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DIVERSITY OF VASCULAR PLANTS AT HO CHI MINH MEMORIAL AREA IN CA MAU PROVINCE

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Abstract

This study was conducted to assess the diversity of vascular plants at the President Ho Chi Minh Memorial Area in Ca Mau Province, serving as a scientific basis for the effective exploitation, use, management, and conservation of plant resources in this area. The research results identified 145 species of vascular plants, belonging to 124 genera, and 64 families across four divisions: Ferns (Polypodiophyta), Cycads (Cycadophyta), Pines (Pinophyta), and Magnolias (Magnoliophyta). The life forms of the vascular flora here consist of 5 main groups (Phanerophytes - Ph, Chamaephytes - Ch, Hemicryptophytes - Hm, Cryptophytes - Cr, Therophytes - Th), with Biological Spectrum of the vascular flora 60.0 Ph + 7.59 Ch + 4.83 Hm + 9.65 Cr + 17.93 Th. The utility value of vascular plants was recorded across 10 usage groups, with 135 species used for medicinal purposes accounting for 93.10%, 108 species used for ornamental purposes accounting for 74.48%, edible plants ranking third with 50 species accounting for 34.48% and other uses. The flora in this area includes 3 species with conservation value, with 1 species is classified as Vulnerable (VU) assessed according to the Vietnam Red Data Book (2024), 1 species Vulnerable (VU) according to the Viet Nam Red List of Threatened Species (2024), 1 species listed in Decree 84/2021/ND-CP (2021).

Keywords: *Ca Mau, diversity, Ho Chi Minh Memorial Area, life-forms, vascular plants.*

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ĐA DẠNG HỆ THỰC VẬT CÓ MẠCH TẠI KHU TƯỞNG NIỆM CHỦ TỊCH HỒ CHÍ MINH, TỈNH CÀ MAU

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Tóm tắt

Nghiên cứu này được thực hiện nhằm đánh giá đa dạng hệ thực vật có mạch tại Khu tưởng niệm Chủ tịch Hồ Chí Minh, tỉnh Cà Mau làm cơ sở khoa học cho việc khai thác, sử dụng, quản lý và bảo tồn nguồn tài nguyên thực vật ở nơi đây có hiệu quả. Kết quả nghiên cứu đã xác định được 145 loài thực vật có mạch, 124 chi, 64 họ trong 4 ngành: Ngành Dương xỉ (Polypodiophyta), Ngành Tuế (Cycadophyta), Ngành Thông (Pinophyta) và Ngành Ngọc lan (Magnoliophyta). Dạng sống hệ thực vật nơi đây có 5 nhóm chính (cây có chồi trên mặt đất (Phanerophytes - Ph), cây có chồi sát mặt đất (Chamaephytes - Ch), cây có chồi nửa ẩn (Hemicryptophytes - Hm), cây có chồi ẩn (Cryptophytes - Cr), cây có chồi một năm (Therophytes - Th)) với phổ dạng sống BS = 60,0 Ph + 7,59 Ch + 4,83 Hm + 9,65 Cr + 17,93 Th. Giá trị sử dụng thực vật có mạch được ghi nhận có 10 nhóm công dụng, trong đó 135 loài được sử dụng làm thuốc chiếm 93,10%, 108 loài làm cảnh chiếm 74,48%, cây ăn được xếp thứ ba với 50 loài chiếm 34,48%, cùng các công dụng khác. Khu hệ thực vật nơi đây có 3 loài có giá trị bảo tồn, gồm 1 loài cấp VU theo thang đánh giá của Sách đỏ Việt Nam (2024), 1 loài cấp VU theo Danh lục đỏ Việt Nam (2024) và 1 loài trong Nghị định 84/2021/NĐ-CP (2021).

