

Cycas ammonitia (Cycadaceae), a new species from the ammonite-rich semi-deciduous forests in Mindoro Island, Philippines

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Abstract

Cycas ammonitia Agoo, Madulid & Linis (Cycadaceae, Section *Cycas*, Subsection *Rumphiae* K.D.Hill) is described from Mansalay, Oriental Mindoro, Philippines. The species grows in seasonally dry semi-deciduous forests on steep ridges over calcareous soils derived from Jurassic ammonite-rich deposits of the Mansalay Formation. Morphologically, *Cycas ammonitia* resembles *Cycas edentata* de Laub. and *Cycas nitida* K.D.Hill & A.Lindstr. in having smooth sclerotesta and a spongy endotesta in the seeds. However, it is distinguished by its very short microsporophyll and megasporophyll apical spines and its unique inland habitat on ammonite-bearing rocks, unlike the coastal or littoral distribution of its relatives. A key to the Philippine species of *Cycas* subsection *Rumphiae* is provided.

Introduction

In the Philippines, *Cycas* L. diversity is notably high, with 12 species endemic and one species extending outside of the archipelago (Laubenfels and Adema 1998; Lindstrom et al. 2008; Madulid and Agoo 2009; Agoo and Madulid 2012; Agoo et al. 2019). These are found in coastal or littoral areas, lowland forests, open grasslands over ultrabasic soils, and on karst limestone cliffs. Two species of *Cycas* Section *Cycas*, Subsection *Rumphiae* K.D.Hill were previously recognised from the Philippines, *C. edentata* de Laub. and *C. nitida* K.D.Hill & A.Lindstr. (Lindstrom et al. 2008).

Mindoro Island belongs to a distinct biogeographic region in the Philippines, serving as a critical faunal transition zone between the Greater Luzon and Greater Palawan Pleistocene aggregate island complexes. As the country's seventh-largest island, it is topographically defined by Mt Halcon—the 23rd-highest peak in the Philippines at 2,616 metres (8,583 ft) (Pinoy Mountaineer 2008)—and by the Mt Iglit-Baco Natural Park, a key conservation area. This park harbors the island's most iconic and evolutionarily significant endemic: the critically endangered tamaraw (*Bubalus mindorensis* (Heude), family Bovidae). As the only endemic bovine species in the Philippines and one of the rarest large mammals in Southeast Asia, the tamaraw is a flagship for grassland-forest mosaic conservation; its dwindling population (fewer than 600 individuals) is entirely restricted to Mindoro, making its survival intrinsically tied to the island's intact habitats. Complementing this biological uniqueness, Mindoro experiences a strong climatic dichotomy: the western province (Occidental Mindoro) falls under Climate Type 1, with

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a pronounced dry season from November to April, while the eastern province (Oriental Mindoro) falls under Climate Type 3, with a less defined dry period and a longer, wetter rainy season. This climatic heterogeneity directly influences the vegetation mosaics—from dry grasslands to moist forests—that sustain the tamaraw and the island’s broader, yet understudied, biodiversity.

Mindoro is part of the Palawan microcontinent rather than the Philippine mobile belt (Aurelio et al. 2012; Yan et al. 2018). This microcontinent includes the Palawan, Culion, and Calamianes Island Group (collectively known as Northern Palawan), as well as Mindoro, Lubang, and Romblon Islands. The Palawan microcontinent separated from the East Asian margin through continental rifting, was subsequently translated southward, and ultimately accreted to the developing Philippine mobile belt between the Late Eocene and the Early Oligocene (Yan et al. 2018; Bird et al. 1993; Sarewitz and Karig 1986). As a result of this tectonic history, it carried with it a biota of Laurasian affinity (Bird et al. 1993; Sarewitz and Karig 1986). Consequently, Mindoro and Palawan have floral and faunal elements not found elsewhere in the Philippines. For example, the endemic tamaraw (*Bubalus mindorensis*) is restricted to Mindoro, while Palawan hosts its own distinctive fauna, such as the Palawan peacock-pheasant (*Polyplectron napoleonis* Lesson).

In southwestern Mindoro, particularly in Mansalay, a unique lithological element is the Mansalay Formation, which consists predominantly of sandstone, shale, siltstone, and minor limestone and conglomerate. It is dated as late Middle Jurassic to early Late Jurassic (Calloviaian–Oxfordian) and is approximately 160–175 million years old. The formation is notably rich in ammonite fossils, which represent the oldest ammonite deposits in the Philippines (Mines and Geosciences Bureau 2010). The Mansalay Formation forms part of the basement of south-eastern Mindoro within the Palawan microcontinent and is unconformably overlain by younger Paleogene and Miocene sedimentary units.

