

Characteristics of wetland flora in Dong Thap Muoi nature reserve, Tien Giang province

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Đặc điểm hệ thực vật đất ngập nước tại Khu bảo tồn sinh thái Đồng Tháp Mười, tỉnh Tiền Giang

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ABSTRACT

This study aimed to analyze the floral attributes of Dong Thap Muoi Nature Reserve in Tien Giang province. Findings revealed the presence of 136 vascular plant species spanning 113 genera and 53 families within the Polypodiophyta and Angiospermatophyta phyla. These species manifest in six primary life forms: trees, shrubs, vines, herbs, epiphytes, and palms. Notably, the flora demonstrates significant utility, encompassing seven categories of beneficial plants: medicinal plants, edible plants, ornamental plants, tannins-dyes, essential oils, poisonous plants, and other valuable types. Moreover, two species, *Elaeocarpus hygrophilus* Kurz and *Oryza rufipogon* Griff., classified as Vulnerable in the Vietnam Red Data Book (2007), are noteworthy for their conservation importance. Six plant dominant associations further distinguish the area's vegetation as *Melaleuca cajuputi* Maton & Sm. ex R.Powell, *Stenochlaena palustris* (Burm.f.) Bedd., *Bambusa pallida* Munro.Voss, *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f., *Ficus microcarpa* L.f., and *Salvinia cucullata* Bory. These associations play a crucial role in providing habitat, foraging, and nesting grounds during the breeding season for various species. The study suggested that effective long-term conservation strategies should focus on preserving the existing floral diversity. Concurrently, efforts should be made to prioritize selecting and introducing indigenous tree species in reforestation programs to rehabilitate depleted zones or enhance vegetative cover on barren lands.

TÓM TẮT

Nghiên cứu này được thực hiện nhằm xác định đặc điểm thực vật tại Khu bảo tồn sinh thái Đồng Tháp Mười, tỉnh Tiền Giang. Kết quả cho thấy, 136 loài thực vật có mạch, thuộc 113 chi, 53 họ của 2 ngành: Dương xỉ (Polypodiophyta) và Hạt kín (Angiospermatophyta) đã được ghi nhận. Hệ thực vật của khu vực nghiên cứu được đại diện bởi 6 dạng sống gồm thân gỗ, cây bụi, dây leo, thân cỏ, phụ sinh và cau dừa. Các loài thực vật có giá trị sử dụng cao được phân loại thành 7 nhóm hữu ích là cây thuốc; thực vật ăn được; cây cảnh; tanin-thuốc nhuộm; tinh dầu; cây độc; và nhóm cho giá trị khác. Bên cạnh đó, 2 loài có giá trị bảo tồn có tên trong Sách Đỏ Việt Nam (2007), phân hạng Sẽ nguy cấp (VU) là Cà na (*Elaeocarpus hygrophilus* Kurz) và Lúa ma (*Oryza rufipogon* Griff.). Hệ thực vật còn được đặc trưng bởi 6 quần hợp thực vật là Tràm cừ (*Melaleuca cajuputi* Maton & Sm. ex R.Powell), Chối (*Stenochlaena palustris* (Burm.f.) Bedd.), Tre lục bình (*Bambusa pallida* Munro. Voss), Trúc cần câu (*Bambusa multiplex* (Lour.) Raeusch. ex Schult.f.), Gừa (*Ficus microcarpa* L.f.), Bèo tai chuột (*Salvinia cucullata* Bory). Các quần hợp này góp phần cung cấp nơi trú ngụ, kiếm ăn, và làm tổ vào mùa sinh sản cho các loài sinh vật khác. Nhóm tác giả khuyến nghị cần bảo vệ tốt hệ thực vật hiện có trong chiến lược bảo tồn dài hạn, đồng thời ưu tiên các loài cây bản địa cho các chương trình trồng rừng thay thế đối với các diện tích rừng bị chết hoặc trồng bổ sung ở những diện tích đất trống.

1. INTRODUCTION

Dong Thap Muoi Nature Reserve (NR), established in 2000, encompasses an area of 106.82 hectares. It is situated in Village 4, Thanh Tan commune, within the Tan Phuoc district of Tien Giang province. The primary objective of this reserve is to consolidate efforts towards the conservation and development of biodiversity, specifically focusing on the unique features of the acid-alum flooded ecosystem prevalent in the Dong Thap Muoi region [1]. Characterized by its low-lying, deeply inundated lands, the reserve features a predominantly flat landscape interspersed with numerous canals. The hydrological dynamics of the area are seasonally influenced, predominantly by the water flow from the Mekong River and local rainfall patterns. This interaction forms a distinct alum acidic flooded flora system, a hallmark of this ecological zone [2].

The wetland ecosystem of the NR is distinguished by its *Melaleuca cajuputi* Maton & Sm. ex R.Powell forests and various native plants adapted to alum acidic soils. This habitat supports diverse wildlife, including many birds, aquatic species, mammals, amphibians and reptiles. Notably, the bird population in this ecosystem is substantial, with over 12,000 individuals recorded, including endangered and rare species such as *Mycteria leucocephala*, *Leptoptilos javanicus*, *Phalacrocorax carbo*, *Anastomus oscitans*, and *Nettapus coromandelianus*. Additionally, the area is home to approximately 12 mammal species across nine families. Some of these species are of significant conservation importance, including *Prionailurus viverrinus*, *Prionailurus bengalensis*, and *Viverricula indica*. The reptile and amphibian populations are also noteworthy, with 27 reptile species from 9 families and seven amphibian species from 5 families identified. Endangered and rare species such as *Crocodylus siamensis*, *Naja kaouthia*, *Varanus salvator*, *Python molurus*, *Indotestudo elongata*, and *Coelognathus radiatus* have been observed. Furthermore, the aquatic biodiversity of this area includes 20 fish species belonging to 11 families, many of which are native to the region. This rich and diverse wildlife underscores the ecological significance of the NR's wetland

ecosystem [2].

