserved. Therefore, the present work aims to: (1) gather information on the flora of Carey Island, (2) determine whether there are any rare or endangered species with economic importance that need to be conserved, and (3) set a trial for *X. granatum* propagation through tissue culture techniques.

MATERIALS AND METHODS

Sample sites

Floristic survey was conducted from April 2005 to April 2006 covering six sites: (1) the Eagle Sanctuary and Heritage Resort Real Estate, (2) tropical Forest, R&D/East Wing, (3) Wetland/Wildlife, (4) Biodiversity/Wildlife, (5) Tropical Forest Heritage/West Wing, and (6) Outdoor Challenge Camp (Maps 1 and 2).

Site Description

The Eagle Sanctuary and Heritage Resort Real Estate is situated along the sea and mangrove area with uneven flooded earth surface except higher areas. Tropical Forest R&D/East Wing is quite a flat land and is the natural habitat for *Fagraea crenulata*. Wetland/Wildlife is mainly a mangrove area while Biodiversity/Wildlife is located in the palm oil estate. This area is also known as 'Fingers' due to its finger-like shape. Tropical Forest Heritage is an area along the tidal gates and Outdoor Challenge Camp is located along the sea and mangrove area.

From the six sites, eight quadrates, each 10m x 10m were sampled randomly and species were recorded and identified. Identification of the species was done according to Corner (1952).

Techniques used for plant propagation

Propagation of *Xylocarpus granatum was carried* out using standard tissue culture procedures as described by Taha (1993). Various media such as MS (Murashige and Skoog, 1962), DKW (Driver and Kuniyuki, 1984) were used for culture initiation. Various hormones, BAP, TDZ, NAA. 2,4-D, at different concentrations were applied for callus growth and plant regeneration.

Young stem and leaves were used as somatic tissue culture for plant growth initiation.

RESULTS

Surveyed flora of Carey Island were identified. The survey revealed the presence of 53 species which are belonging to 48 genera and 30 families. *Rhizophora apiculata*, *R. mucronata*, *Avicennia intermedia* and *Scyphiphora hydrophyllacea* were some of the common species of the mangrove sites 1, 3, 5 and 6; while *Fagraea crenulata* dominated site 2 (Table 1).

Pteridophytes such as *Adiantum flabellulatum*, *Lygodium salicifolium* and *Nephrolepis biserrata* were the most common flora at site 2; while *Acrostichum aureum*, *Sonneratia alba* and *Avicennia alba* were dominated site 3. At site 4, the dominant species were from the families Gramineae and Cyperaceae. Trees are

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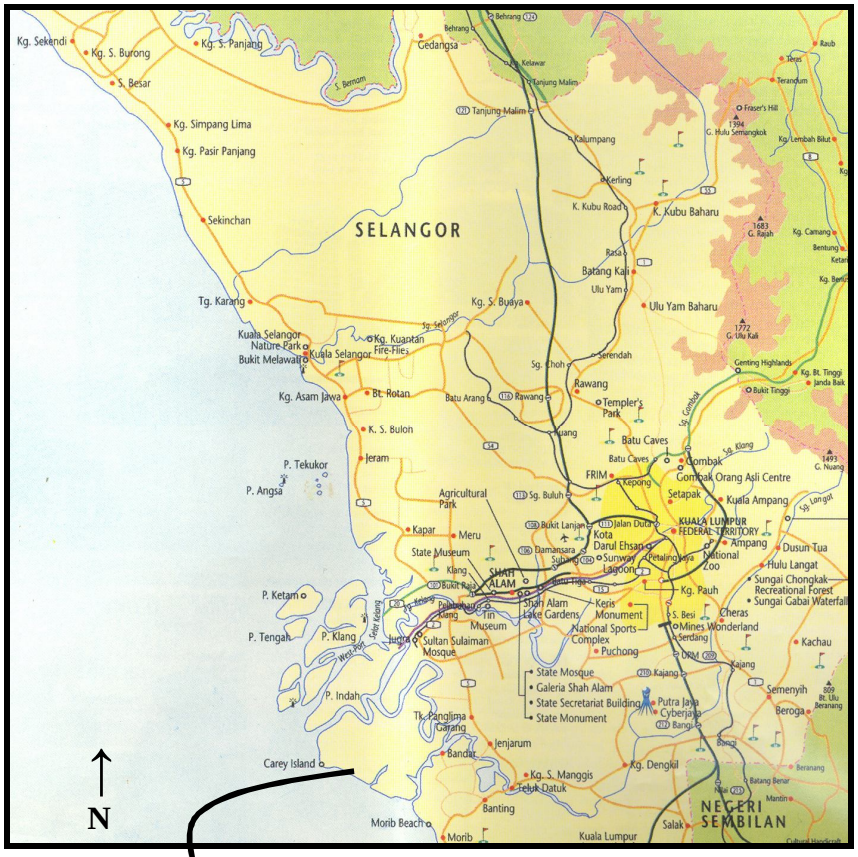
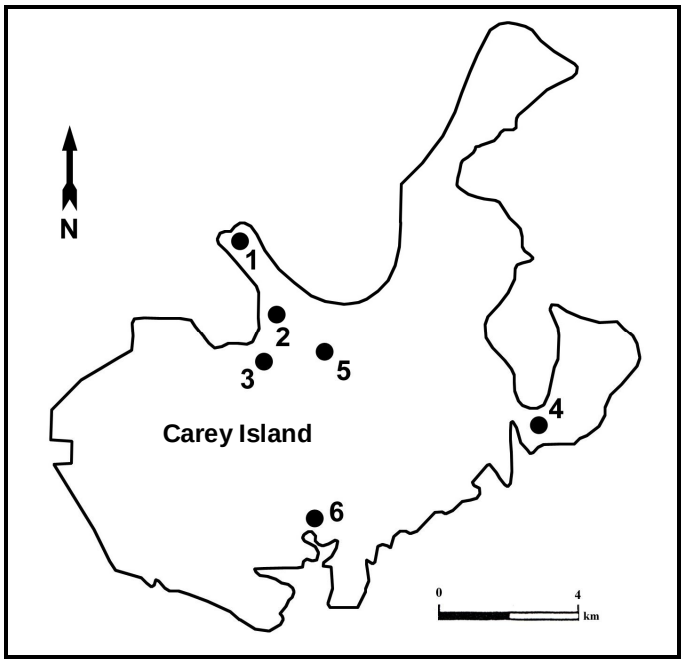