Từ khóa: *Cà Mau, Đa dạng, Khu tưởng niệm Chủ tịch Hồ Chí Minh, Dạng sống, Thực vật có mạch.*

1. Introduction

The President Ho Chi Minh Memorial Area in Ca Mau Province, is a distinctive historical and cultural site, holding profound significance in honoring and commemorating President Ho Chi Minh, the great leader of Vietnam. This location serves not only as a sacred destination for people across the country but also as a space for educating the younger generation about revolutionary traditions, closely linked to cultural and educational activities, while contributing to environmental protection and the development of local ecotourism.

The memorial area is covered by a diverse range of vascular plants, which provide not only aesthetic value but also play a vital role in preserving the living environment. However, the current status of vascular plants in this area has not been fully studied or comprehensively assessed. Under the climate change and significant environmental impacts, studying the diversity of vascular plants will aid in proposing effective conservation solutions, thereby ensuring the sustainability of the local ecosystem.

Stemming from this practical need, the study titled "*Diversity of vascular plants at the President Ho Chi Minh Memorial Area in Ca Mau Province*" was conducted to survey and evaluate the diversity of vascular plants in the area, serving as a scientific basis for the management, conservation, and sustainable exploitation of valuable plant resources.

2. Subjects and research methods

2.1. Research subjects

Vascular plants at the President Ho Chi Minh Memorial Area in Ca Mau Province**.**

2.2. Research methodology

2.2.1. Theoretical research method

Collect, gather, and synthesize information, documents, specialized books, and scientific works related to the research issue that have been published from information channels and through the Ho Chi Minh Memorial Management Board to apply to analyze results, selectively inherit, and discuss the achieved results.

2.2.2. Field research method

The field trips were conducted along six survey sites to accurately assess the vascular plant flora at the President Ho Chi Minh Memorial Area in Ca Mau Province, such as: (1) the parking lot and waiting area; (2) Movie theater and display house; (3) Stone statue exhibition house; (4) Uncle Ho’s stilt house; (5) the lotus lake; and (6) Uncle Ho’s temple (Table 1). The surveys employed specialized methodologies according to Nguyen's research method (2008).

Table 1. Survey sites at the memorial area

No.	Area	Coordinates
1	The parking lot and waiting area	9°11'07.4"N 105°08'15.4"E
2	Movie theater and display house	9°11'07.0"N 105°08'12.3"E
3	Stone statue exhibition house	9°11'06.1"N, 105°08'11.2"E
4	Uncle Ho's stilt house	9°11'06.1"N 105°08'09.5"E
5	Lotus lake	9°11'04.2"N 105°08'07.9"E
6	Uncle Ho's temple	9°11'02.0"N 105°08'06.1"E

At each survey sites, all plant species were surveyed, data was recorded, observations

were made, descriptions were made, local names and plant characteristics were recorded, samples were photographed and samples were collected for species identification.

2.2.3. Laboratory research method

a. Scientific name identification method

The scientific names and their current updates for plant species are determined using morphological comparison based on key references such as: *An Illustated Flora of Vietnam, Vols 1-3* (Pham, 1999-2003); *Useful plants in Vietnam*, Vols 1-2 (Vo and Tran, 2001-2002); Dictionary of common plant, Vols 1-2 (Vo, 2003-2004); *Vietnamese plant's names refenence book* (Vo, 2007); *Plant of the World Online* (2025), https://powo.science.kew.org/.

b. Method for constructing the plant list

Division of branches according to the plant classification system of Stern et al. (2008), Takhtajan (2009). Species names in families are arranged in order from A-Z.

Based on the utility data of identified species in the plant list, the percentage (%) of species in each utility group relative to the total number of species in the flora is calculated.

c. Method for assessing taxon diversity at taxonomic levels

Count the number of species according to the taxonomic levels of genus, family, class according to each plant phylum from low to high based on the constructed flora list, calculate the percentage of taxa to see their diversity level.

d. Method for assessing life form dirersity

Life forms reflect the ecological nature of plant, the life form spectrum is a characteristic of the ecological essence of the flora (Nguyen, 2008). Life forms are evaluated according to Raunkiaer's life form classification system (1934), with supplements by Nguyen (2008).

