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A Discussion on the Renaming of *Cymodocea serrulata* to *Oceana serrulata*: Implications for Seagrass Research and Conservation in Vietnam

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ABSTRACT

The seagrass species previously classified as *Cymodocea serrulata* has been reclassified as *Oceana serrulata*. This reclassification is based on genetic analysis, which reveals a distinct separation of this species from others within the *Cymodocea* genus. This change will have implications for future research and taxonomy, highlighting the value of advanced genetic techniques in elucidating the relationships between seagrass species. Nevertheless, further analysis is warranted as new evidence emerges. The transition to the designation *Oceana serrulata* harmonizes traditional morphological descriptions with modern genetic phylogenetics, enabling a more precise classification. This adjustment will facilitate targeted research on the newly categorized *Oceana* genus's biology, ecology, and conservation. We emphasize the importance of disseminating this update to inform the scientific community about these alterations in species classification. Accurate taxonomy serves as the essential foundation for biological research and conservation efforts. Presenting the rationale and process behind taxonomic changes enhances understanding of scientists' challenges. Furthermore, evaluating name changes encourages scientific discourse and feedback, underscoring the significance of ongoing taxonomic reassessment in advancing seagrass biology and conservation.

Keywords: Seagrass, *Oceana serrulata*, *Cymodocea serrulata*, alismatales, Vietnam.

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INTRODUCTION

The seagrass species commonly known as *Cymodocea serrulata* (R. Brown) Asch. & Mag., 1870 has recently been reclassified under a new genus and name – *Oceana serrulata* (R. Brown) Byng & Christenh., 2018. *Cymodocea serrulata* is a species of seagrasses in the family *Cymodoceaceae*. Scottish botanist Robert Brown originally described it in 1810 and placed it in the genus *Cymodocea* [1]. For over 200 years, it has been recognized by the scientific name *Cymodocea* serrulata, including in the authoritative taxonomic database AlgaeBase [2], Marine Species [3], and Plants of the World Online [4]. However, recent phylogenetic studies and genetic analysis have led scientists to re-examine the evolutionary relationships among seagrass species. Based on this new molecular evidence, taxonomists have proposed that *Cymodocea serrulata* warrants reclassification into its distinct genus *Oceana [5]*.

In 2018, researchers Byng and Christenhusz published findings justifying the renaming of the species to Oceana serrulata [5, 6]. This name change reflects our updated understanding of its genetic separation from other seagrasses in the Cymodocea genus. While its original descriptive epithet serrulata remains, placement in the new genus Oceana is now deemed taxonomically appropriate.

This article will outline the justification and implications of this taxonomic reclassification for the species formerly known as Cymodocea serrulata. We will examine the reasons for the name change, provide background on the new genus Oceana, and discuss potential impacts on future research. The goal is to clarify why this change was made and what it signifies for our scientific understanding of the species.

REASONS FOR NAME CHANGE

The decision to reclassify *Cymodocea serrulata* into the new genus *Oceana* was based on recent molecular analysis and DNA sequencing research. In the last decade, several phylogenetic studies of seagrasses using genetic markers have greatly expanded our understanding of the evolutionary relationships within the family Cymodoceaceae [7]. Advanced genetic techniques have enabled scientists to examine seagrass taxonomy at a much higher resolution [8–11]. Several research teams independently performed conducted molecular phylogenetic analyses. They found strong evidence that *Cymodocea serrulata* forms a distinct genetic clade separate from other species in the genus *Cymodocea*, such as *C. rotundata* and *C. nodosa* [12–14].

In phylogenetic trees based on nuclear ITS sequences, *O. 430errulate* forms a strongly supported clade sister to *Syringodium*, while *C. nodosa* and *C. rotundata* form a separate clade (Fig.4/p6) [14]. Plastid matK sequences show the same pattern, with *O. 430errulate* diverging from *C. rotundata* (Fig.5/p7) [14]. Prior work found *Cymodocea* to be non-monophyletic based on multiple loci, with *O. 430errulate* again closely related to *Syringodium* and not *C. nodosa/C. rotundata* (Fig.1/p4) [13].

