

New taxonomical considerations and nomenclatural changes in the *Cryptocoryne cordata* complex (Araceae)

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ABSTRACT

A revised taxonomy for the Malesian *Cryptocoryne cordata* complex with a resurrection to species level of the diploid *C. cordata* ($2n = 34$), the tetraploid *C. grabowskii* ($2n = 68$), and the hexaploid *C. siamensis* ($2n = 102$), and the consequent nomenclatural changes, are here presented. Some members of the *C. cordata* complex have previously been shown to be involved as parents in naturally occurring hybrids, hence some nomenclatural changes are also made concerning the parents involved in the hybrids.

Keywords: *Cryptocoryne cordata* complex, natural hybrids, taxonomy, nomenclature, chromosome numbers.

INTRODUCTION

Our knowledge of the taxonomy and evolution of the genus *Cryptocoryne* in the Malesian region has increased tremendously since the beginning of the millennium. This is in large part owing to intensified field work, through which opportunities arise to also study accessions in cultivation under comparable growth conditions, enabling possibilities for cytological and molecular studies (e.g., Asih et al., 2022; Bastmeijer et al., 2013; Jacobsen et al., 2016; Wongso et al., 2017, 2020).

Understanding the *Cryptocoryne cordata* Griff. complex and its associated hybrids has been a problematic topic over the years. The distribution area ranges from Peninsular Thailand and Cambodia, Peninsular Malaysia, Sumatera, Natuna Island, and Borneo. *Cryptocoryne cordata s.l.* has in recent years been considered to consist of one species with five varieties: var. *cordata* and var. *wellyi* Wongso with a chromosome number of $2n = 34$; var. *grabowskii* (Engl.) N.Jacobsen with $2n = 68$; and var. *siamensis* (Gagnep.) N.Jacobsen & Sookch. and var. *diderici* (de Wit) N.Jacobsen with $2n = 102$ (Jacobsen, 2002; Bastmeijer 2023; Jacobsen & al. 2012; Wongso & al., 2019).

The leaf morphology of the taxa in the *Cryptocoryne cordata* complex is variable, with a smooth to bullate blade, and colours from green to green brownish with markings to purplish or purple, lower surface paler with reddish to dark red veins. The shape varies from narrowly ovate to cordate, 5–15 by 2–12 cm depending on ecological factors, like e.g., sun or shade or slow or quickly running water. The spathe has a relatively long tube (e.g., 12–35 cm long), the kettle inside white to more or less red spotted in the upper part or suffused more or less reddish over larger parts. The distinguishing characters for the group are in the spathe limb which is more or less flat, 2–5 cm long, more or less backwards bent, ovate with a shorter or longer point, and surface more or less smooth, yellow to red-brownish shaded, if shaded then more intensively so towards the margins and the apex; the throat rather narrow to broad, with a distinct demarcation to the outer part, sometimes with a demarcation that resembles a collar, yellow (rarely reddish spotted).

The cytological complexity combined with difficulties in distinguishing the morphological variations led us to merge the five taxa within one species. We accepted different chromosome numbers within the same species as varieties. *Cryptocoryne diderici* de Wit, *C. grabowskii* Engl. and *C. siamensis* Gagnep. were proposed as varieties of *C. cordata* (Jacobsen, 2002). Numerous new collections of these taxa have been made since 2002, e.g., twice as many new collections of the Bornean *C. grabowskii* and the Thai *C. siamensis* than known before (Bastmeijer et al., 2010; Jacobsen et al., 2012).

Cytological implications and distribution patterns

Knowledge obtained during the last twenty years has proved that the different chromosome levels of diploids with $2n = 34$, tetraploids with $2n = 68$ and hexaploids with $2n = 102$, are correlated with geographical distribution and morphological variation.

It has become clear that the tetraploid Bornean *C. grabowskii* with $2n = 68$ is fertile and sexually

reproducing, with populations reproductively and geographically isolated from the diploid taxa *C. cordata* var. *cordata* with $2n = 34$ occurring from southernmost Thailand, Peninsular Malaysia, and the Sumateran var. *wellyi*, and from the hexaploid taxa with $2n = 102$, i.e., *C. siamensis* var. *siamensis* occurring in southern Thailand and southwestern Cambodia, and Sumateran var. *diderici*. We therefore are of the opinion that it would be more appropriate to resurrect the three to the species level.

When dealing with the genus *Cryptocoryne*, it is now known that species frequently hybridize in nature; due to vigorous vegetative propagation by subterranean stolons, successful hybrids can form large stands, and easily be distinguished once one is aware of the situation (Jacobsen et al., 2016). A change in the taxonomic perception of the *C. cordata* complex also influences naming of parents involved in hybrids, and in some cases the hybrid rank.