e. Method for assessing diversity of plant resources

Classification and identification according to use value based on documents: *List of Vietnamese plant species* (CRES, 2001 & Nguyen, 2003, 2005); *Useful plants in Vietnam* (Vo & Tran, 2001 - 2002); *Dictionary of common plant* (Vo, 2003 - 2004); *Vietnam's Herbal Plants and Remedies* (Do, 2022); *Dictionary of Medicinal plant in Vietnam* (Vo, 2012); *List of medicinal plants in Vietnam* (IOM, 2016).

f. Method for assessing diversity of plant conservation value

Rare and precious plant species with conservation value at the Ho Chi Minh Memorial Area are identified based on Decree No. 84/2021/ND-CP on the management of endangered, precious, and rare forest plants and animals; Vietnam Red Data Book (VAST, 2024); Viet Nam Red List of Threatened Species: http://vnredlist.vast.vn/ (VAST, 2024); Red List of Threatened Species: https://www.iucnredlist.org/ (IUCN, 2025).

g. Method for assessing invasive alien plants

Under Clause 19, Article 3, Chapter 1 of the Vietnam Biodiversity Law, "invasive alien species" are defined as alien species that invade habitats or cause harm to native species, disrupting the ecological balance where they emerge and develop.

The assessment is based on IUCN (2000); *Circular Regulating criteria for identifying and issuing the List of invasive alien species*, No. 35/2018 (Ministry of Natural Resources and Environment, 2018).

3. Results and discussion

3.1. Diversity of plant species composition

The investigation on biodiversity at the President Ho Chi Minh Memorial Area in Ca Mau province recorded 145 vascular plant species belonging to 124 genera, 64 families, in 4 divisions: Polypodiophyta (ferns), Cycadophyta (cycads), Pinophyta (conifers), and Magnoliophyta (angiosperms, including Magnoliopsida and Liliopsida).

3.1.1. Diversity of taxa

Based on the compiled plant list and classification, a total of 145 vascular plant species were identified at the President Ho Chi Minh Memorial Area in Ca Mau Province. These species span 124 genera, 64 families (Table 2).

Table 2. Distribution of taxa at class level across divisions

Division	Class	Families		Genera		Species	
		No.	%	No.	%	No.	%
Polypodiophyta	Polypodiopsida	4	6.25	4	3.23	4	2.76
Cycadophyta	Cycadopsida	1	1.56	1	0.81	1	0.69
Pinophyta	Pinopsida	2	3.12	2	1.61	3	2.07
Magnoliophyta		57	89.07	117	94.35	137	94.48
	Magnoliopsida	44	68.76	80	64.51	97	66.89
	Liliopsida	13	20.31	37	29.84	40	27.59
Total		**64**	**100**	**124**	**100**	**145**	**100**

Analysis of the 145 vascular plant species recorded in the study area indicated an uneven distribution across taxonomic levels. Magnoliophyta was greatest dominant, represented by 137 species (94.48%) across 57 families (89.07%). The other divisions were much less diverse: Polypodiophyta (4 species, 2.76%); Pinophyta (3 species, 2.07%); and Cycadophyta (1 species, 0.69%). These results align with global and regional patterns of tropical plant diversity, underscoring the marked dominance of flowering plants in overall biodiversity.

The surveyed flora consists of five classes within four divisions: Polypodiopsida, Cycadopsida, Pinopsida, and two classes within Magnoliophyta, namely Magnoliopsida and Liliopsida. Magnoliopsida is the most diverse class, containing 44 families, 80 genera, and 97 species (66.89%), followed by Liliopsida with 13 families, 37 genera, and 40 species (27.59%). The remaining three classes - Polypodiopsida, Cycadopsida, and Pinopsida - exhibit significantly lower diversity, each represented by only a few species (4, 1, and 3 species, respectively). This result aligns with the global trend where dicotyledonous plants typically dominate floristic diversity.

