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continued on the back inside cover

Cover: A mesmerising Indian Luna moth *Actias selene* is dancing through the starry night (by Vincent van Gogh) moonlit sky, displaying its ballistic display of feather tail. Digital artwork by Vyshnavee Sneha Jaijar.

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REVIEW

An annotated checklist of the genus *Amorphophallus* Blume ex Decne. (Araceae): an update on the distribution and conservation status of its species

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Abstract: Araceae's most remarkable genus is *Amorphophallus*, which is propagated for food, ornamental, and herbal medicine due to its medicinal properties. This checklist includes 241 accepted species of *Amorphophallus*, featuring their scientific names, covered countries, conservation and distribution status, ecological habitats, and biogeographical regions. Around 83% of *Amorphophallus* species are native, and 17% were endemic, and found in Burundi, Benin, Cambodia, Cameroon, Congo, China, Equatorial Guinea, India, Indonesia, Laos, Myanmar, Madagascar, Malaysia, Nigeria, Philippines, Thailand, and Vietnam. Thailand is the most species-rich country (66 spp.), while Indo-Malay is the most species-rich biogeographic region (56.65%). Furthermore, limestone areas are the typical ecological habitat in which *Amorphophallus* species can be found (9.76%). IUCN Red List of Threatened Species documents the genus as 'Critically Endangered' (4.15%), 'Vulnerable' (2.90%), 'Endangered' (0.83%), 'Near Threatened' (0.83%), 'Least Concern' (0.83%), 'Data Deficient' (0.83%); 76.35% (184 species out of 241) were not evaluated because the report's scope for assessing threatened plants might be inadequate, and 13.70% have no record. This inventory from digital databases will assess a more holistic strategic conservation plan of *Amorphophallus* species worldwide.

Keywords: Amorphous, biogeography, diversity, ecological habitat, endemic, global databases, native, occurrences, phallus, worldwide.

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Author contributions: GJDA: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Resources (equal); Supervision (equal); Writing – original draft (equal); Writing – review and editing (equal). MAC: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Supervision (equal); Writing – original draft (equal); Writing – review and editing (equal). NFB: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Supervision (equal); Writing – original draft (equal); Writing – review and editing (equal).

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INTRODUCTION

One of the globally biggest families is the Araceae (Moodley et al. 2016; Bulawin et al. 2024), and one of the largest genera of the family Araceae is *Amorphophallus* (Claudel 2021; Bulawin et al. 2024). About 241 accepted species of *Amorphophallus* are distributed worldwide (IPNI 2022; GBIF 2022; WCVP 2022; Bulawin et al. 2022–2024), and 70% of species can be found in southeastern Asia (Claudel et al. 2019). Most species are limited, and only a few are distributed over a large area (Grob et al. 2003). *Amorphophallus* species are native in southern and southeastern Asia, northern Australia & Oceania, China, Taiwan, Bangladesh, India, Sri Lanka, Laos, Burma, Thailand, Vietnam, Borneo Island, Java Island, Malaysia, Philippines, Celebes Island, Sumatra, New Guinea, Fiji, and Samoa extending from tropical and subtropical climates (Sivilla & Santos 2021).

Amorphophallus is derived from the Greek word amorphous which means deformed, and phallus meaning penis (Yuzammi 2009). Most parts of the plant manifest varied and unique appearances, one of which is the plant's height (Claudel et al. 2017). *Amorphophallus* is well known for its colossal flowers and decaying flesh odor (Liu et al. 2017). The colorful spathe of the inflorescence is essential for breeding and laying eggs of the insects (Ulrich et al. 2016). The spadix at the center of the flower emits heat and odor that entices pollinators (Diaz & Kite 2006; Barthlott et al. 2009). The essential part of the flower is the appendix, an organ that draws the attention of insects for pollination (Chartier & Gibernau 2009). The tuber is the underground stem that serves as a storage organ and for plant propagation. *Amorphophallus* plant commonly grows with an individual leaf (Mc Pherson & Hetterscheid 2011), and the lamina has elliptical leaflets with acute to acuminate apex, similar to the leaves of young trees, and a lichen-like pattern covers the petiole (Claudel et al. 2019). The conspicuous characteristics of *Amorphophallus* that can be readily identified are the mark arrangement or pattern and the shade of the petiole (Gustini et al. 2017).

In the Philippines, India, Sri Lanka, and other southeastern Asian countries, *Amorphophallus* is used for human consumption, not only as an ornamental plant (Sivilla & Santos 2021), but also for medicinal purposes. Tubers, young branches, and inflorescence are the parts of *Amorphophallus* that are edible, and can be used in traditional healing (Anil et al. 2011; Phornvillay et al. 2015; Mastuti et al. 2018; Sookchaloem et al. 2018). *Amorphophallus* was a secondary food source, next to rice, and was utilized in land-clearing ceremonies as an offering of food in some countries (Mursyidin et al. 2022). It is also used in making chips (Misra et al. 2010) and pasta (Chua et al. 2010). Essential parts of plants can be utilized as a source of medicine and food ingredients (Rivai et al. 2022). Traditionally, it has been used as an herbal medicine due to its medicinal properties (Sharma et al. 2022).

The contemporary inventory of accepted *Amorphophallus* species with scientific names, number of occurrences, countries, conservation & distribution status, ecological habitat, and biogeography is introduced in this world checklist. This study utilized digital databases to have a general checklist of *Amorphophallus*, distribution, and conservation status globally. Through this checklist, the different accepted species of *Amorphophallus* worldwide, the countries where the species were found, conservation status, habitat, and biogeography regions where the species were distributed are identified. This study will serve as a basic standard of information regarding the genus diversity, distribution, and global conservation to improve strategic management, and a sustainable plan.

MATERIALS AND METHODS

Knowledge about the ecology, characteristics, and habitats of most plants is limited or nonexistent. The plant's global databases help address some of the plant's growth forms (Taseski et al. 2019). This study provides a worldwide inventory of the accepted species of *Amorphophallus*, covered countries, conservation & distribution status, ecological habitat, and biogeographic regions (Table 3). All the acquired information on *Amorphophallus* species came from digital articles, online herbaria (Table 2) (Internet Directory for Botany 2022; NYBG 2022), and public access databases on biodiversity (Table 1) (Pelser et al. 2011 onwards; CATE Araceae 2022; GBIF 2022; IAS 2022; IPNI 2022; POWO 2022; Tropicos 2022; WCSP 2022; WCVP 2022; WFO 2022). Only the taxonomically accepted species of *Amorphophallus* were included in this paper. The checklist did not include synonyms and varieties. The well-known online international system, open access that provides a database for plant biodiversity is the Global Biodiversity Information Facility (GBIF) (Reyserhove et al. 2020). The scientific names of accepted species of *Amorphophallus* were obtained from the GBIF (2022) and cross-checked against the World Checklist of Vascular Plants (WCVP 2022), International

Image 1. The biogeographic realms of the world (Olson et al. 2001) used in the study of *Amorphophallus* species (Source: www.scribblemaps.com).

Plant Names Index (IPNI 2022), and other online herbaria. Also, the number of occurrences, covered countries, biogeographic regions, and conservation status were added in the analysis. The information on distribution and ecological status of *Amorphophallus* species was acquired from the Plant of the World Online (POWO 2022), International Plant Names Index (IPNI 2022), and online herbaria worldwide. In this checklist, various online herbaria, biodiversity databases, and protologues were also utilized to verify the information of *Amorphophallus* species.

The status of occurrences was zero when a survey of a taxon at a specific time and place encountered no specimens. The NR abbreviation was used for no record occurrences based on online herbarium databases. Covered countries were documented by using ISO 3166-1 alpha-2 code (https://www.nationsonline.org/oneworld/country_code_list.htm). These countries where the various species of *Amorphophallus* were found aligned according to the counterpart biogeographic regions (Image 1), such as Neotropical—NE, Nearctic—NT, Afrotropical—AT, Palearctic—PA, Australasia—AS, and Indo-Malay—IM (Olson et al. 2001). On the one hand, the detailed conservation status was according to the IUCN Global Red List Category. The following abbreviation was used for the conservation status of *Amorphophallus* species: UA—Unassessed, DD—Data Deficient, LC—Least Concern, NT—Near Threatened, VU—Vulnerable, EN—Endangered, and CR—Critically Endangered. For those *Amorphophallus* species without a record, the NR abbreviation was used. Information about the distribution status of *Amorphophallus* species used the abbreviation EC for endemic *Amorphophallus* and NA for native species of *Amorphophallus*. The ecological habitat of various species of *Amorphophallus* were indicated (Figure 7), and those *Amorphophallus* species with unknown ecological habitat or no record based on online herbarium databases were given the abbreviation UK.

RESULTS AND DISCUSSION

Out of 241 species of *Amorphophallus* worldwide (Table 3) (Bulawin et al. 2022–2024), around 7,463 total occurrences of *Amorphophallus* species were recorded in global databases from different countries. Other countries had zero occurrences due to the absence of encountered specimens when a survey of a taxon at a specific time and place was conducted, and some species had no record in global databases. The species with the highest occurrences were

Table 1. Databases used for a worldwide checklist of *Amorphophallus* species.