Recent botanical surveys in southern Mindoro have led to the discovery of a previously undescribed *Cycas* species. *Cycas ammonitia* Agoo, Madulid & Linis (Section *Cycas*, Subsection *Rumphiae*), formally described in this paper, was discovered in the municipality of Mansalay, growing in seasonally dry semi-deciduous forests on steep ridges over calcareous soils derived from Jurassic ammonite-rich deposits. Preliminary observations indicate that this species possesses a unique combination of morphological characters, including very short microsporophyll and megasporophyll apical spines, which distinguishes it from other members of Subsection *Rumphiae*.

Key to the Identification of Philippine *Cycas*, Section *Cycas*, Subsection *Rumphiae*

1. Inland species, on ammonite-rich rocks; microsporophylls apical spine very short, 0.1–0.5 cm (1cm) long; megasporophyll apical spine very short, 0.5–0.7 cm long;.....***Cycas ammonitia***
- 1: Littoral or coastal species; microsporophylls apical spine at least 0.9 cm long; megasporophyll apical spine 1.5–4 cm long.....2
2. Megasporophyll lamina with short or indistinct lateral spines.....***Cycas edentata***
- 2: Megasporophyll lamina with 8–16 lateral spines on each side.....***Cycas nitida***

Taxonomy

Cycas ammonitia Agoo, Madulid & Linis, *sp. nov.*

Type: PHILIPPINES: Mindoro Island, Mansalay Municipality, Oriental Mindoro Province, Mindoro Mountain Range, 9 Apr 2026, Agoo & N. Rag-op 26-008 (holo PNH; iso DLSUH).

Diagnosis: Similar to *Cycas edentata* and *C. nitida* in having smooth sclerotesta and a spongy endotesta of the seeds; but differ significantly by its very short microsporophyll apical spine (0.1–0.5 cm long) and megasporophyll apical spine (0.5–0.7 cm long) vs microsporophyll apical spine at least 0.9 cm long and megasporophyll apical spine 1.5–4 cm long in *Cycas edentata* and *Cycas nitida* and its unique habitat in a semi-deciduous forest near creeks over ammonite-bearing deposits.

Stem arborescent, 1–5 m high, rough, nodes distinct, 18–30 cm in diameter (reaching 100 cm in a few individuals). *Cataphylls* caducous, shed early and not persistent on the mature trunk; stem surface characterized by persistent, rough leaf bases with distinct nodal constrictions. *Leaves* (including *petiole* and *rachis*) 122–279 cm long; *petiole* 31–86 cm long, terete to slightly flattened, 2.0–3.5 cm wide in the middle, expanding to 6.0–8.0 cm wide at the smooth swollen, pulvinus (clavate base); *rachis* 91–193 cm long, 0.3–2.0 cm wide; *spines* 13–45 on each side, present from the basal 5–17% to the distal 60–76% of the petiole length. *Leaflets* 63–91 on each side, slightly arching to arching; *basal leaflets* 18–34 cm long, 1.0–1.6 cm wide; 1.5–3.0 cm between leaflets; *middle leaflets* 23.5–37 cm long, 1.0–1.7 cm wide; 1.0–2.3 cm between leaflets; *tip leaflets* 15–36.5 cm long, 1.0–1.5 cm wide; 1.0–2.0 cm between leaflets; *apical leaflet* usually absent, when present up to 26 cm long, 1.2 cm wide. *Male*: strobilus sub-cylindrical, 65 cm long, 10.0 cm wide, *microsporophyll* 4.5 cm long, 2.0 cm wide, extending to 0.5 cm thick top, *apical spine* 0.1–0.5 cm (1 cm). *Female*: *megasporophyll* 33–47 cm long, 1.0 cm wide; *lamina* narrow, 5.5–6.0 cm long, 3.2–3.5 cm wide, bearing 4–9 pungent lateral spines on each margin; *apical spine* consistently abbreviated, measuring 0.5–0.7 cm long; *ovules* 4–5. *Seed* 5.4 cm long, 3.8 cm wide; *sclerotesta* smooth, tapered at one end, with well-developed spongy endotesta. Figure 1.