3.1.2. Diversity of family level

In total, the 5 families rich in species encompass 41 of the 145 recorded species, representing 28.27% of the flora (Table 3). The study identified the 5 most species-rich plant families as follows: Poaceae (11 species, 7.57%), Asteraceae and Apocynaceae (9 species each, 6.21%), Moraceae and Arecaceae (6 species each, 4.14%). Altogether, these families accounted for 41 species, or 28.27% of the total recorded species.

Table 3. The most diverse plant families in the flora of the Ho Chi Minh Memorial Area in Ca Mau Province

No.	Family	Number of Species	Percentage (%)
1	Poaceae	11	7.57
2	Asteraceae	9	6.21
3	Apocynaceae	9	6.21
4	Moraceae	6	4.14
5	Arecaceae	6	4.14
	Total	**41**	**28.27**

There are 2 most diverse genera among the 124 genera in the flora, which are *Ficus* (with 6 species), and *Ipomoea* (with 3 species).

3.2. Diversity of life forms

The analysis of life-forms diversity of vascular plants at the President Ho Chi Minh Memorial Area in Ca Mau Provine, based on Raunkiaer's system (1934) with modifications by Nguyen (2008), reveals a clear dominance of phanerophytes (plants with above-ground buds), accounting for 60.0% of the total species.

Table 4. Life forms

Life form	Symbol	Number of species	Percentage of life forms (%)
1. Phanerophytes	Ph	87	60.00
1.1. Magaphanerophytes	*Mg*	13	8.97
1.2. Mesophanerophytes	*Me*	23	15.86
1.3. Microphanerophytes	*Mi*	25	17.23
1.4. Nanophanerophytes	*Na*	6	4.14
1.5. Epiphytes phanerophytes	*Ep*	1	0.69
1.6. Succelent phanerophytes	*Sp*	1	0.69
1.7. Lianas phanerophytes	*Lp*	12	8.28
1.8. Herb phanerophytes	*Hp*	6	4.14
2. Chamaephytes	Ch	11	7.59
3. Hemicryptophytes	Hm	7	4.83
4. Cryptophytes	Cr	14	9.65
5. Therophytes	Th	26	17.93
Total		**145**	**100**

The data from Table 4 showed that the Phanerophytes group had the most species with 87 species (accounting for 60%) and is the most dominant in the flora here, followed by the group of plants with Therophytes (Th) 26 species (accounting for 17.93%); the third

Cryptophytes (Cr) with 14 species (accounting for 9.65%); the fourth Chamaephytes (Ch) with 11 species (accounting for 7.59%) and finally Hemicryptophytes (Hm) with 19 species (accounting for 4.83%). From Table 5, the life form spectrum or biological spectrum (BS) of vascular plants in Ho Chi Minh Memorial Area was constructed as follows:

BS = 60 Ph + 7.59 Ch + 4.83 Hm + 9.65 Cr + 17.93 Th

In the Phanerophytes group (Ph), it was found that the small groups were distributed very unevenly with the following life form spectrum: Ph = 8.97 Mg + 15.86 Me + 17.23 Mi + 8.28 Lp + 0.69 Ep + 4.14 Na + 4.14 Hp + 0.69 Sp. Of which, Microphanerophytes (Mi) had the most species (25 species); followed by Mesophanerophytes (Me) with 23 species; followed by Magaphanerophytes (Mg) with 13 species; Lianas phanerophytes (Lp) with 12 species; Nanophanerophytes (Na) and Herb phanerophytes (Hp) both had 6 species; Succelent phanerophytes (Sp) and Epiphytes phanerophytes (Ep) both only with 1 species. This high proportion of woody plants reflects the tropical monsoon climate of the region, where stable temperatures and seasonal rainfall facilitate the growth of perennial species.

Therophytes group (Th) ranking second with 17.93% (26 species), the notable presence of annual plants indicates the flora's adaptation to the distinct dry season and potentially human-impacted or open landscapes within the memorial area. Other life forms including Cryptophytes (Cr) at 9.65%, Chamaephytes (Ch) at 7.59%, and Hemicryptophytes (Hm) at 4.83% contribute to the ecological structural complexity of the site.