The wetland ecosystem of the NR not only holds significant conservation value but serves as an ideal destination for eco-tourism, annually attracting tens of thousands of visitors. It functions as an educational site for environmental learning for students in the district and as a venue for scientific research for students from universities in the Mekong Delta.

Despite its critical role in biodiversity conservation, particularly in preserving bird species in the NR, there has been a notable gap in research concerning its flora. This study is designed to address this gap by exploring the unique characteristics of the wetland's flora. The research focuses on two key aspects: (1) the diversity of the taxa, life-forms, and the value and conservation significance of the flora, and (2) the composition and characteristics of plant associations in the wetland. The findings from this study will provide a scientific foundation for developing strategies and plans for the effective management, preservation, and enhancement of the flora. This, in turn, will contribute to the broader goal of biodiversity conservation in the NR.

2. RESEARCH METHODOLOGY

2.1. Study site

This study was conducted in Dong Thap Muoi Ecological Reserve in Tien Giang province from March to September 2023 (Figure 1). The Reserve is in a tropical climate zone characterized by two distinct seasons: a rainy season from May to November and a dry season from December to April the following year. The study area experienced an average annual temperature of 27.3°C, with humidity levels fluctuating between 74.1% and 82.5%. The average yearly rainfall was from 1,396 mm to 1,528 mm. Its average elevation was about 0.7 m above sea level. The hydrological conditions of the Reserve were influenced by three primary factors: the upstream water flow from the Mekong River, the tidal regime of the East Sea, and local rainfall patterns. The area is part of a flood zone notable for late-arriving and early-receding floods, typically lasting about 3-4 months, with flood depths ranging from 1.5 m to 2 m. Both soil and water in the area showed characteristics of alum acidity [2].

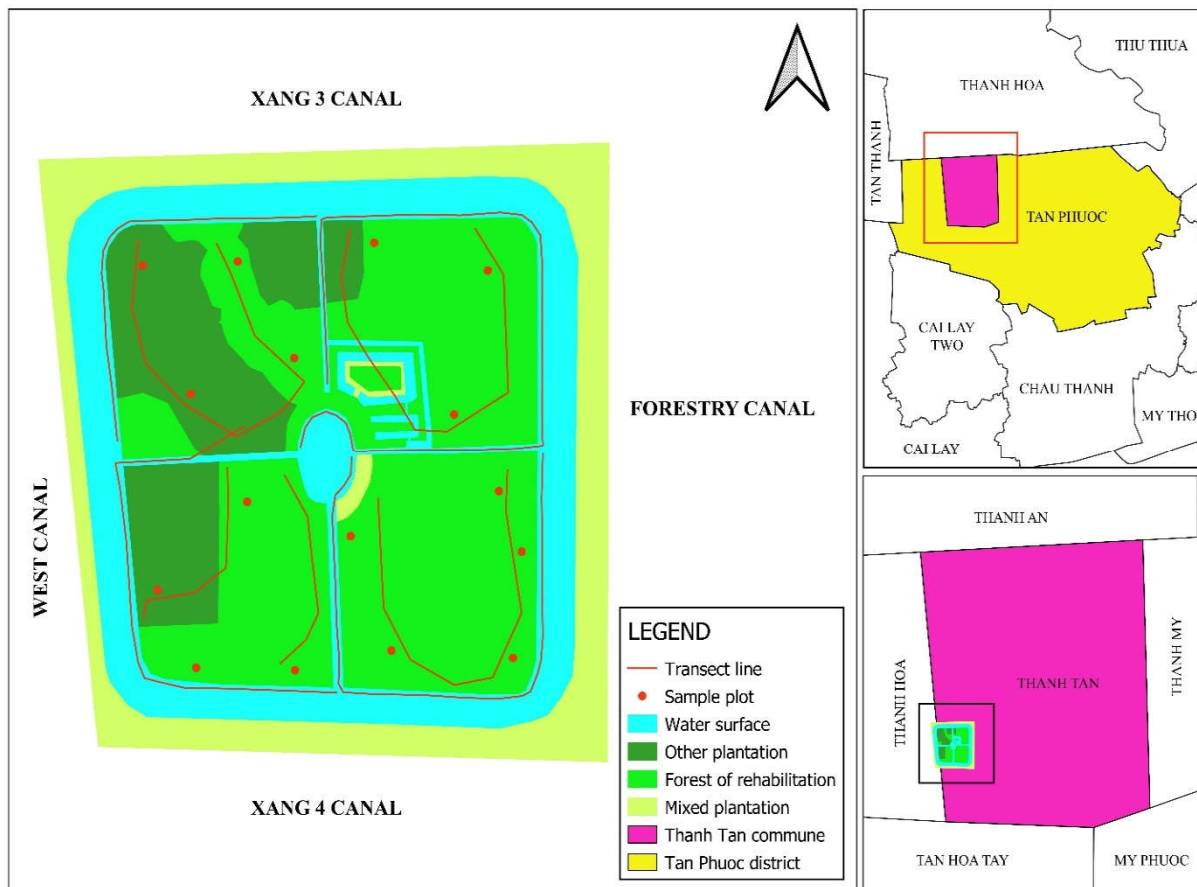


Figure 1. Map of the transect line and sample plot

2.2. Inheritance method

Gather all relevant documents and research works to serve as a basis for orienting research content and field surveys.