Diagnostic characters: *Cycas ammonitia* shares with *C. edentata* and *C. nitida* a smooth sclerotesta and spongy endotesta but differs markedly in its conspicuously abbreviated microsporophyll apical spine (0.1–0.5 vs 0.9–2.4 cm) megasporophyll apical spine (0.5–0.7 vs 1.5–4 cm) and its strictly inland habitat on calcareous soils over Jurassic ammonite deposits, an ecological preference unique within the subsection.

Distribution: and Habitat: *Cycas ammonitia* is a narrow edaphic endemic, known only from Mindoro Island, Philippines, where it is strictly confined to inland, seasonally dry semi-deciduous forests on calcareous, ammonite-rich soils derived from the Mansalay Formation. It occurs exclusively on steep, well-drained ridges and slopes of limestone hills, never on adjacent non-calcareous substrates, growing as an understory plant in seasonally dry semi-deciduous forests dominated by bamboos, palms, *Vitex parviflora*, and *Sterculia mindorensis*, where a significant proportion of canopy trees shed their leaves during the pronounced dry season (November to April) to reduce water loss. The species has been recorded at three localities, all within Mansalay Municipality, Oriental Mindoro Province—at elevations

ranging from 100 to 450 meters above sea level (Figure 2). The highly localized, disjunct distribution of these limestone outcrops creates a naturally fragmented metapopulation structure, further

supporting the role of edaphic specialization in the species' evolutionary history.