REVISED CLASSIFICATION OF THE *CRYPTOCORYNE CORDATA* COMPLEX AND ITS HYBRIDS

Key to taxa in the *Cryptocoryne cordata* complex (excluding hybrids)

- 1a.** Spathe limb all yellow (to greenish) 2
- 1b.** Spathe limb more or less brownish tinged in the apical part 5
- 2a.** Kettle mostly (except Natuna Islands) with a purple zone in the upper part (Borneo); appendix purple spotted to purple *C. grabowskii*
- 2b.** Kettle without a purple zone in the upper part, sometimes purplish in the lower part; appendix white 3
- 3a.** Leaves mostly ovate to narrowly ovate, dark green to purplish on upper surface, purple on lower surface (W Cambodia populations can have leaves of up to 80 cm in length and the spathe limb seems to be irregularly rough on the surface (E Thailand, W Cambodia)
..... *C. siamensis* var. *siamensis*
- 3b.** Leaves \pm cordate (to ovate in more quickly running streams), green to brownish marmorated on upper surface, green to purplish on lower surface 4
- 4a.** Leaves evenly green (to brownish) on upper surface, lower surface lighter green; spathe short, 10–15 cm long, spathe limb greenish at opening (Sumatera) *C. cordata* var. *wellyi*

4b. Leaves green but mostly with brownish markings on upper surface, lower surface lighter green to light purple; spathe 20–40 cm long (Malay Peninsula) *C. cordata* var. *cordata*

5a. Kettle mostly with a purple zone in the upper part (Borneo, including Natuna material) *C. grabowskii*

5b. Kettle without a purple zone in the upper part, sometimes purplish in the lower part **6**

6a. Leaves mostly ovate to narrowly ovate, dark green to purplish on upper surface, purple on lower surface; spathe limb surface not rough; spadix appendix whitish (S Thailand)

..... *C. siamensis* var. *siamensis*

6b. Leaves ± cordate (to ovate in more quickly running streams), green or with brownish markings on upper surface, green to purplish on lower surface; spadix appendix red spotted (Sumatera)..... *C. siamensis* var. *diderici*

Species and varieties

1. *Cryptocoryne cordata* Griff.

Cryptocoryne cordata Griff. var. *cordata*, Notulae ad Plantas Asiaticas 3: 138 (1851) & Icones Plantarum Asiaticarum 3: plate 172 (1851). — Type: PENINSULAR MALAYSIA. Griffith 6012 (lectotype, K; isolectotype, P, designated by Rataj, 1975). [$2n = 34$]. **Figure 1.**

Cryptocoryne kerrii Gagnep., Notulae Systematicae 9: 132 (1941). — *C. siamensis* Gagnep. var. *kerrii* (Gagnep.) Rataj, Revision of the Genus *Cryptocoryne* Fischer, Studie ČSAV, č. 3: 93 (1975). — Type: THAILAND. Song Kla: Saba Toi, 25 March 1928, Kerr 14783 (lectotype, K; isotype K, designated by Rataj, 1975).

Cryptocoryne stonei Rataj, Revision of the Genus *Cryptocoryne* Fischer, Studie ČSAV, č. 3: 95 (1975). — Type: PENINSULAR MALAYSIA. Negeri Sembilan: Pasoh F.R., 25 April 1972, YAP Sk. 156 (holotype KLU, isotype L).

Cryptocoryne cordata Griff. var. *wellyi* Wongso, Taiwania 64(3): 331 (2019). — Type: INDONESIA. Sumatera: Riau Province, Indragiri Hulu Regency, SW of Rengat, 1 Sept. 2015, S. Wongso, SW1528 [B 1633] (holotype, BO; isotypes, C, L). [$2n = 34$]. **Figure 2.**



Figure 1: *Cryptocoryne cordata* Griff. var. *cordata*. (A) Peninsular Malaysia, Pahang, Rd. 63 from Rompin to Muadzam Shah, natural stand in secondary forest, *NJM 11-50*. (B) Thailand, Narathiwat Province, Princess Sindrihorn Swamp Forest Research Centre, spathe limbs, *NJT 02-26*. (C) Peninsular Malaysia, Johore, Kluang towards Mersing, cut open kettle, *NJM 01-07*. — Photos N. Jacobsen



Figure 2: *Cryptocoryne cordata* Griff. var. *wellyi* Wongso. (A) Indonesia, Sumatera, Riau Province, SW of Rengat; habitat at type locality with submerged stand in the stream and emergent on the bank, SW1528. (B) Just opened spathe limb with a greenish colour showing the narrow collar zone and the rough surface. (C) Older spathe limb with colour change to yellow. (D) Cut open kettle with flap closing the exit. — Photos S. Wongso

2. *Cryptocoryne grabowskii* Engl.