2.3. Field investigation

Firstly, we conducted a preliminary analysis of the study area based on information collected from the Reserve Management Board. Then, transect lines and sample plots on the transect lines were established to ensure the representativeness of the study area. Investigations were carried out in late March, early April 2023, and September 2023. A total of 9 transects were established, with four transect lines corresponding to Xang 3 Canal, Xang 4 Canal, West Canal, and Forestry Canal. The remaining five transects were established in the dominant plant associations of *Melaleuca cajuputi*, mixed Bamboo and *Ficus spp.*, *Elaeocarpus hygrophilus*, *Stenochlaena palustris*, *Lygodium sp.* On each transect passing through different plant association types, we set up 2-3 plots. A total of 16 sample plots were established. The Braun-Blanquet

(1964) methods were applied to select the appropriate investigation sample plot size [3]. In particular, the timber or mixed timber and bamboo establishes plots of 100 m² (10 m x 10 m). The herbaceous, shrubs, and vines plant association set up a sample plot of 1 m² (1 m x 1 m). Information on tree species composition, number of individuals, diameter at breast height (DBH), and overall height (H) was collected on each sample plot. According to the Biodiversity Research Handbook [4], plant specimens were collected, photographed, and processed. Besides, the characteristics of the types of plant association were observed and described: dominant species, species composition, number of individuals of each species, height, density and coverage of the vegetation layer.

2.4. Data analysis

The scientific names were identified using the morphological comparison method based on specialized documents, An Illustrated Flora of Vietnam [5], combined with expert methods in comparing specimens to identify species names accurately. Scientific names were adjusted

according to POWO (2023) [6], and Brummitt's (1992) method was used to build the species list [7]. Plant life forms were determined according to An Illustrated Flora of Vietnam [5]. Evaluation of the use value of species by direct interviews with NR staff and local people, and at the same time searching documents on 1900 useful plant species in Vietnam [8], Vietnamese medicinal plants and herbs [9], look up Vietnamese medicinal herbs [10]. The threatened species assessment was based on the Vietnam Red Data Book (2007) [11]. Assess plant diversity according to the Biodiversity Research Handbook [4]. Determine the types of plant association based on the Braun-Blanquet method (1964) [3].

3. RESULTS

3.1. Species diversity and resource value

3.1.1. Diversity of species composition

A total of 136 species belonging to 113 genera and 53 families of two phyla of vascular plants were recorded. Most recorded species belong to Angiosperms (132 species, 97.06%); The Polypodiophyta accounts for a very low proportion with four species (2.94%), namely *Stenochlaena palustris* (Burm.f.) Bedd.), *Lygodium flexuosum* (L.) Sw.), *Lygodium japonicum* (Thunb.) Sw.), and *Salvinia cucullata* Bory. Angiosperms dominate the species composition and are almost absolutely at the family and genus classification levels (Table 1). Detailed analysis in the Angiosperms, the Eudicots dominate the Monocot class with a proportion of 80.15%, 79.65%, and 73.58% compared to 16.91%, 17.70%, and 20.75%, respectively, at species, genus, and family levels.

Table 1. Distribution of taxa of the flora

Phylum	Family		Genera		Species	
	Number	(%)	Number	(%)	Number	(%)
Polypodiophyta	3	5.66	3	2.65	4	2.94
Angiospermatophyta	50	94.34	110	97.35	132	97.06
<i>Eudicots</i>	39	73.58	90	79.65	109	80.15
<i>Monocots</i>	11	20.75	20	17.70	23	16.91
Total	53	100	113	100	136	100

This study has listed the ten most species-rich families (72 species, 52.94%) and (58 genera, 51.32%), with Fabaceae accounting for the most significant proportion (17 species, 12.50%), the lowest is Rubiaceae (4 species,

3.54%) (Figure 2). Besides, three families have four species (3.54%), four families have three species (2.21%), four families have two species (1.47%), and 32 monotypic families (0.74%) were also identified.