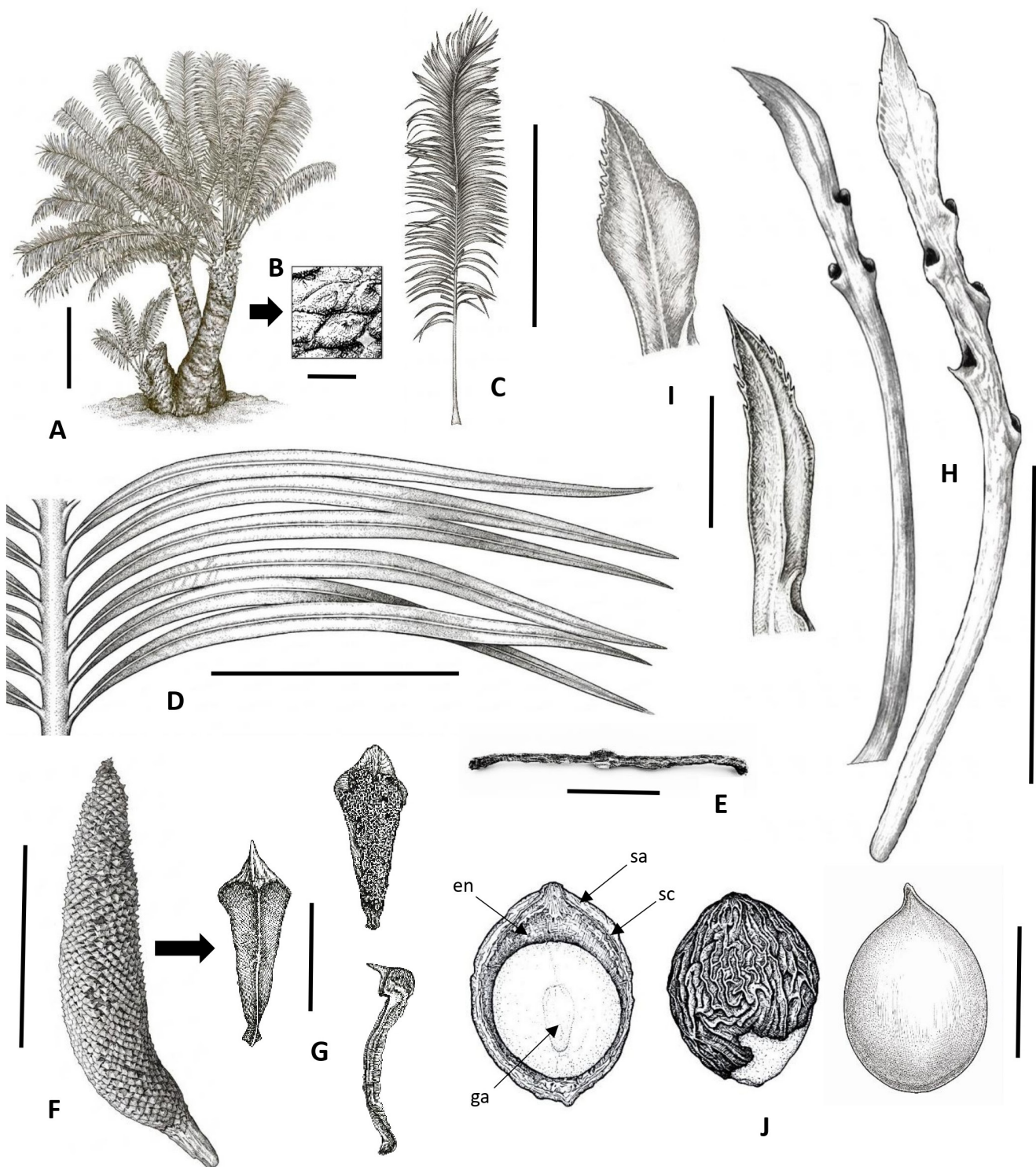


Figure 1. *Cycas ammonitia*. A. Habit. B. Bark. C. Leaf. D. Part of a leaf showing petioles. E. Cross-section of a leaflet. F. Microsporangiate strobilus. G. Microsporophylls. H. Megasporophylls. I. Terminal lamina of megasporophylls. J. Seeds (en = endotesta; ga = gametophyte; sa = sarcotesta; sc = sclerotesta). A – E and H–J from *Agoo and N Rag-op 26-008* (PNH, DLSUH), F– G from *Agoo and N Rag-op 26-009* (PNH, DLSUH). Scale bar: A = 1 m., B = 2 cm., C = 1 m., D = 10 cm., E = 1 cm., F = 30 cm., G = 3 cm., H = 20 cm., I = 5 cm., J = 3 cm.

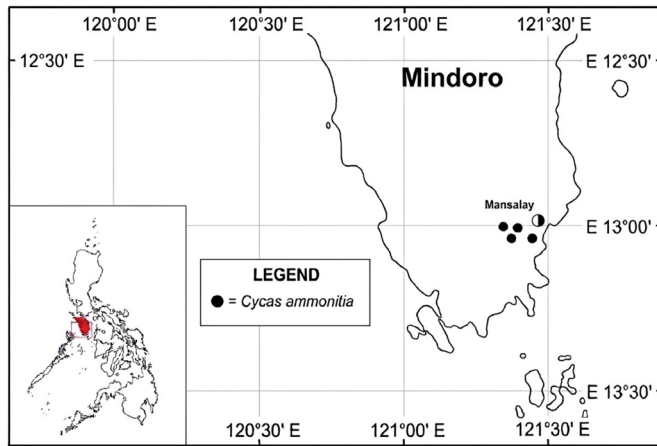


Figure 2. Distribution of *Cycas ammonitia* (Section *Cycas*, Subsection *Rumphiae*) in Mindoro, Philippines.

Geologic Setting: The type locality and all known populations lie within the Mansalay Formation (Late Middle Jurassic to early Late Jurassic), a geologically distinctive unit composed of interbedded sandstone, shale, siltstone, and minor limestone, notably rich in ammonite fossil deposits (Mines and Geosciences Bureau 2010). The weathering of this formation produces shallow, nutrient-poor, highly calcareous soils with elevated pH and specific calcium/magnesium ratios. *Cycas ammonitia* appears to be strictly associated with these soils, and its absence from adjacent, geologically younger, non-calcareous substrates suggests a physiological adaptation—likely involving specialized root symbioses or ion-transport mechanisms—that has driven its niche conservatism and restricted endemism. This narrow edaphic envelope is a far stronger driver of speciation than subtle morphological variation, and we propose that the evolutionary history of *C. ammonitia* is inextricably linked to the discontinuous distribution of Mansalay Formation limestone across Mindoro.

Conservation Status: *Cycas ammonitia* is proposed to be classified as Critically Endangered (CR) following IUCN Red List Categories and Criteria B1ab(iii)+2ab(iii) (IUCN Standards and Petitions Committee 2024). The species has a very limited extent of occurrence (EOO) estimated at less than 10 km² and an area of occupancy (AOO) well below 10 km², based on confirmed records from only three sitios within two adjacent barangays in Mansalay, Oriental Mindoro. Individuals are observed to be severely fragmented, with fewer than 250 mature individuals estimated from field surveys. The habitat is undergoing continuing decline in extent and quality due to shifting cultivation (*kaingin*), swidden agriculture, collection of ornamental cycads, and encroachment by agricultural expansion. No individuals have been recorded from any protected area, and the species remains vulnerable to stochastic extinction events. Immediate conservation actions, including *ex-situ* propagation and habitat monitoring, are strongly recommended.