Database	Webpage URL
CATE Araceae	https://cate-araceae.myspecies.info/
Co's Digital Flora of the Philippines	https://www.philippineplants.org/
Global Biodiversity Information Facility (GBIF)	https://www.gbif.org/
International Aroid Society	https://www.aroid.org/
International Plant Names Index (IPNI)	https://www.ipni.org/
World Checklist of Selected Plant Families (WCSP)	https://wcsp.science.kew.org/home.do
Plants of the World Online (POWO)	https://powo.science.kew.org/
The World Flora Online (WFO)	https://www.worldfloraonline.org/
Tropicos	https://www.tropicos.org/home
World Checklist of Vascular Plants (WCVP)	https://wcvp.science.kew.org/taxon/979828-1

Table 2. Herbaria used for the confirmation of *Amorphophallus* species [NYBG Steere Herbarium (2022) | Internet Directory for Botany (2022)].

Institution	Location	Herbarium code
Adelaide Botanic Garden	Australia	AD
Berlin-Dahlem Botanical Garden	Germany	B
Bonn Botanic Garden	Germany	BONN
Botanic Garden of Marburg University	Germany	MB
Calicut University Botanical Garden	India	CALI
Chinese National Herbarium	China	PE
Fairchild Tropical Botanic Garden	USA	FTG
Forest Herbarium	Thailand	BKF
Gothenburg Botanical Garden	Sweden	GB
Hamburg Botanical Garden	Germany	HBG
Herbarium Bandungense Jurusan Biologi	Indonesia	ITB
Herbarium Bogoriense	Indonesia	BO
Herbarium, Institute of Botany, Academia Sinica, Taipei	Taiwan	HAST
Herbarium Universiti of Kebangsaan	Malaysia	UKMB
Huntington Botanical Gardens	California	HNT
Institute of Tropical Biology	Vietnam	VNM
Leiden Botanic Garden	Netherlands	L
Missouri Botanic Garden	USA	MO
National Herbarium of the Netherlands or Herbarium Hamburgense	Netherlands	HBG
National Taiwan University Herbarium	Taiwan	TAI
Royal Botanic Garden	Australia	K
Saint Petersburg University	Russia	LECB
Shivaji University	India	SUK
Wageningen Herbarium	Netherlands	WAG

A. paeoniifolius (12.31%), *A. abyssinicus* (10.49%), *A. baumannii* (5.21%), *A. dracontiodes* (4.98%), *A. konjac* (4.66%), *A. galbra* (4.45%), *A. aphyllus* (3.95%), *A. titanium* (2.99%), and *A. variabilis* (2.33%). *Amorphophallus paeoniifolius* had the highest occurrences of all the species of *Amorphophallus*, which was known for its geographical extent. This species can be cultivated in many regions, including southeastern Asia (Gao et al. 2017; Bulawin et al. 2022). Most of the species with highest occurrences could be found in the following countries: Nigeria, Togo, Indonesia, Burkina Faso, Guinea, United States, and Belgium in Afrotropic, Indo-Malay, Nearctic, and Palearctic regions (Image 1). Table 3 presents the worldwide checklist of *Amorphophallus* species based on digital databases and herbarium records.

There were various accepted species of *Amorphophallus* from different countries worldwide. The most species-rich country based on the record of digital databases was Thailand with (66 species), followed by France (39 species), Vietnam (34 species), United States (34 species), Indonesia (32 species), Malaysia (30 species), Laos (28 species), India (22 species), Philippines (21 species), and China (18 species) (Figure 2). Manifesting distinct habitats for the diversity and bioresources of the species (Sungkajanttranon et al. 2018) made Thailand the most species-rich country of *Amorphophallus* species. Figure 3 presents the number of *Amorphophallus* species by country based on online herbarium and databases.

The generally recognized and accepted assessment criteria to identify the condition of the species for conservation design are the IUCN Red List of Threatened Species (Yudaputra et al. 2022). Based on the digital databases, 76.35% of *Amorphophallus* species were unassessed for conservation status, and 13.70% have no record. Around 4.15% of *Amorphophallus* species globally are CR, 2.90% VU, 0.83% EN, 0.83% NT, 0.83% LC, and 0.83% DD (Figure 4). This result shows that *Amorphophallus* species are included in the list of protected flora (Wulandari et al. 2022) since some were Critically Endangered, Vulnerable, Endangered, and Near Threatened according to IUCN Red List Criteria (2022).

Native species occur naturally in a region; endemic species are native and restricted to a specific area (Dempsey 2022). Globally, 83% of *Amorphophallus* species were native, and 17% were endemic (Figure 5). Based on the record of digital databases, the 10 most countries with native species of

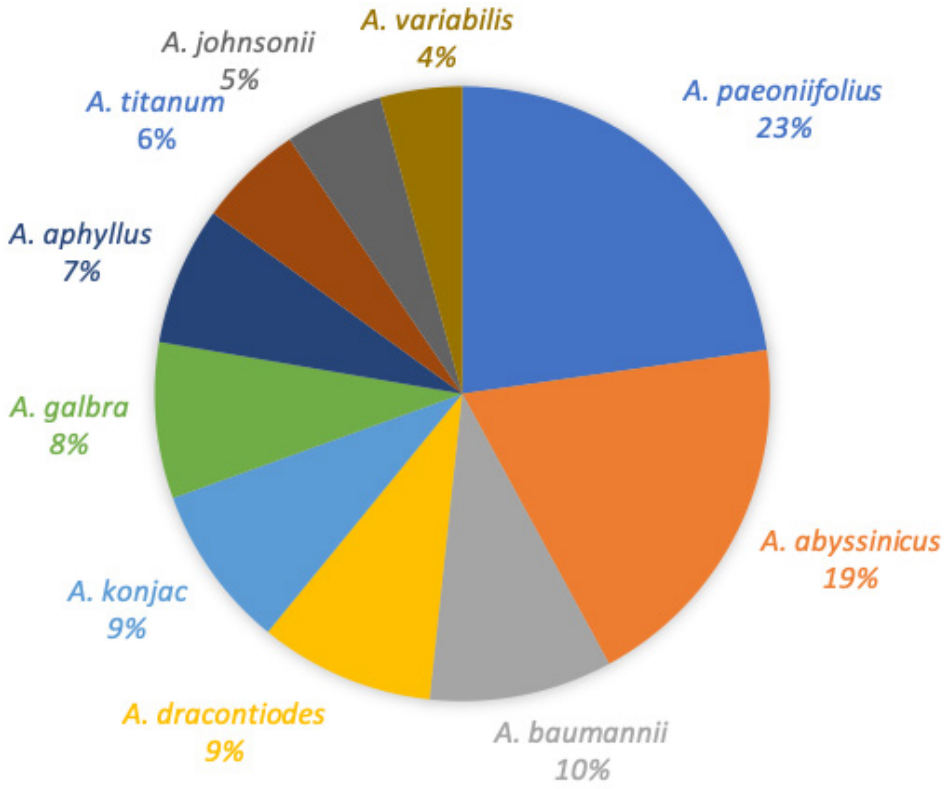

Figure 1. Species of *Amorphophallus* with higher number of occurrences.

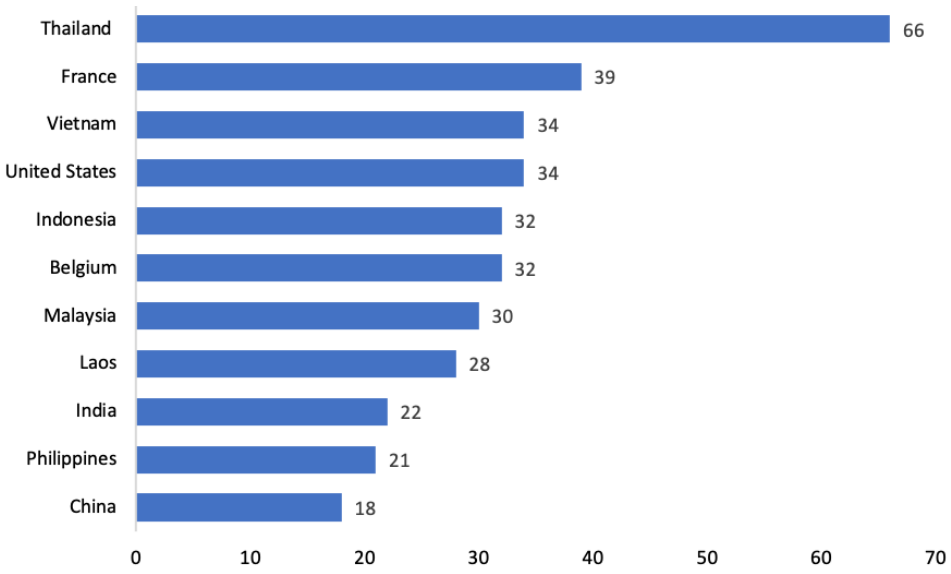

Figure 2. Countries with a higher number of *Amorphophallus* species.