Cryptocoryne grabowskii Engl., Botanische Jahrbücher für Systematik 25: 28 (1898). — *Cryptocoryne cordata* Griff. var. *grabowskii* (Engl.) N.Jacobsen, Aqua-Planta 27(4): 151 (2002). — Type: INDONESIA. S Kalimantan: distr. Dussen Timor, Siong River, Nov 1881, *Grabowski s.n.* (lectotype, B, designated by Jacobsen, 1985). [2n = 68]. **Figure 3.**

Cryptocoryne grandis Ridl., Journal of the Straits Branch of the Royal Asiatic Society 44: 17 (1905). — *Cryptocoryne cordata* Griff. ssp. *grandis* (Ridl.) Sadilek, Die Aquarien- und Terrarienzeitschrift 32: 57 (1979). — Type: MALAYSIA. Sarawak: Jungle path to Matang, 23 Sept. 1892, *Haviland 2319* (lectotype, SING, designated by Jacobsen, 1985).

[*Cryptocoryne zonata* de Wit, Meded. Bot. Tuinen Belmonte Arbor. Wageningen 13: 280 (1970). — *C. cordata* Griff. var. *zonata* (de Wit) N.Jacobsen, Aqua-Planta 27(4): 151 (2002); nomina invalida (“type” not a single gathering; see Turland et al., 2018: Art. 8.2)].

C. striolata Engl. var. *cordifolia* Ridl., Journal of the Straits Branch of the Royal Asiatic Society 49: 47 (1908). — Type: MALAYSIA. Sarawak: Siul Hill, Sept. 1909, *Ridley s.n.* (lectotype SING, designated by Jacobsen, 1985).

[*C. “lastii”* Bouwmeester, Het Aquarium 34: 32 (1963), nom. inval. (no Latin, no type); Oosterbaan, Het Aquarium 35: 26 (1964), nom. inval. (no Latin, no type); Bouwmeester & Hoogendoorn, Het Aquarium 37: 52 (1966), nom. inval. (no Latin, no type)].

Note on the validity of the name *Cryptocoryne zonata* de Wit

The “type” specimen (*A.J. Key, s.n.* WAG; now L) cited in the protologue is evidently an amalgam of two gatherings from different localities made on different dates, according to the label. [https://medialib.naturalis.nl/file/id/WAG0000233_MLN/format/large]

The two gatherings are not able to be distinguished from each other on the sheet, and so cannot be individually linked to one or other date and locality with certainty, and so are not open to being interpreted as two individual specimens mounted on the same sheet from which one could be selected as a lectotype. Therefore, the specimen is not acceptable as a type under Art. 8.2 of the Shenzhen Code (Turland et al., 2018) wherein a type must be a single gathering, with the consequence that *Cryptocoryne zonata* de Wit was not validly published. Were *Cryptocoryne zonata sensu* de Wit to be recognised again as distinct, the name would need to be validated as a new species with an appropriate new type.