Etymology: The specific epithet *ammonitia* refers to the ammonite fossil deposits found within the Mansalay Formation that are dated as Middle to Late Jurassic (Aurelio et al. 2012; Andal et al. 1968). The unique calcareous geological substrate, to which this species is restricted, highlights the intimate link between the plant's edaphic niche and its speciation.

Common name: *pitugu, saraag* (Hanunuo) (Madulid 2001).

Notes: *Cycas ammonitia* is placed in Section *Cycas* Subsection *Rumphiae* following the infrageneric classification of Hill (1995) and Lindstrom et al. (2008). This placement is supported by the presence of a spongy endotesta within the seed, a defining synapomorphy of Subsection *Rumphiae*, and glabrous ovules, which characterize Section *Cycas* (Lindstrom et al. 2008).

Section *Cycas* ranges from India and Sri Lanka through mainland Southeast Asia and Malesia to Fiji, Tonga, and East Africa (Hill 1995; Lindstrom and Hill 2007). Subsection *Rumphiae* is uniquely defined by buoyant seeds adapted for oceanic dispersal and includes widespread species such as *C. rumphii*, *C. edentata*, and *C. thouarsii* across the Indian and Pacific Oceans (Dehgan and Yuen 1983; Hill 1994). In the Philippines, Lindstrom et al. (2008) recognised two native *Rumphiae* species: *C. edentata* (widespread in coastal forests and beach strands throughout the archipelago) and *C. nitida* (restricted to littoral forests on the northern and eastern coasts of Luzon, including Babuyan, Rapu-Rapu, Alabat, and Polillo Islands).

Two sterile specimens collected by the prominent American anthropologist H.C. Conklin, *Conklin 268* (A 2247691 [image!], PNH 18682) (1953) and *Conklin s.n.* (A 2247690 [image!], PNH 37914) (1958), are hereby assigned to *Cycas ammonitia*. Both were collected from the south-eastern slopes of Mt Yagaw, Mindoro, within the same vicinity as the currently known populations of *C. ammonitia*. The first specimen was in a *puru* (primary forest) at 330 m above sea level and noted to have golden yellow seeds. The second specimen was among other specimens of flowering plants collected on 12 April 1958 at elevations between 160 and 330 m on the south-eastern slopes of Mt. Yagaw. His research in Mansalay, Oriental Mindoro, was based in Tarubong (now within Tangkulang and Hawili Dos, Panaytayan, Mansalay), where he documented swidden agriculture and the way of life of the local Mangyan communities.

Other Specimens Examined: PHILIPPINES: Mindoro: Oriental Mindoro Prov., Mindoro Mountain Range, Mansalay, 457 m elev., Agoo and N. Rag-op 26-009 (male), 9 Apr 2026 (PNH, DLSUH); Oriental Mindoro Prov., Mindoro Mountain Range, Mansalay, 227 m elev., Agoo and D. Rag-op 26-010 (female), 9 Apr 2026 (PNH, DLSUH); Oriental Mindoro Prov., Mindoro Mountain Range, Mansalay, 177 m elev., Agoo and D. Rag-op 26-011 (sterile), 9 Apr 2026 (PNH, DLSUH); Oriental Mindoro Prov., Mindoro Mountain Range, Mansalay, 118 m elev., Linis and Ulem 26-004 (male), 9 Apr 2026 (PNH, DLSUH); Oriental Mindoro Prov., Mindoro Mountain Range, Mansalay, 320 m elev., Linis and Ulem 26-005 (female), 10 Apr 2026 (PNH, DLSUH); Mindoro, Mt Yagaw, southeast slope, 330 m elev., *Conklin 268* (A 2247691; PNH 18682), 27 Jul 1953, fide Lindstrom et al. (2008) as *C. vespertilio*; Mindoro, Mt Yagaw, east slope, *Conklin s.n.* (A 2247690; PNH 37914), 12 Apr 1958, fide Lindstrom et al. (2008) as *C. vespertilio*.

The mention of *Cycas wadei* in connection with Mansalay (Mindoro) by Zamora & Co (1986) likely reflects a misidentification or misattribution of the herbarium specimen *Conklin 268*, a duplicate of which is deposited at PUH.

Taxonomic position of *Cycas ammonitia*

Microsporophyll and megasporophyll characteristics: The microsporophyll apical spine of *Cycas ammonitia* is not prominent, measuring only 0.1–0.5 cm long. The megasporophyll of *Cycas ammonitia* exhibits a distinctive combination of characters that clearly distinguishes it from all other Philippine species of Section

Cycas, Subsection *Rumphiae* (Table 1; Figure 3). Most notably, the apical spine is conspicuously abbreviated, measuring only 0.5–0.7 cm in length, a condition that contrasts sharply with its closest relatives, *C. edentata* and *C. nitida*, which possess elongate apical spines ranging from 1.5–4.0 cm (Lindstrom et al. 2008).