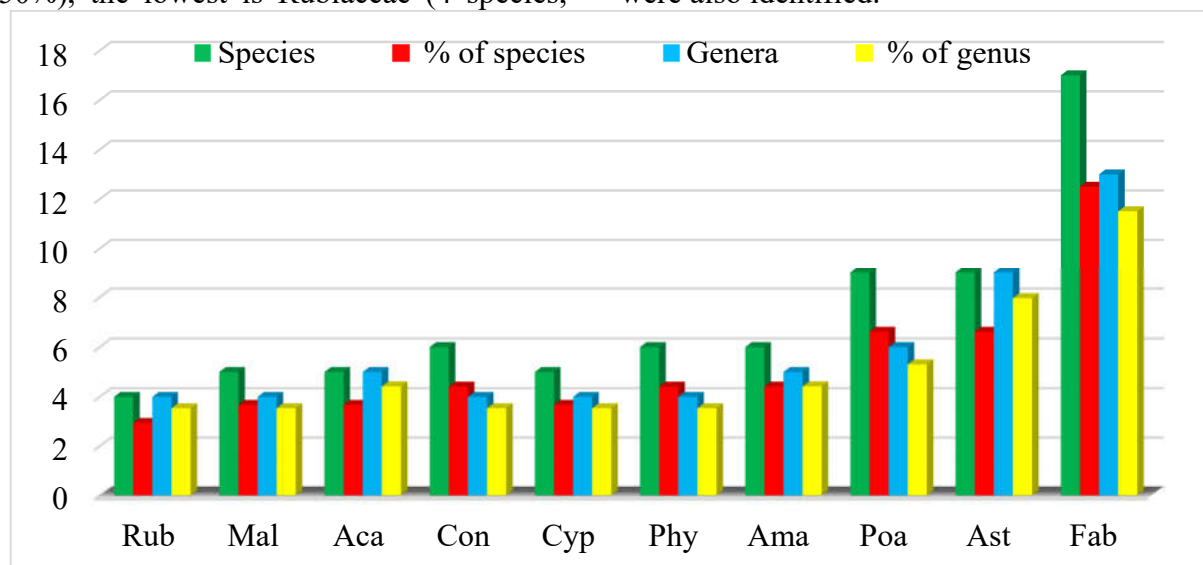


Figure 2. The ten most species-rich families of flora

Rub: Rubiaceae; Mal: Malvaceae; Aca: Acanthaceae; Con: Convolvulaceae; Cyp: Cyperaceae; Phy: Phyllanthaceae; Ama: Amaranthaceae; Poa: Poaceae; Ast: Asteraceae; Fab: Fabaceae

The ten most species-rich genera were also recorded (29 species, 21.32%), *Ficus* and *Bambusa* are the two most diverse genera (4 species, 2.94%), and the lowest are *Senna* and

Mimosa (2 species, 1.47%). Furthermore, four genera with two species (1.47%) and 99 monotypic genera (72.79%) were counted (Figure 3).

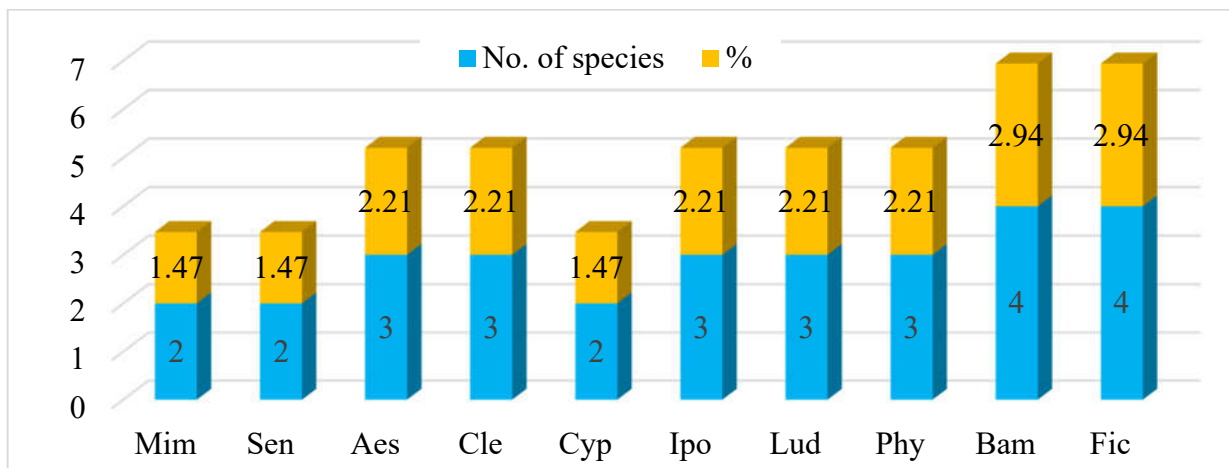


Figure 3. The ten most species-rich genera of the flora

Min: *Mimosa*; Sen: *Senna*; Aes: *Aeschynomene*; Cle: *Cleome*; Cyp: *Cyperus*; Ipo: *Ipomoea*; Lud: *Ludwigia*; Phy: *Phyllanthus*; Bam: *Bambusa*; Fic: *Ficus*

3.1.2. Diversity of life forms

Six main life forms were recorded: woody, shrub, vine, herbaceous, epiphytic/parasitic and palm (Figure 4). Herbaceous plants have the highest species richness (70 species, 51.47%); their main role is to provide a food source for insects and insects, serving as food for aquatic species and birds. Besides, it also provides a habitat for aquatic animals and small birds to nest during the breeding season. Although the woody plant only accounts for 16.18% of the

total number of species in the flora, it plays an essential ecological role, creating the unique characteristics of the flora. Typical species are *Melaleuca cajuputi* Maton & Sm. ex R. Powell, *Elaeocarpus hygrophilus* Kurz, *Ficus microcarpa* L.f., *Ficus subpisocarpa* subsp. *subpisocarpa*, *Pontederia crassipes* Mart, etc. Among them, *Melaleuca cajuputi* Maton & Sm. ex R. Powell, with an area of about 31.8 hectares, is a place that provides habitat, feeding and nesting for birds and other creatures.