Amorphophallus were Vietnam (35 species), followed by Malaysia (31 species), Laos (30 species), Thailand (27 species), Indonesia (24 species), India (21 species), China (16 species), Myanmar (13 species), Democratic Republic of Congo (10 species), and the Cambodia (nine species). The 10 countries with endemic species of *Amorphophallus* were the following: Thailand (34 species), Philippines (20 species), Madagascar four species, Malaysia two species, Nigeria one species, Equatorial Guinea (one species), the Democratic

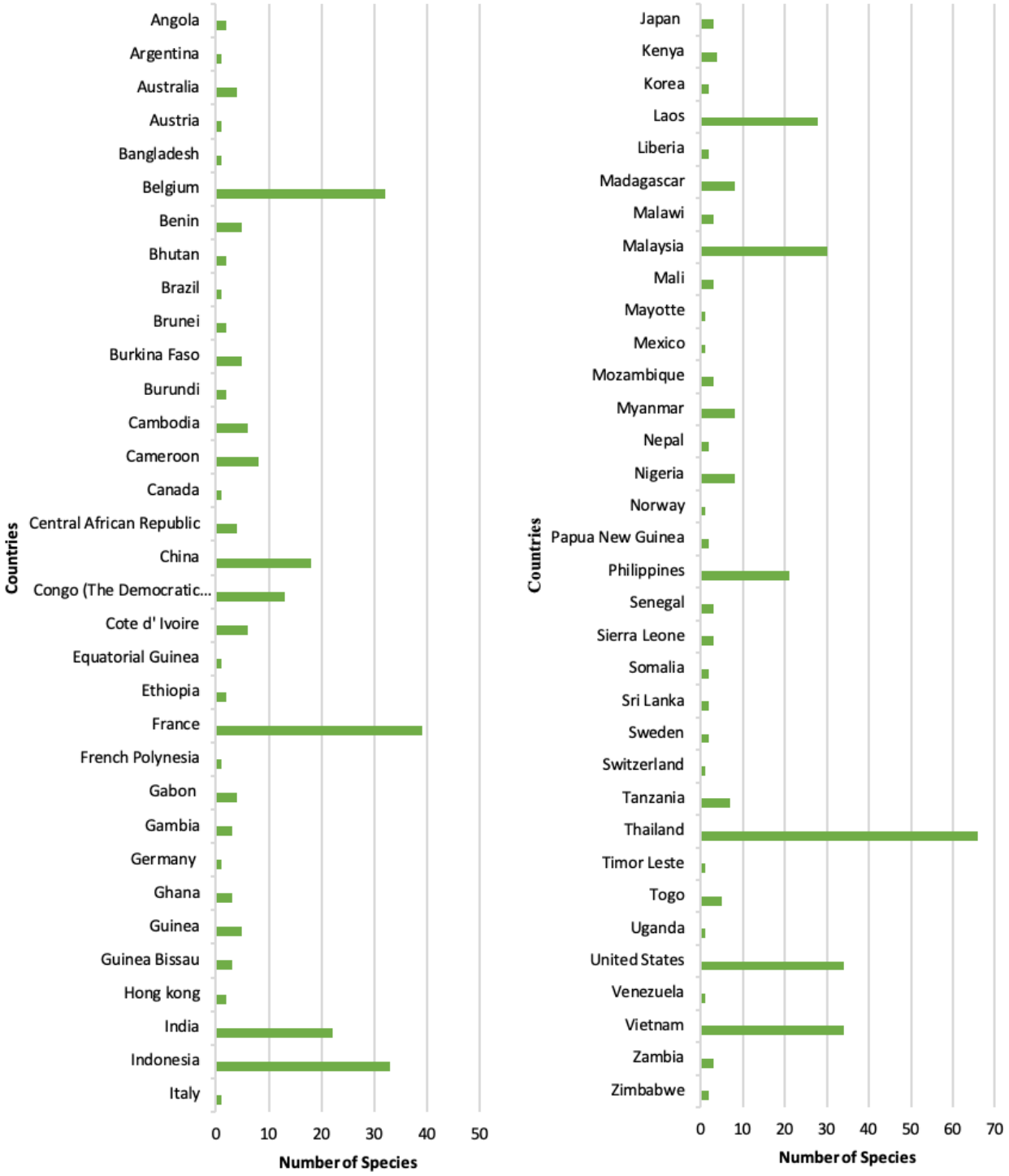

Figure 3. The number of *Amorphophallus* species by country based on online herbarium and databases.

Republic of Congo (one species), Cameroon (one species), Benin (one species), and Burundi (one species) (Figure 6). Most *Amorphophallus* had a broader extent of endemism because of a large scope of geographic adaptation that made it a diverse species (Anil et al. 2014).

Most of the ecological habitat of the *Amorphophallus* species was unknown based on digital databases, with 49.83% (Figure 7). Followed by others or different ecological habitats with 5.72%. Few of *Amorphophallus* species grown in limestone (9.76%), followed by deciduous forest (5.72%), savannah (4.04%), secondary

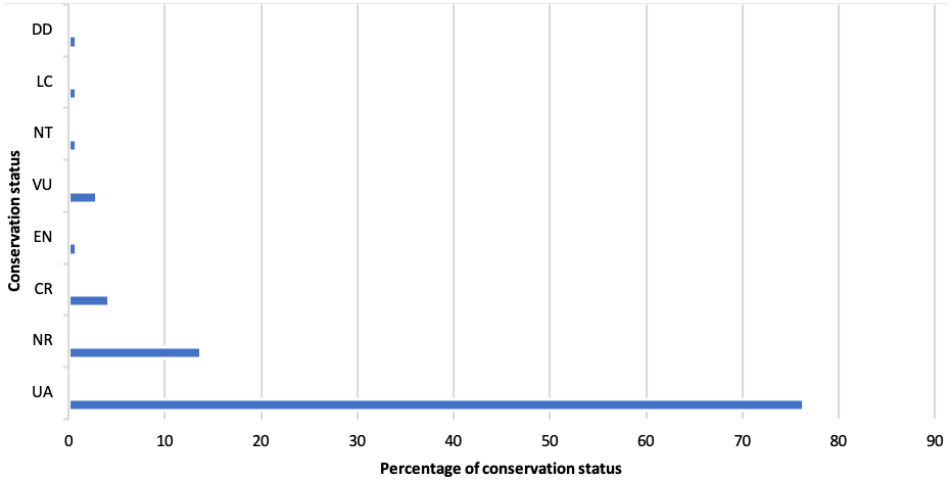

Figure 4. Conservation status of *Amorphophallus* species based on the International Union of Conservation of Nature (IUCN 2022).

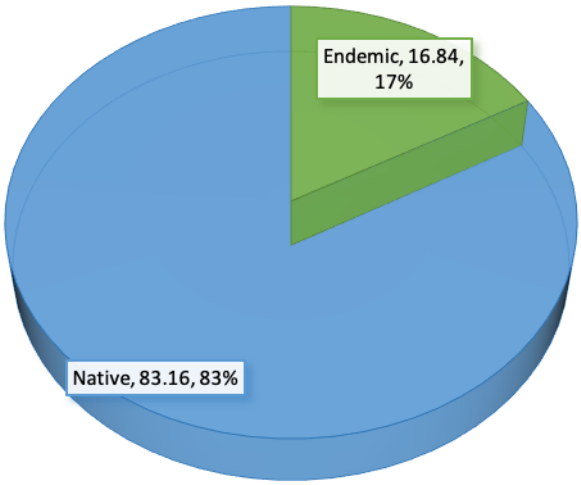

Figure 5. Percentage of *Amorphophallus* species distribution.

forest (3.70%), primary forest (3.03%), dipterocarp forest (2.69%), shady area (2.69%), under bamboo (1.35%), forest margin (1.35%), open forest (1.01%), open woodland (1.01%), lowland forest (1.01%), rich soil with added loam (0.67%), and low land (0.67%). Some species occur in limestone areas rich in decaying organic matter (Nguyen et al. 2016). Additionally, they are primarily found in secondary forests rather than primary forests, as they are considered pioneer species, and few have evolved in open fields (Liu et al. 2017).

Amorphophallus species are abundant in the biogeographical regions of Indo-Malay (56.65%), followed by the Palearctic (19.34%), the Afrotropics (11.85%), Nearctic (9.83%), Australasia (1.16%), and lastly the Neotropics (1.16%). No *Amorphophallus* species are distributed in Oceania and Antarctic biogeography regions. Indo-Malay includes those countries in southern, southeastern Asia, and the southern part of eastern Asia. Most of the *Amorphophallus* species have been discovered in southeastern Asia (Bulawin et al. 2022), and this result suggests that *Amorphophallus* species were abundant in Indo-Malay biogeography.