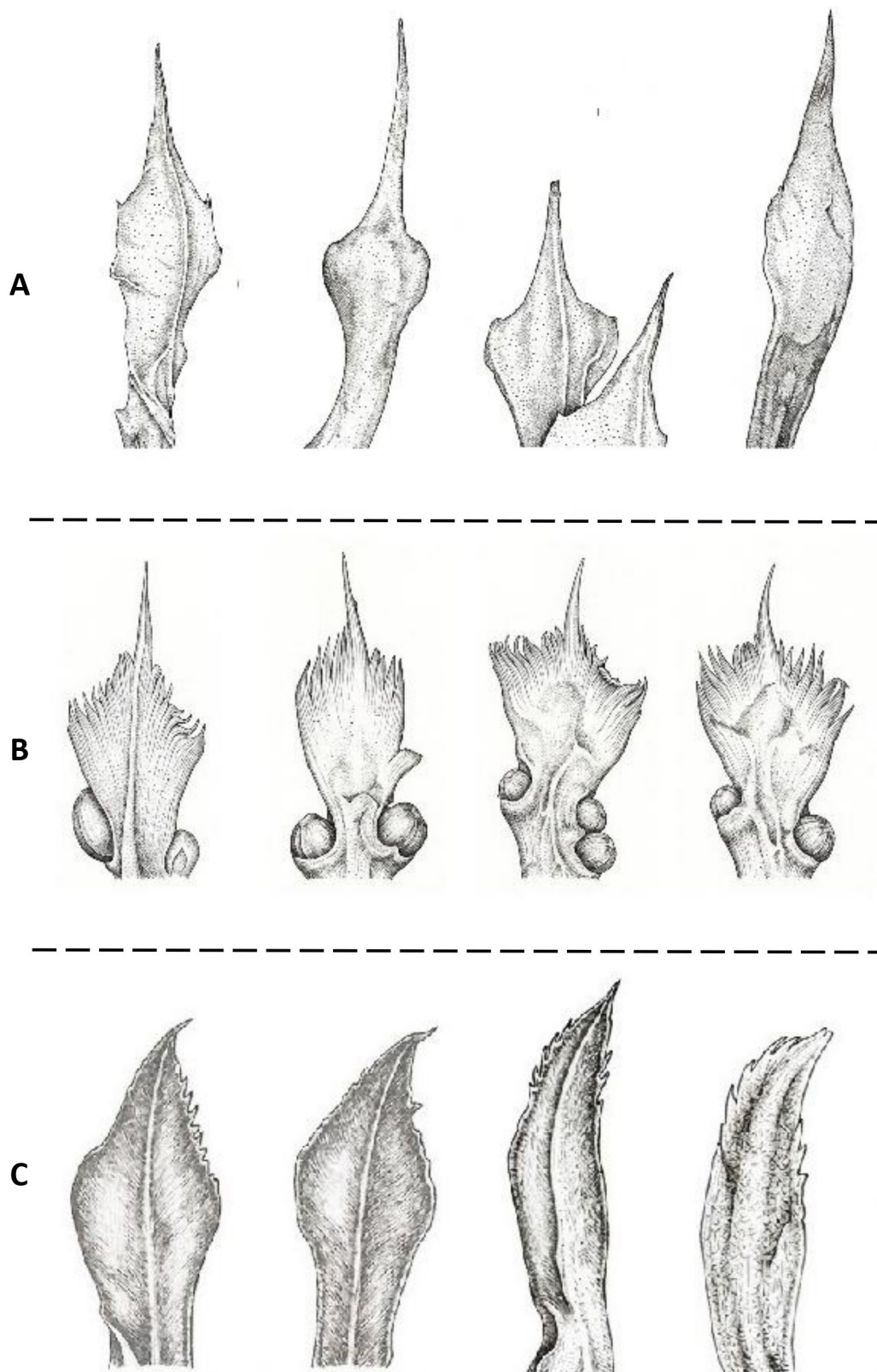


Figure 3. Illustrated comparison of megasporophylls for the Philippine species in *Cycas* Section *Cycas*, Subsection *Rumphiae*: **A**, *Cycas edentata*; **B**, *Cycas nitida*; **C**, *Cycas ammonitia*. (A from Agoo s.n. (DLSUH 6219), B from Ramos & Edaña BS 48310 (PNH); C from Agoo and N Rag-op 26-008 (PNH, DLSUH). Scale bars: A = 6 cm., B = 3 cm., C = 5 cm.