The life-form distribution demonstrates a typical tropical flora characteristics, although it is important to note that many woody species in this specific area are intentionally planted for landscape and commemorative purposes.

3.3. Diversity of plant resource value

Based on the list of plant species identified, classical Vietnamese botanical references documents: An Illustated Flora of Vietnam (Pham, 1999-2003); Useful plants in Vietnam (Vo & Tran, 2001 - 2002); Dictionary of common plant (Vo, 2003 - 2004); Vietnam's Herbal Plants and Remedies (Do, 2004); Dictionary of Medicinal plant in Vietnam (Vo, 2012); List of medicinal plants in Vietnam (The Institute of Medicine, 2016); the results showed that 100% of the recorded species possess certain use value with 10 utility groups (Table 5).

Table 5. Use value of plants

No.	Uses	Number of Species	Percentage (%)
1	Medicinal plants (M)	135	93.10
2	Ornamental plants (Or)	108	74.48
3	Edible plants (Ed)	50	34.48
4	Timber plants (T)	25	17.24
5	Plants for tannin, resin, dye (Ta)	17	11.03
6	Essential oil plants (Eo)	13	8.97
7	Poisonous plants (Mp)	11	7.59
8	Fiber plants (Fb)	10	6.90
9	Oil plants (Oil)	5	3.45
10	Plants with other uses (U)	3	2.07

Among the 145 species identified at the President Ho Chi Minh Memorial Area in Ca Mau Province, most species exhibited diverse uses.

Group of medicinal plants had the highest representation with 135 species, accounting for 93.10% of total species - e.g., *Lygodium flexuosum* (L.) Sw, *Stenochlaena palustris* (Burm.f) Bedd, *Annona glabra* L., *Passiflora foetida* L., *Cleome chelidonii* L.f, *Euphorbia hirta* L., *Phyllanthus amarus* Schumach. & Thonn., *Ludwigia prostrata* Roxb, *Oxalis corniculata* L., *Cyanthillium cinereum* (L.) H.Rob, *Ipomoea triloba* L., *Tradescantia spathacea* Sw., and so on.

Followed by group of ornamental plants (108 species, accounting for 74.48%) such as *Laurus nobilis* L., *Murraya paniculata* (L.) Jack, *Nymphaea pubescens* Willd., *Nelumbo nucifera* Gaertn., *Gomphrena globosa* L., *Plumbago auriculata* Lam., *Bougainvillea glabra* Choisy, *Helianthus annuus* L., *Catharanthus roseus* (L.) G. Don, *Mandevilla sanderi* (Hemsl.) Woodson., *Tecoma stans* (L.) Juss. ex Kunth, *Heliconia psittacorum* L.f., etc.;

The third group of edible plants (50 species, accounting for 34.48%) such as *Peperomia pellucida* (L.) Kunth., *Basella alba* L., *Chrysophyllum cainito* L., *Eryngium foetidum* L., *Mangifera indica* L., *Capsicum frutescens* L., *Ipomoea aquatica* Forsk, *Commelina diffusa* Burm.f., *Musa acuminata* Colla, and more;

The fourth group of timber (25 species, accounting for 17.24%) such as *Melaleuca cajuputi* Maton & Powell, *Samanea saman* (Jacq.) Merr., *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f, *B. vulgaris* Schrad. ex J.C.Wendl., etc. The remaining value of use groups account for a not high percentage.

Of these, 72 species serve multiple purposes, such as medicinal plants that are also edible, ornamental, or have multiple uses, reflecting high multifunctionality, and 12 species serve only one purpose. The predominance of medicinal and ornamental plants highlights the cultural, economic, and ecological values of the studied area.

3.4. Diversity of conservation value

Besides the diversity of species composition, life forms, and uses, vascular plants in the President Ho Chi Minh Memorial Area in Ca Mau Province also have high conservation value. Among of the 145 vascular plant species recorded at the President Ho Chi Minh Memorial Area in Ca Mau Province, 3 species hold conservation significance.