Based on the occurrences, it appears that the genus *Amorphophallus* has lower occurrences than other genera in the family Araceae, such as *Anthurium, Arisaema*, *Arum, Caladium, Calocasia, Dieffenbachia, Monstera, Philodendron*, *Syngonium, Xanthosoma, and Zantedeschia*, especially when it is not in season. The development or maturity of *Amorphophallus* varies across different species, and it is a seasonal plant that undergoes an annual cycle of activity and dormancy (Mc Pherson & Hetterscheid 2011).

Besides, *Amorphophallus* species need an appropriate environmental condition to grow because several factors can affect their growth and distribution such as habitat type, altitude, light, humidity and temperature (Wulandari et al. 2022). These were the reasons why some species of *Amorphophallus* have zero or absence of occurrences in some other countries (Sungkajanttranon et al.2018; Wulandari et al. 2022). *A. paeoniifolius* (Figure 1) had a higher percentage of occurrences because of its comestible tuber and medicinal properties (Anil et al. 2011). It is known for its geographical extent, as this species can be cultivated in many regions (Bulawin et al. 2022).

In describing the rate of biodiversity of a particular ecosystem, evaluation of plants, geographical distribution in terms of species richness, species evenness, endemism, and conservation status is fundamental (Batuyong et al. 2020). Out of 10 countries with a higher number of *Amorphophallus* species,

Table 3. Worldwide checklist of *Amorphophallus* species based on digital databases and herbarium records.

Species	Number of occurrences	Country	IUCN Red List status	Status of distribution	Ecological habitat	Biogeographic region
1. *A. aberrans* Hett.	5	TH, FR	UA	EC in TH	Dry savannah forest	IM, PA
2. *A. abyssinicus* (A.Rich.) N.E.Br.	783	BE, CD, BF, TZ, CI, CM, GN, NG, TG, CF	UA	NA to NG, BF, NE, TG, ZM, CM, NA, CF, TD, ET, ZA, TZ, UG, ZW	UK	PA, AT
3. *A. adamsensis* Magtoto, Mones, Ballada, Austria, R.M.Dizon, Alangui, Regina	NR	PH	NT	EC in PH	UK	IM
4. *A. albisphathus* Hett.	17	TH, BE, MY, US	UA	EC in TH	Limestone	IM, PA, NT
5. *A. albus* P.Y.Liu & J.F.Chen	23	CN, FR, CH, BE, SE	UA	NA to CN	Open forest	PA
6. *A. allenii* A. Galloway, Malkm. Huss., Prehsler & Claudel	0	TH	NR	NA to TH	UK	IM
7. *A. amygdaloides* Hett. & Sizemore	5	TH	UA	EC in TH	UK	IM
8. *A. andranogidroensis* Hett. & Mangelsdorff	2	MG	UA	EC in MG	Deciduous forest	AT
9. *A. angolensis* (Welw. ex. Schott) N.E.Br.	79	GA, CD, CF, AO, CN	UA	NA to AO, GA, SD, CD	UK	AT, PA
10. *A. angulatus* Hett. & A.Vogel	11	MY	UA	NA to Borneo	UK	IM
11. *A. angustispathus* Hett.	4	MM	UA	NA to MM	UK	IM
12. *A. ankarana* Hett. Ittenb. & Bogner	25	MG, BE, FR	UA	EC in MG	Limestone	AT, PA
13. *A. annulifer* Hett.	2	ID	UA	NA to Java	UK	IM
14. *A. antsingyensis* Bogner, Hett. & Ittenbach	27	MG	UA	EC in MG	Primary & secondary forest/ limestone	AT
15. *A. aphyllus* (Hook.) Hutch.	295	BJ, SN,GM, SL, GN, GW, ML, BE, TG, CI	UA	NA to BF, CF, TD, GW, ML, SN, SL,TG	Savannah/dry forest	AT, PA
16. *A. arcuspadix* A.Galloway, Ongsakul & Petra Schmidt	1	FR	UA	NA to LA	UK	PA
17. *A. ardii* Yuzammi & Hett.	NR	ID	NR	NA to Sulawesi	UK	IM
18. *A. asper* (Engl.) & Gehrm.	7	ID	UA	NA to Sumatra	UK	IM
19. *A. asterostigmatus* Bogner & Hett.	13	TH	UA	EC in TH	Limestone	IM
20. *A. atrorubens* Hett. & Sizemore	2	TH	UA	EC in TH	Limestone	IM
21. *A. atroviridis* Hett.	9	TH, BE	UA	EC in TH	Limestone	IM, PA
22. *A. bangkokensis* Gagnep	2	TH	UA	EC in TH	Low-lying waste ground	IM
23. *A.barbatus* A.Galloway & Ongsakul	0	LA	NR	NA to LA	UK	IM
24. *A. barthlottii* Ittenb. & Lobin	6	CI, LR	UA	NA to CI, LR	UK	AT
25. *A. baumannii* (Engl.) N.E.Br.	389	BE, GH, TG, SN, BF, NG, GW, SL, GM, NG	UA	NA to NG, BF, NE, NG, SN, SL, CF, TD, GM, GH, GW, LR, TG	Savannah/ open woodland/and stony soil	PA, AT
26. A. *beccarii* Engl.	26	ID, FR	UA	NA to Sumatera	UK	IM, PA
27. *A. bequaertii* De Wild.	4	CD	UA	EC in East CD	Primary forest	AT
28. *A. blumei* Schott, 1863	0	IN	NR	NR	UK	NR
29. *A. bognerianus* Sivad & Jaleel	2	IN	UA	NA to East Himalaya	UK	IM
30. *A. bolikhamxayensis* A.Galloway, Ongsakul & Petra Schmidt	1	FR	UA	NA to LA	UK	PA
31. *A. bonaccordensis* Sivad. & N.Mohanan	4	IN	UA	NA to IN	UK	IM
32. *A. borneensis* (Engl.) Engl. & Gehrm	18	MY, ID, BE, BN	UA	NA to Borneo	UK	IM, PA,
33. *A. boyceanus* Hett.	1	TH	UA	EC in TH	UK	IM
34. *A. brachyphyllus* Hett.	10	MY	UA	EC in Bau area, Kuching Div.	Lowland forest/ Limestone/ evergreen forest	IM
35. *A. brevipetiolatus* A.Galloway, Ongsakul & Petra Schmidt	0	LA	NR	NA to LA	UK	IM

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36. *A. brevispathus* Gagnep.	11	TH	UA	EC in TH	Limestone	IM
37. *A. bubenensis* J.T.Yin & Hett.	0	CN	NR	NA to CN South Central	UK	PA
38. *A. bufo* Ridl.	7	MY	UA	NA to Malaya	UK	IM
39. *A. bulbifer* (Roxb.) Blume	161	IN, US, CN, TH, BE, FR, NP, BT, ID	UA	NA to IN, CN, BD, IN, MM, NP	UK	IM, NT, PA,
40. *A. calabaricus* N.E.Br.	34	CM, NG, BJ, CD, GA, UG	UA	NA to NG, CM, KE, UG, CP	UK	AT
41. *A. calcicola* Tamayo, M.N., Magtoto, Liezel, L.M., Sumalinog, M. JR., Reyes, T.D. Jr., Austria, C.M.	NR	PH	CR	EC in PH	Forest/limestone	IM
42. *A. canaliculatus* Ittenb., Hett. & Lobin	6	GA	UA	NA to GA	UK	AT
43. *A. candidissimus* X.Gong & H.Li	0	VN	NR	NA to VN	UK	IM
44. *A. carneus* Ridl.	9	MY, TH	UA	NA to MY, TH	Limestone	IM
45. *A. carnosus* Engl.	9	VN	UA	NA to VN	UK	IM
46. *A. caudatus* Bustamante, R.A.A., Mansibang, J.A., Hetterscheid, W.L.A., Tamayo, M.N.	NR	PH	CR	EC in PH	Low land forest	IM
47. *A. chlorospathus* Kurz ex Hook.f.	3	IN, MM	UA	NA to IN, MM	UK	IM
48. *A. cicatricifer* Hett.	6	TH	UA	EC in Kanchanaburi	Evergreen forest	IM
49. *A. cidarioides* J.R.Callado, Medecilo & Hett.	NR	PH	NR	EC in PH	Watery areas	IM
50. *A. cirrifer* Stapf.	9	TH	UA	EC in TH	Deciduous forest/ open forest	IM
51. *A. claudelii* A.Galloway & Ongsakul	1	FR	UA	NA to LA	UK	PA
52. *A. coaetaneus* S.V.Liu & S.J.Wei	18	VN, FR, CN, US	UA	NA to CN, VN	Forest valley	IM, PA, NT
53. *A. commutatus* (Schott) Engl.	56	IN	UA	NA to IN	UK	IM
54. *A. consimilis* Blume	80	SN, GM, BJ, ML, FR, GW, BE	UA	NA to GM, SN	Low land	AT, PA
55. *A. corrugatus* N.E.Br.	43	TH, US, VN	UA	NA to CN, MM, TH	Primary forest/ evergreen forest	IM, NT
56. *A. costatus* Hett.	5	MY, ID	UA	NA to Borneo	UK	IM
57. *A. coudercii* (Bogner) Bogner	5	KH, VN	UA	NA to KH	UK	IM
58. *A. crinitus* A.Galloway, Luu, Malkm.-Huss., Prehsler & Claudel	0	VN	NR	NA to VN	UK	IM
59. *A. crispifolius* A.Galloway, Ongsakul & Petra Schmidt	0	LA	NR	NA to LA	UK	IM
60. *A. croatii* Hett. & Galloway	2	LA	UA	NA to LA	UK	IM
61. *A. cruddasianus* Prain	5	MM, TH, US	UA	NA to MM, TH, LA	UK	IM, NT
62. *A. curvistylis* Hett.	7	TH	VU	EC in Kanchanaburi	Limestone/ deciduous forests	IM
63. *A. declinatus* Hett.	7	PH	UA	EC in PH	UK	IM
64. *A. decus-silvae* Backer & Alderw.	27	ID, US	UA	NA to Jawa	UK	IM, NT
65. *A. discophorus* Backer & Alderw.	5	ID	UA	NA to Jawa	UK	IM
66. *A. dracontioides* (Engl.) N.E.Br.	372	BJ, TG, CI, BF, GH, NG, GN	UA	NA to NG, BF, CF, GM, GH, CI, NE, TG	Dry savannah	AT
67. *A. dunnii* Tutcher	52	CN, HK, BE, DE, FR, US	UA	NA to CN	UK	IM, PA, NT
68. *A. dzui* Hett.	6	VN	UA	NA to VN	UK	IM
69. *A. eburneus* Bogner	23	MY	UA	EC in Padawan (Kuching Div.) and Tebedu (Samarahan Div,).	Lowland forest/ limestone	IM
70. *A. echinatus* Bogner & Mayo	3	TH, LA	DD	EC in Kanchanaburi	Dense, moist forest	IM
71. *A. eichleri* (Engl.) Hook.f.	24	BE, FR, CD, CF, BR, CM	UA	NA to CD	Primary rain forest	PA, AT, NE