While megasporophyll characters in *Cycas* have been shown to exhibit variable congruence with molecular phylogenies in some instances, the consistent expression of this abbreviated spine across all examined individuals from geographically disjunct

populations within Mindoro supports its utility as a stable taxonomic marker when assessed in conjunction with the full suite of vegetative and reproductive characters.

Table 1. Comparison of *Cycas ammonitia* with Philippine Subsection *Rumphiae* species.

Character	<i>C. edentata</i>	<i>C. nitida</i>	<i>C. ammonitia</i>
Microsporophyll apical spine length	Prominent, 0.9–2.4 cm	Prominent, 1.3–2.3 cm	Not prominent, 0.1–0.5 cm
Megasporophyll lateral spines	Short or indistinct	8–16 distinct spines (on each side)	4–9 spines (on each side)
Megasporophyll apical spine length	1.5–4 cm	1.5–4 cm	0.5–0.7cm
Sclerotesta	Smooth	Smooth	Smooth
Spongy endotesta	Present	Present	Present
Typical habitat	Littoral / coastal	Littoral / coastal	Inland, seasonally dry semi-deciduous forest on calcareous ammonite-rich soils
Distribution	Widespread throughout the Philippines	Northern and eastern Luzon	Endemic to Mansalay, Mindoro

In addition to the abbreviated apical spine, *C. ammonitia* bears 4–9 lateral spines on each side of the megasporophyll lamina, whereas *C. nitida* possesses 8–16 distinct lateral spines, and *C. edentata* has lateral spines that are short or nearly indistinct (Lindstrom et al. 2008). The megasporophyll lamina is neither deeply pectinate (as in Section *Wadeae* K.D.Hill & A.Lindstr.) nor entirely entire, but rather intermediate in form, further supporting its placement within Subsection *Rumphiae*. The reduced apical spine in *C. ammonitia* may represent an adaptation to local pollinator or seed dispersal mechanisms, though this hypothesis requires further investigation. In other species of Subsection *Rumphiae*, the megasporophyll apical spine is typically well-developed and sharply upturned, potentially functioning in pollinator attraction or as a defensive structure (Lindstrom and Hill 2007).

Nevertheless, we emphasize that microsporophyll and megasporophyll morphology alone is not the primary basis for species delimitation here. The aberrant condition of the apical spine is treated as a consistently observable, supporting character, its true taxonomic significance emerges only when interpreted within the unique ecological and edaphic context presented below.

Ecological and edaphic specialization: Perhaps the most compelling evidence for recognizing *C. ammonitia* as a distinct species lies not in morphology alone, but in its strict edaphic specialization. Unlike the broadly distributed littoral and coastal species of Subsection *Rumphiae*, *C. edentata* and *C. nitida*, which occur on a variety of substrates near the seashore, *C. ammonitia* is an obligate calcicole, confined exclusively to inland, seasonally dry, semi-deciduous forests on calcareous soils derived from the ammonite-rich limestone members of the Jurassic Mansalay Formation. This narrow substrate preference, coupled with the fragmented distribution of limestone karst outcrops across Mindoro, strongly suggests that edaphic isolation has acted as a primary mechanism for allopatric divergence and reproductive isolation, reinforcing the morphological distinctions observed in this taxon. Its absence from adjacent non-calcareous substrates

points to a physiological adaptation, likely involving specialized root symbioses or ion-transport mechanisms, that has driven its niche conservatism and restricted endemism.

Seed morphology: In seed morphology, *C. ammonitia* closely resembles both *C. edentata* and *C. nitida* in having a smooth sclerotesta and a well-developed spongy endotesta—characters that are typical of Subsection *Rumphiae* and support its placement within this group. However, these shared seed characters, while useful for higher-level classification, do not obscure the clear species-level distinctions provided by the megasporophyll morphology and the unique ecological niche. The combination of smooth sclerotesta, spongy endotesta, abbreviated apical spine, reduced lateral spine count, and strict calcicolous habitat is not found in any other described Philippine *Cycas* species, thereby justifying the recognition of *C. ammonitia* as a morphologically and ecologically distinct species.