The distinct placement of *O. 430errulate* apart from *Cymodocea* species in multiple phylogenies provides consistent evidence that it is genetically divergent and warrants recognition as a distinct genus. Kwan et al. (2023) suggest placing *O. 430errulate* into its genus based on their ITS/matK phylogenies, corroborating previous findings of *Cymodocea* paraphyly [14]. Petersen et al. (2014) likewise recommend transferring *O. serrulata* out of the *Cymodocea* genus based on molecular data rejecting its monophyly [13] in phylogenetic trees for seagrass species using DNA sequence data from two genes - the 5.8S ribosomal RNA gene and the RuBisCo large subunit gene. The resulting trees with *C. serrulata* allied with *Syringodium* rather than *C. nodosa/C. rotundata* (Fig.1/p63) *[15]*. The marked differentiation of *C. serrulata* in multiple phylogenies provides robust evidence that it is genetically divergent and merits reclassification into its distinct genus.

Through the analysis of chloroplast genes rbcL, ITS, 5.8S, and *mat*K, along with nuclear ribosomal ITS markers, researchers have conclusively demonstrated that *Cymodocea serrulata* is genetically isolated and merits reclassification into its monotypic genus *Oceana* [5].

The morphological differences among species within the *Cymodocea* genus, such as *Cymodocea nodosa*, can present challenges. Typical individuals of *C. nodosa* in Tunisia usually have leaves with blunt tips and small serrated leaf margins. However, some individuals exhibit different leaf shapes, with round or indented leaf tips and margins without serrations. This morphological variability can make distinguishing between species based solely on physical characteristics difficult. Therefore, additional independent genetic markers are suggested to distinguish *Cymodocea* species clearly. Genetic markers can provide a more accurate and reliable method for species identification, as environmental factors influences them less and can reveal differences at the molecular level that are not apparent through morphological analysis alone [16].

Oceana refers to the marine habitat and alludes to the species' genetic uniqueness among seagrasses. It was chosen to align with an updated understanding of evolutionary relationships indicated by molecular evidence. This reclassification aligns the formal taxonomy with current phylogenies and enables better evolutionary classification of species within Cymodoceaceae. The name change acknowledges the species distinction revealed through advanced genetic analysis.

IMPACTS OF NAME CHANGE

The new genus *Oceana* references this species' marine habitat and the genetic uniqueness [5]. While retaining the original serrulata epithet, placement in Oceana enables more accurate phylogenetic classification as a genetically distinct seagrass lineage; it has implications for future research on the biology and ecology of *O. serrulata* as a newly delineated genus, including examining geographic variations in morphology, stress tolerance, and ecosystem functions across its distribution range [17].

For conservation, the revised taxonomy allows a better understanding of population genetics and connectivity in *O. serrulata*, including identifying evolutionarily significant units and vulnerable populations [17, 18].

In Asia, researchers can now investigate genetic influences on *O. serrulata's* morphology, stress tolerance, and ecosystem functions like sediment stabilization across its range. Comparisons of geographic variations in life history traits are also possible, and revisiting historical studies could provide new insights from the updated taxonomy [19, 20].

In Vietnam, researchers can examine factors affecting *O. serrulata's* growth, adaptations, and nursery role in crucial habitats, separately from other seagrasses [21–24]. Conservation studies can identify isolated populations to prioritize for protection. Analyzing previous Vietnam studies under the new taxonomy may reveal novel patterns and trends.

Overall, renaming this species recognizes its evolutionary distinctiveness indicated by molecular evidence. The revised nomenclature will enable research explicitly focused on the biology, ecology, and conservation of *O. serrulata* as a unique seagrass lineage.

TAXONOMIC CLASSIFICATION

- Order: Alismatales
- Family: Cymodoceaceae N.Taylor
- Genus: *Oceana* Byng & Christenhusz
- *Oceana serrulata* (R.Br.) Byng & Christenh. (2018)

Homotypic synonyms

Cymodocea serrulata (R.Br.) Asch. & Magnus in Sitzungsber. Ges. Naturf. Freunde Berlin 1870: 84 (1870); *Phucagrostis serrulata* (R.Br.) Kuntze in Revis. Gen. Pl. 2: 744 (1891); *Caulinia serrulata* R.Br. in Prodr. Fl. Nov. Holland.: 339 (1810); *Kernera serrulata* (R.Br.) Schult. & Schult.f. in J.J.Roemer & J.A.Schultes, Syst. Veg., ed. 15[bis]. 7: 170 (1829); *Posidonia serrulata* (R.Br.) Spreng. in Syst. Veg., ed. 16. 1: 181 (1824); *Zostera serrulata* (R.Br.) Targ.Tozz. in Cat. Veg. Mar.: 90 (1826).