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72. *A. elatus* Hook.f.	9	TH, FR, MY	UA	NA to MY, TH	Evergreen forest/ deciduous forest	IM, PA
73. *A. elegans* Ridl.	5	MY, TH	UA	NA to MY, TH	Evergreen forest/ limestone	IM
74. *A. elliottii* Hook.f.	12	SL, TH	UA	NA to SL	Forest between low grass	AT, IM
75. *A. erythrororrhachis* Hett., Pronk & R.Kaufmann	3	MG	UA	NA to MG	UK	AT
76. *A. excentricus* Hett.	8	TH, US	UA	NA to MY, TH	Evergreen forest	IM, NT
77. *A. fallax* (Serebryanyi) Hett. & Claudel	6	VN, LA	UA	NA to VN	UK	IM
78. *A. ferruginosus* A.Galloway	0	LA	NR	NA to LA	UK	IM
79. *A.flammeus* M.A.Calaramo, M.A.R. Batuyong, N.F.Bulawin, G.J.D.Alejandro	NR	PH	VU	EC to PH	Limestone forest thickets with loamy substrate	IM
80. *A. flotoi* (S.Y.Hu) Govaerts	67	TH, US, LA, FR, KH	UA	NA to KH, VN, LA, TH	UK	IM, NT. PA
81. *A.fontarumii* N.F.Bulawin, M.M.Medecilo-Guiang, G.J.D.Alejandro	NR	PH	CR	EC to PH	Limestone	IM
82. *A. forbesii* (Engl.) Engl. & Gehrm.	1	ID	UA	NA to Sumatra	UK	IM
83. *A. fornicatus* Hett., J.R.Collado & Wistuba	NR	PH	NR	EC to PH	Secondary forest	IM
84. *A. fuscus* Hett.	5	TH, BE	UA	NA to TH	Limestone	IM, PA
85. *A. galbra* F.M.Bailey	332	AU, PG, ID, US	UA	NA to PG, AU,	UK	AS, IM, NT
86. *A. gallaensis* (Engl.) N.E.Br.	14	KE, SO, IT, ET	UA	NA to KE, SO, ET	Dry Savannah/ open woodland	AT, PA
87. *A. gallowayi* Hett.	4	FR, LA, VN	UA	NA to LA	UK	IM, PA
88. *A. gigas* Teijsm. & Binn.	39	ID, US	TD	NA to Sumatera	UK	IM, NT
89. *A. glaucophyllus* Hett. & Serebryanyi	0	TH	NR	EC in Kanchanaburi	UK	IM
90. *A. gliruroides* Engl.	1	TH	UA	NA to MM	UK	IM
91. *A. glossophyllus* Hett.	9	VN, FR	UA	NA to VN	UK	IM, PA
92. *A. goetzei* (Engl.) N.E.Br.	20	TZ, MW, MZ, CD	UA	NA to MZ, TZ, CD	Evergreen forest/ River valleys	AT
93. *A. gomboczianus* Pic. Serm.	24	ET, ZM	UA	NA to ET	Savannah/ open woodland/ forest margin/proximity of river	AT
94. *A. gracilior* Hutch.	3	NG, BJ	UA	EC in BJ, NG	Primary rain forest/swamps	AT
95. *A. gracilis* Engl.	2	ID	UA	NA to Sumatera	UK	IM
96. *A. haematospadix* Hook.f.	20	MY, FR, TH, US	UA	NA to MY, TH	Limestone	IM, PA, NT
97. *A. harmandii* Engl. & Gehrm	45	TH, KH, LA	UA	NA to KH, LA, TH, VN	Deciduous forest/ under bamboo	IM
98. *A. hayi* Hett.	1	VN	DD	NA to VN, CN	Secondary forest	IM
99. *A. hemicryptus* Hett. & J.F.Maxwell	0	KH	NR	NA to KH	Deciduous forest/ Hardwood forest/	IM
100. *A. henryi* N.E.Br.	172	TH, CN, AR, BE, US	UA	NA to TH	Limestone/mixed forest/bamboo plantation	IM, PA,NE, NT
101. *A. hetterscheidii* Ittenb. & Lobin	3	CD, CF	UA	NA to CF, GA, CD	UK	AT
102. *A. hewittii* Alderw.	66	MY, ID	UA	NA to Borneo	UK	IM
103. *A. hildebrandtii* (Engl.) Engl. & Gehrm	104	MG	LC	NA to MG	UK	AT
104. *A. hirsutus* Teijsm. & Binn.	9	ID, IN, FR	UA	NA to Sumatera	UK	IM, PA
105. *A. hirtus* N.E.Br.	73	TH, CN, JP	UA	NA to TH	Dense grassland	IM, PA
106. *A. hohenackeri* (Schott) Engl. & Gehrm.	30	IN	UA	NA to IN	UK	IM
107. *A. hottae* Bogner & Hett.	12	MY	UA	NA to Borneo	UK	IM