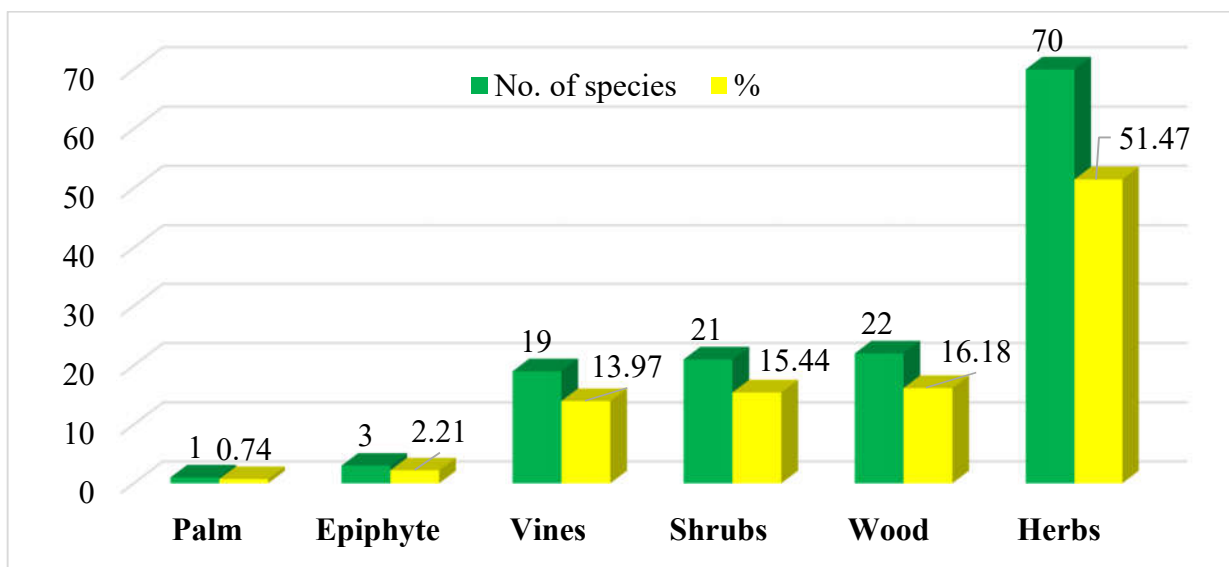


Figure 4. Species distribution in life form groups of the flora

Vines (19 species, 15.08%), of which *Stenochlaena palustris* (Burm.f.) Bedd. plays a leading role in forming vegetation on the ground and water surface and climbing on native tree species to create a unique flora vegetation. Besides, *Lygodium flexuosum* (L.) Sw., *Lygodium japonicum* (Thunb.) Sw., *Flagellaria indica* L., *Causonis trifolia* (L.) Mabb. & J. Wen was also significantly involved in this vegetation.

3.1.3. Significance of forest resource conservation

a. Use value

Through investigation and recording of species composition, comparison of specialized documents, and consultation with information from local people and officials. 121/136 useful species (88.97%) belonging to seven value groups were found: medicinal plants, edible plants, ornamental plants, tannins-dyes, essential oils, poisonous plants and other values. Medicinal plants have the highest number of species (113 species, 85.92%) and the lowest number of poisonous plants (3 species, 2.21%) (Figure 5).

Medicinal plant: This group is concentrated in some popular families such as Asteraceae, Amaranthaceae, Acanthaceae, Lamiaceae, Fabaceae, Phyllanthaceae, Euphorbiaceae, Cleomaceae, and Cyperaceae. Typical medicinal plant species such as *Flagellaria indica* L., *Caryota mitis* Lour., *Causonis trifolia* (L.) Mabb. & J. Wen, *Scleromitrium diffusum* (Willd.) R.J. Wang, *Phyllanthus reticulatus* Poir., *Ludwigia hyssopifolia* (G. Don) Exell, *Mesosphaerum suaveolens* (L.) Kuntze, *Senna alata* (L.) Roxb., *Senna tora* (L.) Roxb., *Cleome chelidonii* L.f., *Cleome viscosa* L., *Achyranthes aspera* L., *Acanthus ilicifolius* L., *Andrographis paniculata* (Burm.f.) WalL. ex Nees, *Clinacanthus nutans* (Burm.f.) Lindau, *Lygodium flexuosum* (L.) Sw., etc.,

Edible plants (37 species, 27.21%):

Vegetable group (24 species, 17.64%): This

group mainly uses young leaves and tops; a few use flowers to make vegetables; popular dishes can be boiled, soup, stir-fried, or hotpot. Some typical species are *Stenochlaena palustris* (Burm.f.) Bedd., *Passiflora foetida* L., *Antidesma ghaesembilla* Gaertn., *Crassocephalum crepidioides* (Benth.) S. Moore, *Emilia sonchifolia* (L.) DC., *Enydra fluctuans* Lour., *Hibiscus surattensis* L., *Glinus oppositifolius* (L.) Aug, DC., *Pontederia crassipes* Mart., *Nymphaea pubescens* Willd., *Bambusa pallida* Munro) Voss, etc.

Among them, *Stenochlaena palustris* (Burm.f.) Bedd. is a wild vegetable and covers most of the plant association. Young shoots are considered a specialty in the NR and neighbouring areas. It can be processed into many dishes, of which boiled is regarded as the most popular dish for locals. After the vegetables are processed, add seasoned vinegar dipping sauce, soy sauce, or sweet and sour fish sauce, and eat with crispy fried fish. Boiled water only needs a little salt and monosodium glutamate to become a soup; its sweetness is not inferior to any other type of soup. Young shoots are used to stir-fry garlic, stir-fry beef, hot pot, sour soup, etc. Besides, young shoots of *Nymphaea pubescens* Willd. also considered a characteristic of local people, it is used to cook sour soup or hot pot.