Heterotypic synonyms

Cymodocea acaulis Peter in Abh. Königl. Ges. Wiss. Göttingen, Math.-Phys. Kl., n.f., 13(2): 39 (1928); *Cymodocea asiatica* Makino in Bot. Mag. (Tokyo) 26: 211 (1912); *Thalassia reptans* Sol. ex Graebn. in H.G.A.Engler (ed.), Pflanzenr., IV, 11: 147 (1907), not validly publ.

Figure 1. Morphology of *Oceana serrulata*. A: Do Son Herbarium; B: Seagrass-watch; C: Van Luong Cao 2019

Morphology

Leaves: Linear, strap-shaped leaves 4-7 mm wide and can reach 10-25 cm lengths. Leaves have 10-17 parallel veins that are distinct but do not protrude. When leaves fall, they leave behind closely spaced scars arranged around the erect stem, a key distinguishing feature of this species.

Stems/Rhizomes: Long creeping rhizomes 2-5 cm long anchor the plant in soft sediments. Stems are slender, branching, and have nodes. Adventitious roots form at the nodes.

Roots: Fibrous adventitious roots form at nodes along creeping stems and have many fine hairs. Help anchor plant.

Flowers: Tiny flowers are paired on short stalks from stem nodes. Lack petals.

Fruits: Oblong fruits 5-7 mm long containing a single seed.

Seeds: Oblong, smooth, light brown seeds around 4 mm long.

Habit: Forms dense beds or meadows. Rhizomatous growth allows rapid vegetative spread and colonization.

Distinguishing features: Serrated leaf margins, oblong fruits, rhizomatous growth habit, strap-shaped/ribbon-like leaves.

DESCRIPTION OF NEW NAME

The new genus *Oceana* chosen for this seagrass species comes from the Latin "Oceanus", meaning ocean. It references the marine habitat where these seagrasses grow fully submerged underwater. The name change places *Cymodocea serrulata* (now *Oceana serrulata*) in a monotypic genus as the sole species within the *Oceana*. This categorization correctly recognizes its phylogenetic isolation from other seagrass genera in the family *Cymodoceaceae*, such as *Cymodocea*, *Halodule*, and *Syringodium*. While some seagrass genera like *Zostera* contain multiple species, the genus *Oceana* is currently considered monotypic, containing only *O. serrulata*. This distinction justifies its unique genus name, specifying its evolutionary divergence.

Moreover, *Oceana* also euphonically flows well with the species epithet *serrulata*, which Brown originally derived from the Latin word "serrulatus", meaning serrated or saw-toothed. This term describes the distinctive morphological feature of the seagrass, characterized by serrated leaf margins. Retaining *serrulata* connects to the described species in 1810, while *Oceana* signals its updated taxonomic placement based on genetic evidence. Together, *Oceana serrulata* integrates long-standing morphological descriptors with new phylogenetic classification.

The name *Oceana serrulata* effectively conveys the species' evolutionary uniqueness and habitat characteristics. It modernizes a centuries-old name through improved scientific understanding of genetic relationships between seagrass species.

GLOBAL DISTRIBUTION

Figure 2 illustrates the known global distribution of *Oceana serrulata*, mapped across tropical and subtropical coastal regions worldwide. The blue shading indicates confirmed occurrences based on observational records and herbarium specimens documented in the literature and databases.