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108. *A. impressus* Ittenb.	10	MW, TZ BE	UA	NA to MW, TZ	UK	AT, PA
109. *A. incurvatus* Alderw.	0	ID	NR	NA to Sumatera	UK	IM
110. *A. infundibuliformis* Hett., A.Dearden & A.Vogel	10	MY	UA	NA to Borneo	Lowland/ dipterocarp	IM
111. *A. interruptus* Engl. & Gehrm.	39	VN	CR	NA to VN	UK	IM
112. *A. johnsonii* N.E.Br.	210	GH, CI, BF, BN, ML, NG, LR, TG, GN, CM	UA	NA to NG, BF, GH, PG,CI, LR, ML	Savannah	AT, IM
113. *A. josefbogneri* Hett.	1	TH	UA	EC in South Western Thailand: Kanchanaburi	UK	IM
114. *A. julaihii* Ipor, Tawan & P.C.Boyce	3	MY	UA	NA to Borneo	UK	IM
115. *A. juliae* P.C.Boyce & Hett.	0	MY	NR	EC to Sarawak	UK	IM
116. *A. kachinensis* Engl. Gehrm.	22	CN, MM, TH, LA	UA	NA to CN, LA, MM, TH	Limestone	PA, IM
117. *A. khammouanensis* A.Galloway	0	LA	NR	NA to LA	UK	IM
118. *A. kienluongensis* V.D.Nguyen, Luu & Hett.	0	VN	VU	NA to VN	UK	IM
119. *A. kiusianus* (Makino) Makino	130	JP, CN, HK, US, BE, KR	VU	NA to CN, JP, TW	UK	PA, IM, NT
120. *A. konjac* K. Koch	348	CN, US, JP, MX, PH, NO, KR, FR, AT	UA	NA to CN	Forest margin/ secondary forest	PA, NT, NE, IM
121. *A. konkanensis* Hett., S.R.Yadav & K.S.Patil	7	IN	UA	NA to IN	UK	IM
122. *A. koratensis* Gagnep	18	LA, TH, KH	UA	NA to KH, LA, TH	Deciduous/ dipterocarp forest	IM
123. *A. krausei* Engl.	93	TH, MM, FR, LA	UA	NA to BD, CN, LA, MM, TH	Deciduous/ depterocarp forest/ Evergreen forest	IM, PA
124. *A. kuznetsovii* (Serebryanyi) Hett. & Claudel	1	VN	UA	NA to VN	UK	IM
125. *A. lacourii* Linden & André	120	TH, VN, FR, US, KH, LA, AU, BE	UA	NA to KH, LA, TH, VN	UK	IM, PA, NT, AS
126. *A. lambii* Mayo & Widjaja	27	MY, FR, IN, BE, TH	UA	NA to Borneo	UK	IM, PA
127. *A. lanceolatus* (Serebryanyi) Hett. & Claudel	2	VN	UA	NA to VN	UK	IM
128. *A. lanuginosus* Hett.	3	VN	CR	NA to VN	UK	IM
129. *A. laoticus* Hett.	9	LA	UA	NA to LA	Evergreen/ deciduous forest	IM
130. *A. lewallei* Malaisse & Bamps	11	BI, VE	CR	EC in Burundi	Savannah	AT, NE
131. *A. linearis* Gagnep	12	TH	UA	EC in TH	Evergreen/ deciduous/ dipterocarp forest/ bamboo forest	IM
132. *A. linguiformis* Hett.	3	ID	UA	NA to Borneo	UK	IM
133. *A. longicomus* Hett. & Serebryanyi	1	VN	UA	NA to VN	UK	IM
134. *A. longiconnectivus* Bogner	8	IN	UA	NA to IN	UK	IM
135. *A. longispathaceus* Engl. & Gehrm	3	PH	UA	EC in PH	UK	IM
136. *A. longistylus* Kurz ex Hook.f.	2	IN	UA	NA to Andaman Is.	UK	IM
137. *A. longituberosus* (Engl.) Engl. & Gehrm	52	TH, MY, FR, BE	UA	NA to BD, TH, MY	Evergreen/ Decidious/ Dipterocarp forests	IM, PA
138. *A. lunatus* Hett. & Sizemore	2	TH	UA	EC in TH	Secondary forest	IM
139. *A. luzoniensis* Merr.	6	PH	UA	EC in PH	UK	IM
140. *A. lyratus* (Roxb.) Kunth	0	IN	NR	NA to IN	UK	IM
141. *A. macrophyllus* (Gagnep. Ex Serebryanyi) Hett. & Claudel	7	TH, FR, VN	UA	NA to TH VN	UK	IM, PA

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142. *A. macrorhizus* Craib	58	TH, CN	UA	EC in TH	Deciduous/ Dipterocarp forests	IM, PA
143. *A. malkmus-husseinii* A.Galloway, Prehsler & Claudel	0	LA	NR	NA to LA	UK	IM
144. *A. mangelsdorffii* Bogner	8	MG, BE	UA	NA to MG	UK	AT, PA
145. *A. manta* Hett. & Ittenbach	3	ID	UA	NA to Malaya and Sumatera	UK	IM
146. *A. margaritifer* (Roxb.) Kunth	24	IN	UA	NA to IN, BD, MM	UK	IM
147. *A. margretae* Ittenb.	1	CD	UA	NA to CD	UK	AT
148. *A. maximus* (Engl.) N.E.Br.	41	TZ, SO, KE, MZ, ZW, BE, CM, MW	UA	NA to KE, MZ, SO, TZ, ZW	UK	AT, PA
149. *A. maxwellii* Hett.	11	TH, BE	UA	EC in Kanchanaburi	Deciduous forest/ limestone	IM, PA
150. *A. mekongensis* Engl. & Gehrm.	6	LA, VN	UA	NA to LA, VN	UK	IM
151. *A. merrillii* K.Krause	3	PH	UA	EC in PH	UK	IM
152. *A. mildbraedii* K.Krause	5	CM	UA	NA to CM	UK	AT
153. *A. minimus* Bustamante, R.A.A., Claudel, C., Altomonte, J.C.A., Udasco, L.C. Jr., Tamayo, M.N.	NR	PH	CR	EC in PH	Montane / dipterocarp/ secondary forests	IM
154. *A. minor* Ridl.	2	MY	UA	NA to MY	UK	IM
155. *A. mossambicensis* (Schott ex Garcke) N.E.Br.	10	ZM, TZ, MZ, CD, US, ZW	UA	NA to MZ, TZ, ZM, CD, ZW	Savannah	AT, NT
156. *A. muelleri* Blume	106	TH, ID, IN, MM, MY, FR, US, TL	UA	NA to IN, TH, ID, MY, BN, MM	Secondary forests	IM, PA, NT
157. *A. mullendersii* Malaisse & Bamps	5	CD	UA	NA to AO, CD	Savannah/ Gallery forests	AT
158. *A. myosuroides* Hett. & A.Galloway	4	LA, BE, FR	UA	NA to LA	UK	IM, PA
159. *A. mysorensis* E.Barnes & C.E.C. Fisch.	11	IN	UA	NA to IN	UK	IM
160. *A. napalensis* (Wall.) Bogner & Mayo	49	IN, NP, TH, BT, BD, BE, US	UA	NA to IN BD, NP	UK	IM, PA, NT
161. *A. napiger* Gagnep.	15	TH, LA	UA	NA to KH, LA, TH, VN	Deciduous forests	IM
162. *A. natolii* Hett., Wistuba, V.B.Amoroso, Medecilo & Claudel	NR	PH	CR	EC in PH	Limestone	IM
163. *A. niahensis* P. C. Boyce & Hett.	4	MY	UA	NA to Borneo	Limestone/shady area	IM
164. *A. nicolaii* Hett.	0	VN	NR	NA to VN	UK	IM
165. *A. nicolsonianus* Sivadasan	11	IN	UA	NA to IN	UK	IM
166. *A. obovoideus* Alderw.	0	ID	NR	NA to Sumatera	UK	IM
167. *A. obscurus* Hett. & Sizemore	4	TH	UA	EC in Ubon Ratchathani	UK	IM
168. *A. ochroleucus* Hett. & V.D.Nguyen	8	FR, VN	NT	NA to VN	UK	PA, IM
169. *A. oncophyllus* Prain ex Hook.f.	0	CN	NR	NA to Andaman Is.	UK	PA
170. *A. ongsakulii* Hett. & A.Galloway	6	LA, FR, BE	UA	NA to LA	UK	IM, PA
171. *A. operculatus* Hett. & Sizemore	8	FR, TH	UA	EC in Chumphon	UK	PA, IM
172. *A. opertus* Hett.	1	VN	UA	NA to VN	UK	IM
173. *A. paeoniifolius* (Dennst.) Nicolson	919	AU,IN, ID, PH, TH, PF, PG, YT, CN	LC/UA	NA to IN, BD, MY, ID, CN, LA, KH, MM, PH	Secondary forest/ shady places	AS, IM, AT, PA
174. *A. palawanensis* Bogner & Hett.	21	PH	CR	EC to PH	Rich soil with added loam	IM
175. *A. paucisectus* Alderw.	2	ID	UA	NA to Sumatera	UK	IM
176. *A. pendulus* Bogner & Mayo	18	MY, ID	UA	NA to Borneo	UK	IM
177. *A. perakensis* Engl.	2	MY	UA	NA to Malaya	UK	IM
178. *A. perrieri* Hett. & Wahlert	16	MG, US	UA	NA to MG	Semi-deciduous forest	AT, NT