Based on the Vietnam Red Data Book (2024), *Barringtonia asiatica* (L.) Kurz. is classified as species needing conservation at the "Vulnerable – VU" level. In addition, *Podocarpus pilgeri* Foxw is recorded at the "Vulnerable – VU" level according to the Viet Nam Red List of Threatened Species (2024).

Additionally, *Cycas revoluta* Thunb is classified as species listed under Annex IIA of Decree 84/2021/NĐ-CP, requiring strict protection under Vietnamese law.

3.5. Assessment of alien plant species

Based on *Circular Regulating Criteria for Identifying and Issuing the List of Invasive Alien Species*, No. 35/2018 (Ministry of Natural Resources and Environment, 2018), the President Ho Chi Minh Memorial Area in Ca Mau Province has 4 alien plant species were identified, accounting for 2.76% of the total 145 species recorded.

According to Circular No. 35/2018/TT-BTNMT issued by the Ministry of Natural Resources and Environment, lantana (*Lantana camara*) is listed in Appendix 1 (invasive alien species), while flossflower (*Ageratum conyzoides*) and leucaena (*Leucaena leucocephala*) and

wedelia (*Sphagneticola trilobata* (L.) Pruski) are listed in Appendix 2 (potentially invasive alien species). These species demonstrate high adaptability, rapid growth rates, and competitive advantages over native plants through resource competition or allelopathic effects. Particularly, *Lantana camara* and *Ageratum conyzoides* are concerning due to their allelopathic properties, whereas *Leucaena leucocephala* significantly alters soil structure. Although these alien species represent only a small proportion of the local flora, their presence poses substantial challenges for biodiversity conservation efforts in the study area.

Table 7. Invasive alien plant species

No.	Species Name	Appendix 1	Appendix 2
1	*Lantana camara* L.	X	
2	*Ageratum conyzoides* L.		X
3	*Leucaena leucocephala* Lam		X
4	*Sphagneticola trilobata* (L.) Pruski		X

These species are known for their high adaptability and rapid reproduction, which can lead to competition with native flora for light, nutrients, and space. In particular, *Lantana camara* and *Sphagneticola trilobata* tend to form dense thickets that can suppress the growth of indigenous ground cover and seedlings.

Although these species currently contribute to the site's greenery (some used for ornamental or medicinal purposes), their presence poses a long-term risk to the local biodiversity. Therefore, it is essential for the management board to implement regular monitoring and controlled pruning to prevent these species from spreading uncontrollably and affecting the ecological balance of the memorial area.

4. Conclusion

The study on the vascular plant flora at the President Ho Chi Minh Memorial Area in Ca Mau Province yields several key scientific findings.

A total of 145 vascular plant species were identified, belonging to 124 genera and 64 families. The Magnoliophyta division is overwhelmingly dominant, representing 94.48% of the total species recorded.

The vascular plant flora in this area includes 3 species with conservation value, with *Barringtonia asiatica* is classified as Vulnerable (VU) assessed according to the Vietnam Red Data Book (2024), *Podocarpus pilgeri* (VU) according to the Viet Nam Red List of Threatened Species (2024) and *Cycas revoluta* which is protected under Decree 84/2021/ND-CP (2021)

The flora exhibits high multi-functionality with 10 distinct usage groups. Medicinal plants are the most prominent (135 species, 93.10%), followed by ornamental plants (108 species, 74.48%) and edible plants (50 species, 34.48%).

The presence of four invasive or potentially invasive alien species (*Lantana camara, Ageratum conyzoides, Leucaena leucocephala*, and *Sphagneticola trilobata*) suggests that active management and monitoring are required to preserve the ecological integrity of the native flora.

In summary, the President Ho Chi Minh Memorial Area possesses a diverse and highly valuable plant resource. These results provide a scientific basis for local authorities to implement effective strategies for the conservation, management, and sustainable exploitation

of these botanical assets.

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