Map (1): Location of Carey Island.



Map (2): Studied sites at Carey Island

rarely observed at site 4 except for *Macaranga triloba*, which is one of the common pioneer tree species. Pioneer species, sometimes called light-demanders can only germinate and established in big gaps (Whitmore, 1993). *Pluchea indica* and *Wedelia biflora* were only observed at site 5 while *Acanthus ilicifolius* and *Lumnitzera racemosa* were only recorded at site 6.

Some of the species such as *Acrostichum aureum*, *Stenochlaena palustris* and *Nephrolepis biserrata* were commonly observed in lowland of secondary forest and open areas like rubber, oil palm, coconut and cocoa plantations. *Stenochlaena palustris* is potentially important as a vegetable. *Passiflora foetida* is commonly recorded in disturbed areas while *Asystasia* was considered as the most dominant weed in oil palm plantations especially in West Johore. It is a fast growing species, able to survive under shady areas and can dominate an area within a short period of time.

Xylocarpus species, found at site 1, 2, 3 and 6 are considered as important endangered mangrove species in Malaysia by the Malaysian government. The species occur together with species from the families Avicenniaceae and Rhizophoraceae. *Xylocarpus* species are dwindling in Carey Island but are an essential wood in the life style of the *Mah Meri* indigenous people, whose evocative carvings are the major essence of their customs.

As an approach for conservation, propagation of *Xylocarpus* species has shown promising results (Plates 1-4). Table 2 shows the response of various explants of *Xylocarpus granatum* to various media supplemented with different hormones. Although regeneration of this species was not successful, it was the first attempt for conservation of this species. Through biotechnological methods such as tissue culture, it is hoped that plant propagation of this species will be achieved in the near future. Serious efforts are being carried out, for instance, induction of somatic embryogenesis is in progress although only the formation of globular stage was observed thus far and work is currently in progress to further develop the somatic embryos up to regeneration of complete plants. Even in the literature, thus far, regeneration of this species has not been successful, only formation of callus was reported. Addition of sodium chloride and pH reduced to 4 had been attempted for improvement of callus growth.

Discussion

From the present study and previous results it is evident that biodiversity exists in an oil palm plantations contrary to the conventional preconceived notions of mono-crop planting. These results are in agreement with (Haron (2006) and Yahya *et al*. (2006). It can be a significant harbour of wildlife and plants that are rare, endangered or of scientific, heritage or ethnobotanical interest.

Table (1): List of recorded species in studied sites.