The fruit, seed, flower group (16 species, 11.76%): This group mainly the product of trees and shrubs for food, such as *Annona glabra* L., *Elaeocarpus hygrophilus* Kurz, *Samanea saman* (Jacq.) Merr, *Tamarindus indica* L., *Syzygium cumini* (L.) Skeels, *Antidesma ghaesembilla* Gaertn., *Causonis trifolia* (L.) Mabb. & J. Wen), *Ananas comosus* (L.) Merr., etc. On the other hand, the fruits of species of the *Ficus* genus provide food for birds here.

The spice group (8 species, 5.88%) includes *Enydra fluctuans* Lour., *Emilia sonchifolia* (L.) DC., *Tamarindus indica* L., *Hibiscus surattensis* L., *Hibiscus sabdariffa* L. etc.

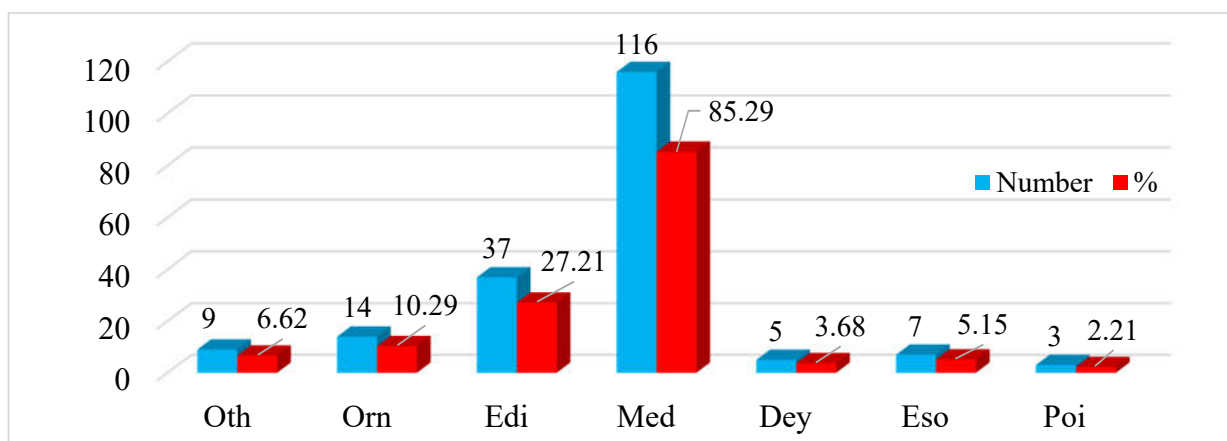


Figure 5. Composition of useful plant groups

Oth: Other groups; Orn: Ornamental plants; Edi: Edible plants; Med: Medicinal plants; Dey: Tannin, dye; Eso: Essential oil; Poi: poisonous plants. The total number of species and the percentage (%) are more than the number of recorded species and greater than 100% because a species can give more than one value.

Tannin and dye plant (5 species, 3.68%):

This group is represented by some typical plant species such as *Terminalia catappa* L., *Elaeocarpus hygrophilus* Kurz, *Clitoria mariana* L., *Phyllanthus reticulatus* Poir., and *Syzygium cumini* (L.) Skeels, etc.

Ornamental plant (14 species, 10.29%):

This group includes trees, herbs, vines, and shrubs. Some typical species are *Ficus benjamina* L. and *Ficus subpisocarpa* subsp. *subpisocarpa*, *Ficus microcarpa* L.f., *Ochna integerrima* (Lour.) Merr., *Bambusa balcooa* Roxb., *Bambusa pallida* (Munro) Voss, *Bambusa procera* A. Chev. & A. Camus, *Bambusa multiplex* (Lour.) Raeusch, ex Schult, f., *Hopea odorata* Roxb., *Samanea saman* (Jacq.) Merr.

Essential oil (7 species, 5.15%):

Representative species of this group include *Melaleuca cajuputi* Maton & Sm. ex R.Powell, *Eucalyptus camaldulensis* Dehnh., *Hopea odorata* Roxb., etc.

Poisonous plant (3 species, 2.21%):

Represented by *Phytolacca americana* L., the fruit contains poison, *Laportea interrupta* (L.) Chew has hair that causes itching; *Trichosanthes costata* Blume seeds contain poison.

Other uses (9 species, 6.62%):

For fiber (6 species, 4.41%): This group is represented by *Stenochlaena palustris* (Burm.f.) Bedd. can be 8-15 m long, tough, durable, and water-resistant, so it is used to make ropes, fishing equipment, and tying rafters, poles, and

fences. The bark of *Trema cannabina* Lour is used to braid ropes and tie things because the bark has tough fibers. **Green manure (3 species, 2.21%):** This group includes three species: *Lemna minor* L., *Salvinia cucullata* Bory, and *Pontederia crassipes* Mart. **Firewood (1 species, 0.74%):** Only *Casuarina equisetifolia* L. is used to make charcoal; the charcoal of this species has very high heat. **Construction and interior (6 species, 4.41%):** *Acacia auriculiformis* A.Cunn. ex Benth. used for beams, columns, and wood for cabinets, beds, and other household items. *Bambusa balcooa* Roxb., *Bambusa pallia* Munro. Voss, *Bambusa procera* A. Chev. & A. Camus is used in construction and handicrafts.

b. The value of endangered, precious, and rare genetic resources

Among the recorded species, we identified two endangered, precious, and rare plant species classified as Vulnerable in the Vietnam Red Data Book (2007), *Elaeocarpus hygrophilus* Kurz and *Oryza rufipogon* Griff.