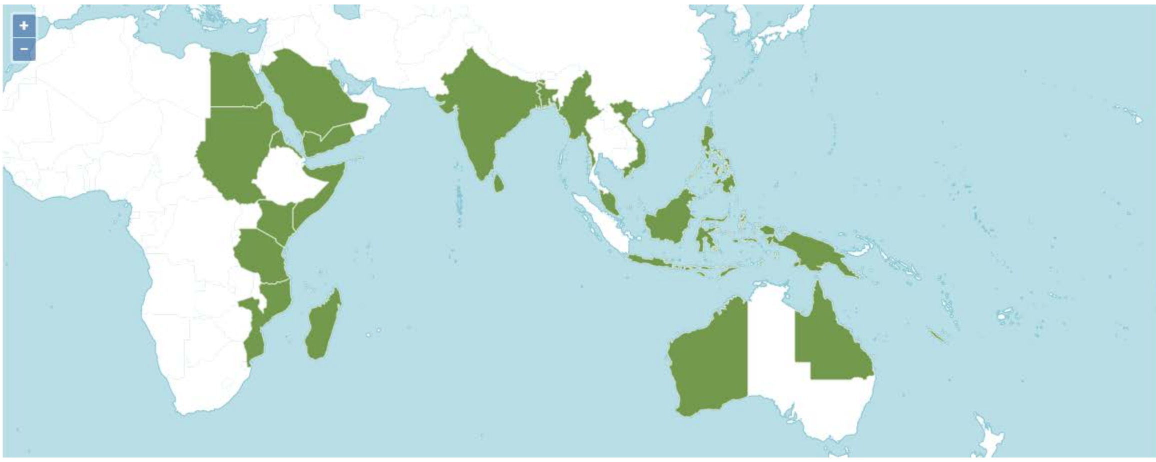

Figure 2. Mapping of *Oceana serrulata* distribution in the world (Plants of the World Online) [4]

Significant concentrations are visible in the Indo-Pacific region, spanning from East Africa [25], throughout South [26, 27] and Southeast Asia [28–31], to northern Australia [26, 32]. Dense stands occur in the Gulf of Thailand [33], around Indonesian islands [26, 29], and in the Philippines [34] and Vietnam [28]. Smaller isolated populations are found in Singapore [14]. In Vietnam, *O. serrulata* distribution of Con Dao, Phu Quoc, and Khanh Hoa [35, 36].

In the Atlantic Ocean, a broad distribution is observed along the west coast of Africa from Senegal to Angola. *Oceana serrulata* is also widespread in the Caribbean Sea and the tropical Americas [26, 37, 38].

While this distribution highlights all currently known locations, further sampling is still needed to fully delimit range boundaries and uncover any cryptic diversity between populations. Disjunct occurrences likely exist outside mapped areas. Reported range limits may also be expanded as new observational evidence is documented in the literature.

This global overview visually summarizes the pantropical distribution of *Oceana serrulata* across three major ocean basins based on collated occurrence data from published sources. It represents the latest understanding of biogeography for this widely dispersed seagrass species.

CONCLUSION

The scientific name for the seagrass species historically known as *Cymodocea serrulata* has been revised to *Oceana serrulata*, reflecting its reclassification into a newly described genus. This name change was prompted by recent phylogenetic studies providing molecular evidence that *C. serrulata* is genetically divergent from other species of *Cymodocea*. Based on multiple published phylogenies utilizing DNA sequence analysis, taxonomists determined that *C. serrulata* warrants separation into its distinct genus *Oceana*, named for its oceanic habitat. The new name *Oceana serrulata* succeeds in categorizing the species following its evolutionary divergence while maintaining the connection to the original epithet serrulata describing its serrated leaves.

Reclassifying this seagrass will impact future research and how it is taxonomically categorized. The name change recognizes that advanced genetic techniques have improved the understanding of relationships between seagrass species over traditional morphology-based taxonomy. It will facilitate research targeted at the biology, ecology, and conservation of the newly described genus *Oceana*. Regarding classification and biological diversity, this leads to a change in the number of seagrass genera in Vietnam, increasing from 9 to 10 genera. At the same time the species count remains the same at 15 species. However, ongoing analysis and specific studies are still required to fully resolve seagrass evolutionary history and taxonomy as new evidence emerges in Vietnam. Periodic taxonomic revisions highlight that updating classification schemes is vital as scientific knowledge grows over time. The transition from *Cymodocea serrulata* to the accepted name *Oceana serrulata* represents an essential milestone for seagrass biology. It integrates centuries-old morphological description with modern genetic phylogenetics to enable more evolutionary accurate classification.

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Appendix I. Morphology of *Cymodocea serrulata* of the first records in Vietnam renamed to *Oceana serrulata* (Nguyen Huu Dai, 1998). Code herbarium 96015