No.	Family	Species	Site No
1.	Acanthaceae	*Acanthus ilicifolius* Linn.	6
2.		*Asystasia coromandeliana* Nees.	2, 4
3.	Araceae	*Scindapsus* sp.	2
4.	Avicenniaceae	*Avicennia alba* Blume	1, 2, 3, 5, 6
5.		*Avicennia intermedia* Griff.	1, 3, 5, 6
6.		*Avicennia officinalis* Linn.	1
7.	Blechnaceae	*Stenochlaena palustris* (Burm.f) Bedd.	2, 4
8.	Combretaceae	*Lumnitzera racemosa* Willd.	6
9.	Compositae	*Ageratum conyzoides* Linn.	4
10.		*Mikania cordata* (Burm.f) B.L. Rob.	2, 4
11.		*Pluchea indica* (Linn.) Less.	5
12.		*Wedelia biflora* DC.	5
13.	Cyperaceae	*Scleria* sp.	4
14.		*Cyperus compressus* Linn.	4
15.		*Eleocharis* sp.	4
16.		*Fimbristylis* sp.	4
17.	Dilleniaceae	*Tetracera indica* (Christm. & Panz.) Merr.	4
18.	Euphorbiaceae	*Excoecaria agallocha* Linn.	1, 5
19.		*Macaranga triloba* (Blume) Mull. Arg.	4
20.		*Mallotus paniculatus* (Lamk.) Mull. Arg.	4
21.	Gramineae	*Paspalum conjugatum* Berg.	4
22.		*Eleusine indica* (L.) Gaertn.	4
23.		*Ischaemum muticum* Linn.	4
24.	Leguminosae	*Derris trifolia* Lour.	1, 3, 5
25.		*Acacia auriculiformis* A. Cunn.	2
26.	Loganiaceae	*Fagraea crenulata* Maing.	2
27.	Malvaceae	*Hibiscus tiliaceus* Linn.	5, 6
28.	Melastomataceae	*Melastoma malabathricum* Linn.	2, 4
29.	Meliaceae	*Xylocarpus granatum* Koen.	1, 2, 3, 6
30.		*Xylocarpus moluccensis* (Lam.) M. Roem.	1, 3, 6
31.	Moraceae	*Ficus parietalis* Blume	2, 4
32.	Musaceae	*Heliconia* sp.	4
33.	Nephrolepidaceae	*Nephrolepis biserrata* Schott.	2, 4
34.	Nymphaeaceae	*Nymphaea pubescens* Willd.	4
35.	Palmae	*Nypa fruticans* (Thunb.) Wurmb.	1, 3, 5
36.		*Elaeis quineensis* Jacq.	2
37.	Passifloraceae	*Passiflora foetida* Linn.	4
38.	Pteridaceae	*Acrosticum aureum* Linn.	1, 3, 4, 5, 6
39.		*Adiantum flabellulatum* Linn.	2
40.	Rhizophoraceae	*Bruguiera gymnorhiza* (L.) Lam.	1, 3, 5, 6
41.		*Bruguiera parviflora* Wight and Arn. ex Griff.	1, 5
42.		*Ceriops tagal* (Perr.) C. B. Rob.	1, 3, 6
43.		*Rhizophora apiculata* Blume	1, 3, 5, 6
44.		*Rhizophora mucronata* Lam.	1, 3, 5, 6
45.	Rubiaceae	*Scyphiphora hydrophyllacea* Gaertn.	1, 3, 5, 6
46.		*Morinda citrifolia* Linn.	2
47.		*Ixora* sp.	3
48.	Schizaeaceae	*Lygodium salicifolium* Presl.	2
49.		*Lygodium flexuosum* Swartz	4
50.	Solanaceae	*Solanum nigrum* Linn.	2, 4
51.	Sonneratiaceae	*Sonneratia alba* Smith	1, 2, 3, 5
52.	Sterculiaceae	*Heritiera littoralis* Dryand.	3
53.	Verbenaceae	*Vitex* sp.	2

Note: 1 = The Eagle Sanctuary and Heritage Resort Real Estate, **2** = Tropical Forest R&D/East Wing, **3** = Wetland/Wildlife, **4** = Biodiversity/Wildlife, **5** = Tropical Forest Heritage/West Wing, and **6** = Outdoor Challenge Camp.