3.2. Diversity of plants association

3.2.1. Plants association of *Melaleuca cajuputi* Maton & Sm. ex R. Powell

This is a typical plant association characteristic of the NR. This habitat dominates the area, with about 31.8 hectares accounting for 29.02% of the total area of the entire region. Besides, *Melaleuca cajuputi* Maton & Sm. ex R. Powell also dominates in the number of individual trees, in which several small-sized trees restock the areas of dead trees. One to two-

storey structure, high population density. Besides, some other woody tree species, such as *Annona glabra* L., and *Elaeocarpus hygrophilus* Kurz. Merr., *Syzygium cumini* (L.) Skeels, *Ficus subpisocarpa* subsp. *subpisocarpa*, *Ficus microcarpa* L.f. Typical climbing species include *Stenochlaena palustris* (Burm.f.) Bedd., *Lygodium flexuosum* (L.) Sw., *Flagellaria indica* L. For low-density areas due to Melaleuca died, the cause was birds coming to reside and build nests to breed; the species composition had the appearance of herbaceous species such as *Ischaemum rugosum* Salisb., *Oryza rufipogon* Griff., *Lepironia articulata* (Retz.) Domin, *Eleocharis dulcis* (Burm.f.) Minn. ex Hensch., *Cyperus malaccensis* Lam.

3.2.2. Dominant association of *Stenochlaena palustris* (Burm.f.) Bedd.

Dominant association of *Stenochlaena palustris* (Burm.f.) Bedd. is one of the two most common plant associations typical of the flora. This group forms climbing vegetation that wraps around the trunks and branches of woody plants, creating a unique landscape of vegetation. The remaining part includes a vegetation layer on the ground and water surface from 0.8 m to 1.5 m thick; in some places, it creates a mat over 2 m high, with the main ingredients being *Stenochlaena palustris* (Burm.f.) Bedd., *Flagellaria indica* L., *Causonis trifolia* (L.) Mabb. & J. Wen, *Trichosanthes costata* Blume, high coverage from 80% to 100%. This association is mainly distributed in floating areas, dead Melaleuca areas, or along the banks of water canals.

3.2.3. Dominant plant association of *Bambusa pallida* (Munro) Voss.

Other bamboo species that also appear are *Bambusa pallida* (Munro) Voss, and *Bambusa multiplex* (Lour.) Raeusch, ex Schult.f., in addition to *Annona glabra* L., *Elaeocarpus hygrophilus* Kurz), Merr., *Ficus microcarpa* L.f. This plant association is distributed on floating land positions formed when dredging canals to regulate water. Typical species of vines are *Flagellaria indica* L., *Passiflora foetida* L., *Causonis trifolia* (L.) Mabb. & J. Wen, *Trichosanthes costata* Blume. The green vegetation layer is mainly *Stenochlaena palustris*

(Burm.f.) Bedd., *Flagellaria indica* L., *Lygodium flexuosum* (L.) Sw.

3.2.4. Dominant plant association of *Bambusa multiplex* (Lour.) Raeusch, ex Schult

Bambusa multiplex (Lour.) Raeusch, ex Schult appears with *Annona glabra* L., *Elaeocarpus hygrophilus* Kurz), Merr., *Ficus microcarpa* L.f. This dominant plant association is distributed on floating soil positions along water regulation channels. Typical species of vines such as *Stenochlaena palustris* (Burm.f.) Bedd., *Causonis trifolia* (L.) Mabb. & J. Wen, and *Flagellaria indica* L. The green vegetation layer is mostly *Stenochlaena palustris* (Burm.f.) Bedd. and a few individuals of *Flagellaria indica* L. and *Gynochthodes proboscidea* Pierre ex Pit.

3.2.5. Dominant plant association of *Salvinia cucullata* Bory

This plant association is distributed floating on the water surface along water-regulating channels and canals, especially the central lake with an almost pure species appearance and high density. Besides *Salvinia cucullata* Bory, there are other herbaceous species such as *Cyperus malaccensis* Lam., *Ludwigia adscendens* (L.) H, Hara, *Nymphaea pubescens* Willd, *Flagellaria indica* L. This plant association provide habitat and feeding grounds for aquatic animals, native fish, frogs, reptiles, and waterfowl.

3.2.6. Dominant plant association of *Ficus microcarpa* L.f.

This plant association is distributed around water regulation channels in highland areas surrounding the *Melaleuca cajuputi* Maton & Sm. ex R.Powell. In addition to *Ficus microcarpa* L.f., there are some other native tree species, such as *Ficus subpisocarpa* subsp. *subpisocarp*, *Elaeocarpus hygrophilus* Kurz, and *Annona glabra* L. The ground vegetation layer is characterized by *Stenochlaena palustris* (Burm.f.) Bedd., and many individuals of *Flagellaria indica* L, *Causonis trifolia* (L.) Mabb. & J. Wen.