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179. *A. pilosus* Hett.	6	VN	UA	NA to VN	UK	IM
180. *A. plicatus* Bok & H.J.Lam	3	ID	UA	NA to Sulawesi	UK	IM
181. *A. polyanthus* Hett. & Sizemore	6	TH, US	UA	NA to TH	Deep shade, near base of rocky outcrop	IM, NT
182. *A. prainii* Hook. f.	53	MY, TH, US, ID, BE, IN	UA	NA to LA, MY, TH, Sumatera	Evergreen forest/ Limestone	IM, NT, PA
183. *A. preussii* (Engl.) N.E.Br.	30	CM	VU	EC in CM	Primary shady forests	AT
184. *A. prolificus* Hett. & Galloway	3	TH	UA	EC in Central TH	UK	IM
185. *A. pulchellus* Hett. & Schuit	0	LA	NR	NA to Laos	Limestone	IM
186. *A. purpurascens* Kurz ex Hook.f.	8	MM	UA	NA to MM	UK	IM
187. *A. pusillus* Hett. & Serebryanyi	6	VN	UA	NA to VN	UK	IM
188. *A. putii* Gagnep	17	TH, MM, US	UA	NA to MM, TH	Evergreen forests/ Shaded places	IM, NT
189. *A. pygmaeus* Hett.	13	TH, US	UA	EC in Prachuap Khiri Khan	Limestone	IM, NT
190. *A. ranchanensis* Ipor, A.Simon & Meekiong	4	MY	UA	NA to Borneo	UK	IM
191. *A. ravenii* V.D.Nguyen & Hett.	0	LA	NR	NA to LA	UK	IM
192. *A. rayongii* Hett. & Medecilo	NR	PH	NR	EC in PH	Near the beach	IM
193. *A. reflexus* Hett. & A.Galloway	3	TH	UA	EC in Khampaeng Phet.	Limestone	IM
194. *A. rhizomatosus* Hett.	8	LA, GQ, GA, GN, NG	UA	NA to LA, VN	UK	IM, AT
195. *A. richardsiae* Ittenb.	4	ZM	UA	NA to ZM	UK	AT
196. *A. rostratus* Hett.	1	PH	UA	EC to PH	Secondary forest	IM
197. *A. rugosus* Hett. & A.L. Lamb	0	MY	NR	NA to Borneo	UK	IM
198. *A. sagittarius* Steenis	3	ID	UA	NA to Jawa	UK	IM
199. *A. salmoneus* Hett.	5	PH	UA	EC in PH	Limestone	IM
200. *A. saraburensis* Gagnep	1	TH	UA	EC in Saraburi	Monsoonal savannah	IM
201. *A. saururus* Hett.	5	FR, TH, US	UA	EC in N. E. TH Loei	UK	PA, IM, NT
202. *A. scaber* Serebryanyi & Hett.	6	VN, LA	UA	NA to VN	UK	IM
203. *A. schmidtiae* Hett. & A.Galloway	1	LA	UA	NA to LA	UK	IM
204. *A. scutatus* Hett. & T.C. Chapm.	4	TH	UA	EC in Phetchabun	UK	IM
205. *A. serrulatus* Hett. & A.Galloway	1	TH	UA	EC in Northern Thailand	UK	IM
206. *A. shyamsalilianus* J.V.Gadpay., Somkuwar & A.A.Chaturv.	0	IN	NR	NA in IN	UK	IM
207. *A. sinuatus* Hett. & V.D.Nguyen	2	FR, VN	UA	NA to VN	UK	PA, IM
208. *A. sizemoreae* Hett.	3	TH, US	UA	EC in Nakhon Sawan	UK	IM, NT
209. *A. smithsonianus* Sivadasan	11	IN	UA	NA to IN	UK	IM
210. *A.sparsiflorus* Hook.f.	3	MY	UA	NA to Malaya	UK	IM
211. *A. spectabilis* (Miq.) Engl.	11	ID	UA	NA to Jawa	UK	IM
212. *A. staudtii* (Engl.) N.E.Br.	23	CM, CI	UA	NA to CM, CD	Primary rainforest/ shaded rich soils	AT
213. *A. stuhlmannii* (Engl.) Engl. & Gehrm	46	TZ, CD, KE	UA	NA to KE, TL, CD	UK	AT
214. *A. subcymbiformis* Alderw.	1	ID	UA	NA to Sumatera	UK	IM
215. *A. sumawongii* (Bogner) Bogner & Mayo	25	TH, FR, BE, US	UA	EC in Sa Ksaeo, Wathana Nakhon	Dry dipterocarp forest	IM, PA, NT
216. *A. suwidjianus* Ipor, Tawan & Meekiong	0	ID	NR	NA to Borneo	UK	IM
217. *A. sylvaticus* (Roxb.) Kunth	31	IN, LK	UA	NA to IN, LK	UK	IM

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218. *A. symonianus* Hett. & Sizemore	14	FR, TH	UA	EC in Loei, Udon Thani	Limestone/ medium shade	PA, IM
219. *A. synandrifer* Hett. & V.D.Nguyen	1	VN	CR	NA to VN	UK	IM
220. *A. taurostigma* Ittenb., Hett. & Bogner	43	MG, BE	VU	EC in MG	Shady humus pockets	AT, PA
221. *A. tenuispadix* Hett.	9	TH, FR, US	UA	EC in south western & Peninsular TH	Rocks at the foot of the hill	IM, PA, NT
222. *A. tenuistylis* Hett.	12	TH, US	UA	NA to KH, TH	Open mixed bamboo & deciduous forests/ limestone	IM, NT
223. *A. terrestris* Hett & Claudel	0	TH	NR	NA to TH	UK	IM
224. *A. teuszii* (Engl.) Motte	11	CD, AO, LK	UA	NA to AO, CD	UK	AT, IM
225. *A. thaiensis* (S.Y.Hu) Hett.	18	FR, TH, US	UA	EC in Mae Hong Son	UK	PA, IM, NT
226. *A. tinekeae* Hett. & A.Vogel	5	MY	UA	NA to Borneo	UK	IM
227. *A. titanum* (Becc.) Becc.	223	AU, ID, US, BE, CA, SE	EN	NA to Sumatera	UK	AS, IM, NT, PA
228. *A. tonkinensis* Engl. & Gehrm	22	VN, LA	UA	NA to CN, VN	Dense tropical forests, moist, shaded places	IM
229. *A. tuberculatus* Hett. & V.D.Nguyen	7	BI	UA	NA to VN	UK	AT
230. *A. umbrinus* A.Galloway, Luu, Malkm. Huss., Prehsler & Claudel	2	VN	UA	NA to VN	UK	IM
231. *A. urceolatus* Hett., A.Galloway & Medecilo	NR	PH	NR	EC in PH	Secondary forest/ exposed places	IM
232. *A. variabilis* Blume	174	ID, CN, BE, US	UA	NA to Jawa, Sunda	UK	IM, PA, NT
233. *A. venustus* Hett., A.Hay & Mood	0	MY	NR	NA to Borneo	UK	IM
234. *A. verticillatus* Hett.	10	VN, FR, BE, US	VU	NA to VN	UK	IM, PA, NT
235. *A. villosus* A.Galloway, Luu, Malkm.-Huss., Prehsler & Claudel	0	VN	NR	NA to VN	UK	IM
236. *A. vogelianus* Hett. & Billensteiner	2	FR	UA	EC to TH Chiang Mai	UK	PA
237. *A. xiei* H.Li & Z.L.Dao	4	CN	UA	NA to CN South Central	Forest margins/ tropical thickets	PA
238. *A. yaoi* A. Galloway, Hett., & Medecilo	NR	PH	NR	EC in PH	Hilly shaded areas	IM
239. *A. yuloensis* H.Li	10	CN, FR, TH	UA	NA to CN, IN, MM	Dense primary evergreen valley forests/limestone	PA, IM
240. *A. yunnanensis* Engl.	111	TH, CN, US, VN, BE, LA, MM	UA	NA to CN, LA, TH, VN	Primary evergreen/ Deciduous/ secondary forest/ forest Margin	IM, PA, NT
241. *A. zenkeri* (Engl.) N.E.Br.	28	CM	UA	EC in Guineo-Congolese region: Fernando Po	UK	AT

Occurrences: NR—no record | 0—no specimens encountered | Country names ISO 3166-1 alpha – 2 codes | IUCN status: UA—Unassessed | DD—Data Deficient | LC—Least Concern | NT—Near Threatened | VU—Vulnerable | EN—Endangered | CR—Critically Endangered | NR—No Record) | Status of distribution: EC—Endemic | NA—Native | Ecological habitat: UK—Unknown | Biogeographic region: NE—Neotropic | NT—Nearctic | AT—Afrotropic | PA—Palearctic | AS—Australasia | IM—Indo-Malay. (Olson et al. 2001).

Thailand is the most species-rich country because of its suitable environment for its growth, which has tropical, and subtropical climates (Figure 2) (Sivilla & Santos 2021). Species richness of plants is greater in the herbaceous forest area compared to other forest zones (Mbuni et al. 2019).

Based on the record of the United Nations, over a million species globally are at risk of extinction, and it was a discouraging report (Dapar et al. 2020). As a result of the climate crisis and anthropogenic activities, there is a consistently declining plant biodiversity (Onyancha et al. 2020; Pasta et al. 2020; Calaramo et al. 2022). IUCN Red List Criteria could assess the extinction risk (Yudaputra et al. 2022). It could figure out the