Biogeographic and evolutionary significance

The discovery of *Cycas ammonitia* in the inland, seasonally dry, semi-deciduous forests of Mansalay, Oriental Mindoro, adds a new dimension to our understanding of Subsection *Rumphiae* in the Philippines. Species of this subsection are typically littoral or coastal, with buoyant seeds adapted for oceanic dispersal (Dehgan and Yuen 1983; Hill 1994). Their distribution across the Indian and Pacific Oceans, from East Africa to Fiji and Tonga, and from southern India and Sri Lanka to northern Australia and Southeast Asia, reflects this effective dispersal mechanism (Lindstrom and Hill 2007: 483). *Cycas edentata*, for example, is widespread along the coasts of the Philippines, often found on beach strands and rocky shorelines (Lindstrom et al. 2008). *Cycas nitida* is similarly restricted to littoral forests on the northern and eastern coasts of Luzon (Lindstrom et al. 2008).

Cycas ammonitia deviates from this ecological pattern by occurring strictly inland, at elevations of 100–400 m above sea level, on steep ridges in residual seasonally dry semi-deciduous forest over calcareous soils derived from Jurassic ammonite-rich deposits. This represents a remarkable ecological shift within the

subsection. One possible explanation is that *C. ammonitia* is a relict population that became isolated inland following sea-level changes and tectonic uplift associated with the collision of the Palawan microcontinent with the Philippine mobile belt during the Miocene (Yan et al. 2018; Aurelio et al. 2012). Alternatively, it may have originated from coastal ancestors that subsequently adapted to inland calcareous habitats, a phenomenon observed in other cycad species (e.g. *Cycas saxatilis* K.D.Hill & A.Lindstr. on limestone cliffs in Palawan; Lindstrom et al. 2008).

Range extension for Subsection *Rumphiae*

Prior to this discovery, Subsection *Rumphiae* in the Philippines was known only from coastal and littoral habitats, with *C. edentata* recorded throughout the archipelago and *C. nitida* restricted to northern and eastern Luzon (Lindstrom et al. 2008). The presence of *C. ammonitia* in an inland habitat on Mindoro extends the ecological range of the subsection significantly. Moreover, it adds a third native *Rumphiae* species to the Philippine cycad flora, underscoring the archipelago's role as a centre of cycad diversity within Southeast Asia.

Mindoro Island, being part of the Palawan microcontinent, has a complex geological history involving rifting from mainland Asia during the Oligocene and subsequent collision with the Philippine mobile belt (Yan et al. 2018; Bird et al. 1993). This tectonic history may have facilitated the isolation and divergence of *C. ammonitia* from its coastal relatives. The species' restriction to the Mansalay Formation, a Jurassic sedimentary unit known for its ammonite fossils, suggests possible edaphic specialisation. Such specialisation on ancient calcareous substrates may have contributed to the species' evolutionary isolation and its unique morphological features.

Biogeographic zones: Mindoro vs the rest of the Philippines

The discovery of *C. ammonitia* (Section *Cycas*, Subsection *Rumphiae*) and *C. mindanaensis* Agoo, Madulid & J.R.Callado (Section *Wadeae*) on Mindoro further supports this biogeographic distinction. Section *Wadeae* is otherwise restricted to Palawan and its satellite islands (Culion Island for *C. wadei*, and Palawan mainland for *C. aenigma* K.D.Hill. & A.Lindstr., *C. curranii* (J.Schust.) K.D.Hill, and *C. saxatilis* K.D.Hill & A.Lindstr.; Lindstrom et al. 2008). The presence of a *Wadeae* species on Mindoro suggests that the section diversified after the Palawan microcontinent fragmented, with Mindoro acting as a separate evolutionary unit for several million years. Meanwhile, the occurrence of an inland *Rumphiae* species on Mindoro, while its relatives remain coastal elsewhere in the Philippines, indicates that Mindoro's unique geological and ecological conditions have promoted local adaptation and speciation.

In contrast, the rest of the Philippine archipelago (Luzon, Visayas, Mindanao) is geologically younger and largely volcanic in origin, belonging to the Philippine mobile belt. Cycad diversity there is dominated by species of Section *Cycas* (e.g., *C. ruminiana* Port ex Regel, *C. vespertilio* A.Lindstr. & K.D.Hill, *C. lacrimans* A.Lindstr. & K.D.Hill, *C. zambalensis* Madulid & Agoo) and the introduced *C. revoluta* Thunb., but not Section *Wadeae* (Lindstrom et al. 2008). The isolation of Mindoro within the Palawan microcontinent has therefore played a critical role in

shaping its unique cycad flora, which includes representatives of two distinct sections found nowhere else in the country.

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