4. DISCUSSION

This study recorded 136 species with an area of more than 106.82 hectares. To evaluate the species diversity of this study, we compared it with some wetland flora in Southern Vietnam.

The species diversity of the current study is lower than the Bau Sau wetland flora, Cat Tien National Park, where 177 species were recorded within an area of 41.69 hectares [12], and the wetland flora of Duc Hue district, Long An province, recorded a total of 155 species [13]. However, it is higher than Hoa An wetland in Phung Hiep district, Hau Giang province, where 56 vascular plant species are recorded within 20 hectares [14]. A comparison of the number of plant associations also shows that the current study records several plant associations (6 plant associations) less than in the Bau Sau wetland area, Cat Tien National Park (13 plant associations) [12]; Duc Hue district wetlands, Long An province with abundance of plant associations according to seasons, water bodies, PH index [13] and Hoa An wetlands, Phung Hiep district, Hau Giang province [14].

Current research shows that the ratio between the Eudicots and Monocots classes at the family, genus, and species levels is 3.36, 4.63, and 4.86, respectively, higher than the general ratio at the family level of the Vietnamese flora is 3.2 [15], in tropical habitats, this ratio ranges from 3-5. For the aquatic flora in Cu Lao Dung, Soc Trang province, the ratios at the family, genus, and species levels are 1, 0.81, and 1.45, respectively [16]. This difference is due to the different characteristics between seasonally wetland flora and aquatic ecosystems. Among them, plants from the Monocots class of aquatic ecosystems have more adapted morphology and structure than Eudicots [17].

This study recorded up to 30 families with single species (58.82%). This finding shows the vulnerability of the ecosystem. When environmental conditions change unfavourably, a certain species belonging to a single-species family is likely to disappear and can change the structure of the flora [16]. In recent years, the water flow from the Mekong River to the NR has been unstable and tends to decrease significantly. This can change the structure and species composition of the flora, causing, according to the impact on the habitat, breeding and finding birds' food here. This will affect the conservation of flora and biodiversity of the NR Management Board.

This study noted the dominance of herbaceous plant species. This finding reflects the nature of the seasonally submerged flora, where herbaceous plants are mainly species of Cyperaceae, Poaceae, Asteraceae, Amaranthaceae, and Lamiaceae. They commonly appear during the rainy and water seasons returning from the Mekong River. Some appear year-round in the West Canal, Forestry Canal, Xang 3 and 4 canals, central lakes and wetlands, all belonging to zones I, II, III, and IV. However, regarding their ecological role, they are home to aquatic animals, fish, frogs, small birds and reptiles. Although woody species account for a lower proportion than herbaceous species, they play an essential role as shelter, nesting during the breeding season, and foraging for birds.

Some plant species are considered symbols and typical of the Conservation Area, shown by their abundance and predominance in the number of individual trees. Among them, the dominant species are *Melaleuca cajuputi* Maton & Sm. ex R.Powell, *Stenochlaena palustris* (Burm.f.) Bedd., *Ficus microcarpa* L.f., *Bambusa* spp.. The recorded plant species, with resistant properties, are mostly endemic to the Dong Thap Muoi region. Seasonally flooded, adapted to soil conditions contaminated with alum, and flooded soils contaminated with alum. Besides native species, some exotic plant species include *Mimosa pigra* L., *Salvinia cucullata* Bory, and *Acacia auriculiformis* A.Cunn. ex Benth. They compete with native plants for nutritional space, habitat, and light. Therefore, it is necessary to focus on implementing effective measures to control and destroy these alien species to conserve native plant species.

The flora is valuable regarding species composition and is assessed as diverse in resource value with six different use value groups. In addition to endemic plant species that are meaningful to people's lives through providing products and vegetables such as *Stenochlaena palustris* (Burm.f.) Bedd., *Nymphaea pubescens* Willd.; provides some speciality fruit and nut species such as *Elaeocarpus hygrophilus* Kurz, *Syzygium cumini* (L.) Skeels, *Annona glabra* L. On the

other hand, forests also store endangered, precious and rare genetic resources that need attention conservation, such as *Elaeocarpus hygrophilus* Kurz and *Oryza rufipogon* Griff.

5. CONCLUSION

A total of 136 vascular plant species belonging to 113 genera and 53 families were recorded. The flora is represented by six life forms: trees, shrubs, vines, herbs, epiphytes and palms. The flora has high use value with seven useful plant groups: the medicinal plants have the highest number of species (116 species), followed by edible plants (37 species), and the lowest is poisonous plants (3 species). In addition, two species with the Vulnerable (VU) classification are listed in the Vietnam Red Data Book (2007): *Elaeocarpus hygrophilus* Kurz and *Oryza rufipogon* Griff.

The flora is also characterized by six plant associations, including *Melaleuca cajuputi* Maton & Sm. ex R.Powell, *Stenochlaena palustris* (Burm.f.) Bedd., *Bambusa pallida* (Munro) Voss, *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f., *Ficus microcarpa* L.f., *Salvinia cucullata* Bory. Among them are plant associations of *Melaleuca cajuputi* Maton & Sm. ex R.Powell plays the most crucial role as a place of residence, feeding and breeding nests for birds and other creatures. Accordingly, in the design of replacement planting, nest planting, interplanting, compensatory planting, and restocking, we recommend prioritizing the selection of native tree species that can adapt to the study area's alum-contaminated soil.

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