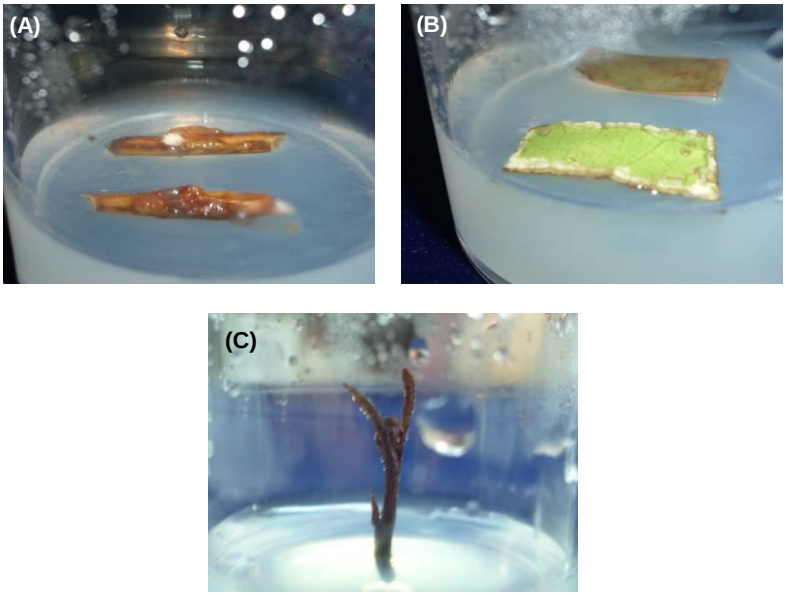


Plate (1): (A) Callus formed on young stem cultured on DKW medium supplemented with 5.0 mg/l NAA and 10, **(B)** Callus formed on young leaves cultured on DKW with 10 mg/l NAA and 10 mg/l 2, 4-D, and **(C)** Shoot bud cultured on MS medium Supplemented with 5.0 mg/l BAP and 3.0 mg/l NAA.

Table (2): The response of different explants of *Xylocarpus granatum* to different media, supplemented with different concentrations of hormones, maintained under 16/8 h light/dark or in total darkness at 25 ± 1° C.

Explant sources	Basic Media	Hormones and Concentration (mg/l)	Observations
Young Stems	MS	BAP (1.0), NAA (1.0)	No change
Shoots	MS	BAP (1), NAA (1)	No change
leaves	MS	BAP (1), NAA (1)	No change
Young stems	MS (charcoal)	BAP (1), NAA (1)	Still growing, no change
Shoots	MS (charcoal)	BAP (1), NAA (1)	Still growing
leaves	MS (charcoal)	BAP (1), NAA (1)	No change
Zygotic embryos	MS	BAP (1), NAA (1)	No change
Young Stems	DKW	(BAP(0.5, 1.0) NAA (1.0)	No change
Shoots	DKW	(BAP(0.5, 1.0) NAA (1.0)	No change
Leaves	DKW	(BAP(0.5, 1.0) NAA (1.0)	No change
Young Stems	MS (dark)	(BAP(0.5, 1.0) NAA (1.0)	No change
Shoots	MS (dark)	(BAP(0.5, 1.0) NAA (1.0)	No change
leaves	MS (dark)	(BAP(0.5, 1.0) NAA (1.0)	No change
Young Stems	MS	TDZ (0.1, 0.5, 1.0, 1.5, 2.0)	No change
shoots	MS	TDZ (0.1, 0.5, 1.0, 1.5, 2.0)	Growing
leaves	MS	TDZ (0.1, 0.5, 1.0, 1.5, 2.0)	No change
leaves	MS	2,4 –D (2.0)	Formation of white callus
leaves	MS	2,4-D (20)	Formation of white callus
Flower buds	MS	2,4-D (20)	Formation of callus
Young stems	DKW (pH 4.8)	2,4-D (5.0)	Formation of callus
leaves	DKW	2,4-D (10), NAA (10)	Formation of callus

Golden Hope has carried out efforts to encourage biodiversity in its plantations through conservation and enhancement activities such as carrying out zero burning. Through this practice, besides contributing to properties and fertility are also enhanced. Other activities are maintenance of natural vegetation riparian border along rivers, maintenance of water catchment area and water bodies and crop diversification with planting of agroforestry species such as *Tectona grandis*, *Azadirachta excelsa* and *Bambusa* species. Riparian borders also act as wildlife refuge and corridors besides reducing siltation of rivers (Nasir and Arifin, 1999).

Based on sporadic documentation over a century in the state of Selangor and Kuala Lumpur, with additional records from various taxonomic revisions to date, about 3200 species of vascular plants, comprising ferns, fern-allies, gymnosperms and flowering plants, have been recorded (Wong, 2006). Therefore about 2% of the flora of Selangor has been documented for Carey Island.

The present documentation may not be exhaustive therefore detailed studies on the major existing flora and

habitats of Carey Island have yet to be seriously undertaken. These studies are crucial in establishing a good vegetation map for the island and complete inventory of flora of Carey Island. To date, there is no evidence to show that species of plants have been lost in the island. However, the species may disappear due to habitat or landscape changes (for agriculture and development). Hence, the biological resources of Carey Island should be preserved and utilized in a sustainable manner.

From the floristic studies, limited occurrence of *Xylocarpus* species was observed, therefore a long term planning for replanting of the species must be tackled urgently. Besides normal growing for replanting of the species, other alternative methods for production of more plants must be done. Biotechnological methods such as tissue culture, cell suspension culture, induction of somatic embryogenesis, synthetic seeds must be attempted. In the present work, although complete plant regeneration was not obtained, embryogenic callus was successfully induced and this callus will further be induced to form somatic embryos which will give rise to many plantlets and which is

estimated to grow faster as compared to conventional reproduction. Moreover, from small pieces of tissues can result in many plantlets which eventually will give rise to many *Xylocarpus* trees.

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