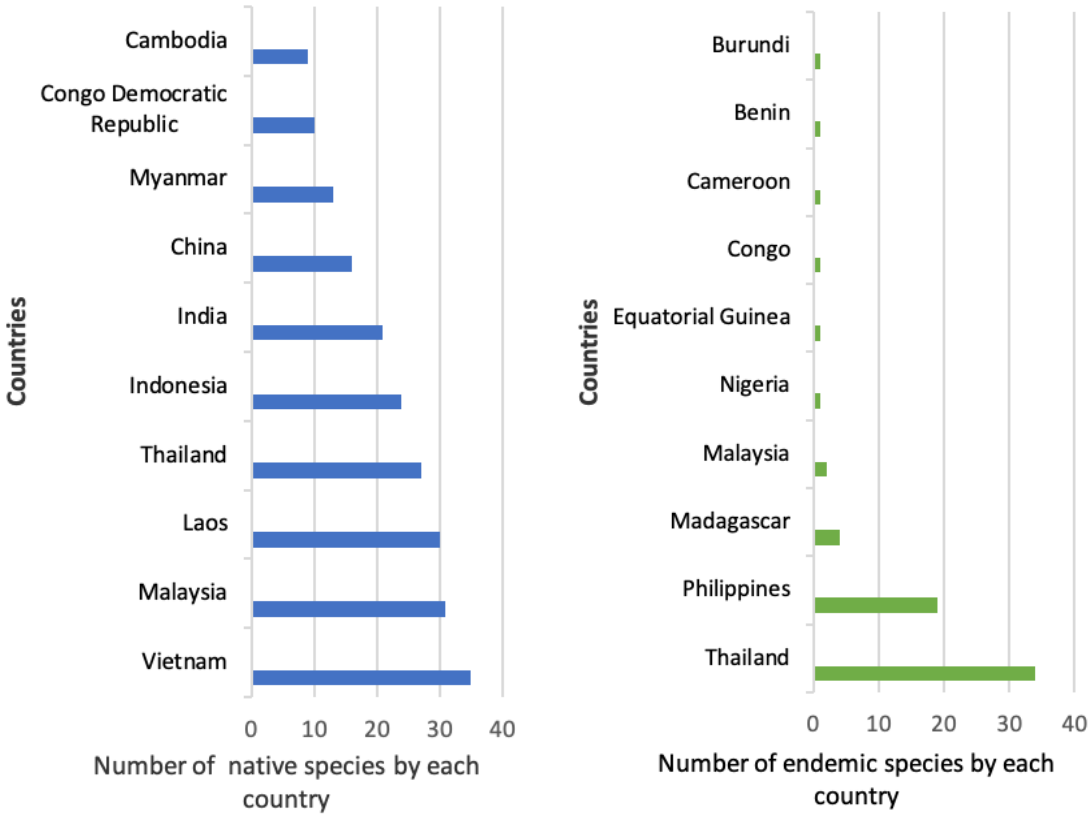

Figure 6. Number of native and endemic species of *Amorphophallus* by country.

danger rate for particular species globally (Brummitt et al. 2015). According to digital databases, 76.35% of *Amorphophallus* species were not evaluated for conservation status, and 13.70% have no record (Figure 4). Around 4.15% of *Amorphophallus* species globally were 'Critically Endangered', 2.90% 'Vulnerable', 0.83% Endangered, 0.83% 'Near Threatened', 0.83% 'Least Concern', and 0.83% 'Data Deficient'. IUCN admitted that the report's scope for assessing threatened plants might be inadequate (Brummitt et al. 2015).

Vietnam had the highest number of native *Amorphophallus* species, while Thailand had the highest number of endemic species, based on digital databases (Figure 6). The natural habitat of Vietnam sustained the diverse vegetation and higher biodiversity (Hung & Potokin 2019), which resulted in more native species surviving in the country. However, endemism is applied to species with a small population size with a very limited ecological distribution (Yudaputra et al. 2022). With the distinct habitat for diversity and bioresources of the species manifested by Thailand (Sungkajanttranon et al. 2018) higher number of endemic *Amorphophallus* species were able to survive and grow in the country. Endemic species in a particular area can adapt more readily and thrive in diverse environmental conditions (Wulandari et al. 2022).

Some *Amorphophallus* species are adapted in a partly shaded area, secondary forest, and grassland (Mc Pherson & Hetterscheid 2011). A few species grow in limestone or karst forest ecosystem (Figure 8) based on digital databases, with 9.76% because some of the *Amorphophallus* species have a shallow root that is susceptible to drought (Misra et al. 2010). *Amorphophallus* needs soil that allows water to drain moderately. For the plant to grow better, appropriate soil nutrients, and proper draining of water in the soil are required (Yuzammi et al. 2018). Also, limestone contains fragments of elements that can enhance soil quality. Because of this, most of the time, *Amorphophallus* species are found in limestone and granite soil (Nguyen et al. 2016).

According to digital databases, *Amorphophallus* species are mostly distributed in the Indo-Malay biogeography region (Figure 9) with 56.65% because 70% of various species of *Amorphophallus* can be found in southeastern Asia (Claudel et al. 2019), which is under Indo-Malay biogeography. The center of distribution of *Amorphophallus* is Thailand because, based on the

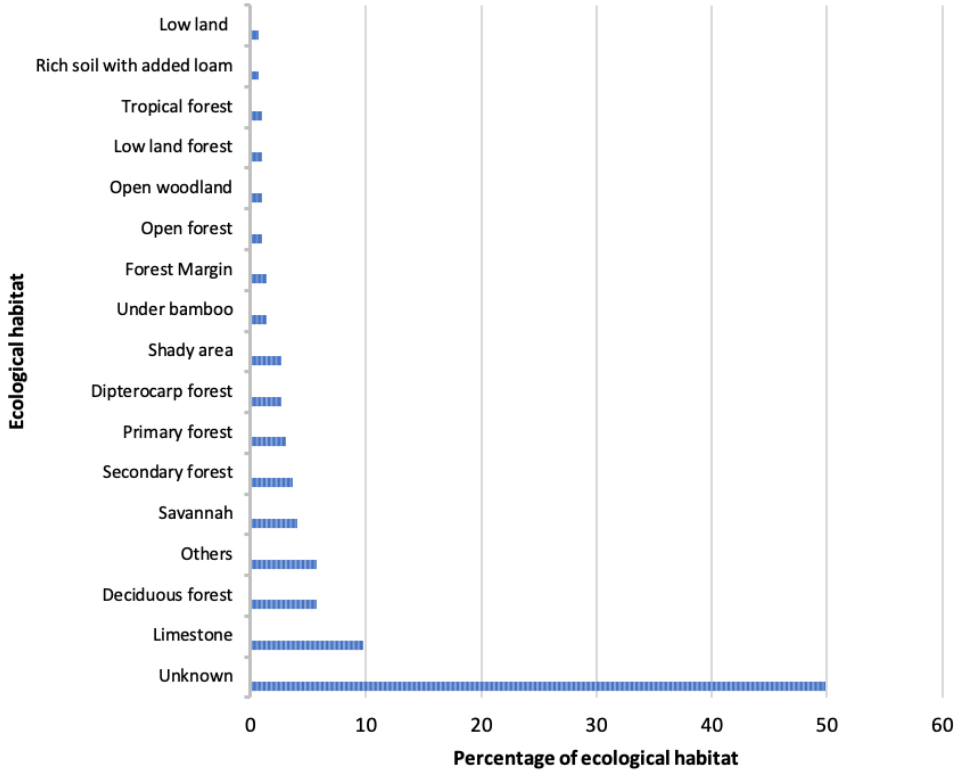

Figure 7. Percentage of each ecological habitat of *Amorphophallus* species.

record of digital databases, Thailand is the most species-rich country due to its ecological status suited for the diversity and bioresources of *Amorphophallus* species.

CONCLUSIONS AND RECOMMENDATIONS

The world checklist of *Amorphophallus* species revealed the current number of accepted species worldwide, their distribution status, ecological habitats, and conservation status. Out of 241 species as of this writing, *A. paeoniifolius* has the most significant number of occurrences, and Thailand is the most species-rich country of *Amorphophallus*. Many *Amorphophallus* species have not been evaluated, which can hinder the accurate assessment of the conservation status of some species. This data needs to be revisited, and more species should be included in the list for further protection. The majority of *Amorphophallus* species were adapted to limestone habitats. Therefore, the limestone ecosystem is one of the areas that people should protect from excessive degradation direct or indirect anthropogenic activities. Moreover, the primary goal of the checklist is to provide a record of all the *Amorphophallus* species worldwide. Ecologists, biogeographers, and taxonomists

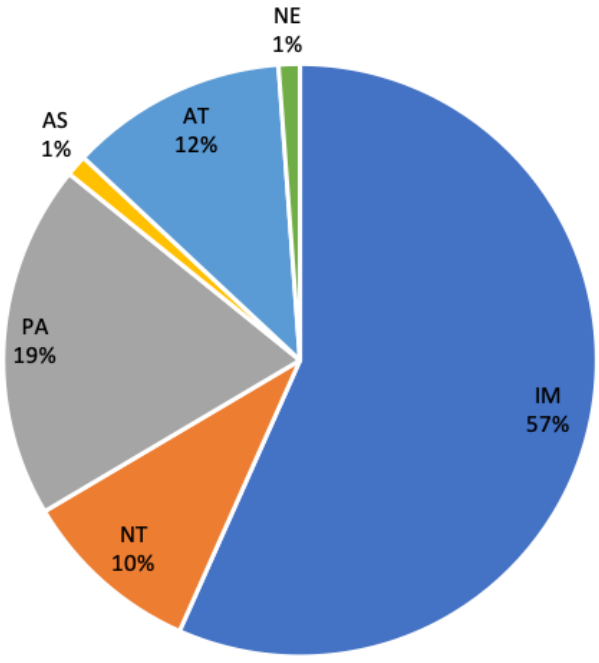

Figure 8. Percentage of *Amorphophallus* species by each geographic region: IM—Indo-Malay| NT— Nearctic | PA—Palaearctic | AS—Australasia | AT—Afrotropic | NE—Neotropic.

must review the digital databases of *Amorphophallus* species and update them to enhance their utility in gaining knowledge about species biodiversity, thereby filling the information gap and making biodiversity details more comprehensive and up-to-date.

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