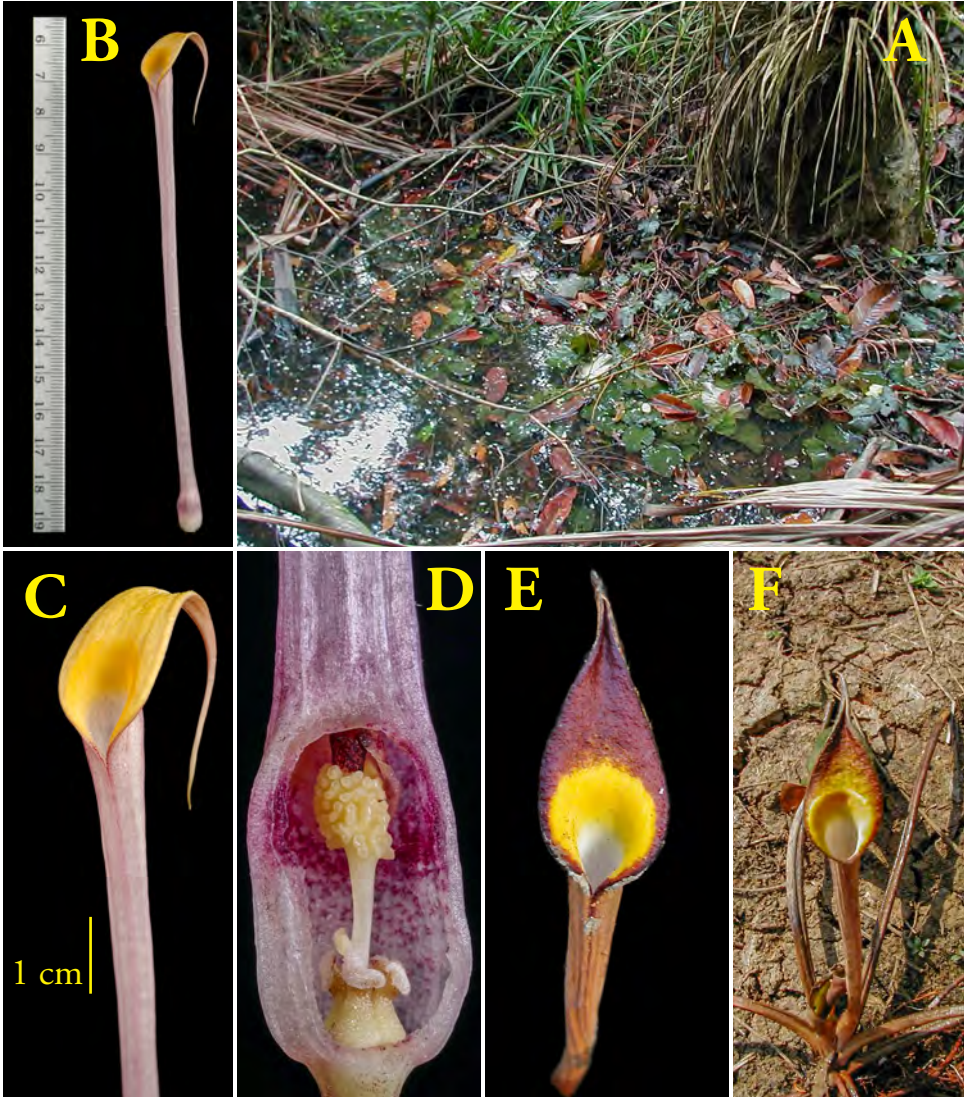


Figure 3: *Cryptocoryne grabowskii* Engl. (A) Indonesia, C Kalimantan, Dusun Timur, secondary forest, SW0308. (B — D) Indonesia, E Kalimantan, SE of Melak, forest stream, SW14035. (B) Spathe. (C) Spathe limb. (D) Cut open kettle with a purple zone in the upper part and a purple spadix appendix. (E) Indonesia, S Kalimantan, Landasan Ulin, S of Syamsudin Noor Airport, spathe limb, SW0305. (F) Indonesia, S Kalimantan, S of Bati-Bati, secondary forest remains, spathe limb, SW0303. — Photos S. Wongso

3. *Cryptocoryne siamensis* Gagnep.

Cryptocoryne siamensis* Gagnep. var. *siamensis, Notulae Systematicae 9(3): 132 (1941). — [*Cryptocoryne cordata* Griff. var. *siamensis* (Gagnep.) N.Jacobsen & Sookch., Thai Forest Bulletin 38: 180 (2010), nom. illeg.: *Cryptocoryne evae* Rataj var. *recordata* Rataj & var. *evae* in synonym.]. — Type: THAILAND. Ban-Wan, Takua Pa, 12 February 1929, *Kerr 17094* (lectotype, K; isolectotypes, BK, K, L, designated by Rataj, 1975; drawing, P). [$2n = 102$].

Figure 4.

Cryptocoryne blassii de Wit, Die Aquarien- und Terrarienzeitschrift 13: 115 (1960). — Type: Nov. 1959; in spirit, sub. num. *de Wit XXII*. (holotype, WAG now in L).

Cryptocoryne evae Rataj var. *evae*, Folia Geobotanica et Phytotaxonomica 9: 314 (1974). — Type: CZECH REPUBLIC. Cult. in Bot. Inst. Sumperk, 17 August 1973, *K. Rataj* (holotype, PR 319736).

Cryptocoryne evae Rataj var. *recordata* Rataj, Folia Geobotanica et Phytotaxonomica 9: 314 (1974). — Type: CZECH REPUBLIC. Cult. in Bot. Inst. Sumperk. 15 September 1973, *K. Rataj* (holotype, PR 319736).

Cryptocoryne siamensis Gagnep. var. *ewansii* Rataj, Revision of the Genus *Cryptocoryne* Fischer, Studie ČSAV, č. 3: 93 (1975). — Type: CZECH REPUBLIC. Cult. in Bot. Inst. Sumperk, 15 August 1974, *K. Rataj* (holotype, PR 335238).

***Cryptocoryne siamensis* Gagnep. var. *siamensis* ‘Rosanervig’**, Bogner & Jacobsen, Aqua-Planta 10(1): 12 (1985). — *Cryptocoryne cordata*. var. *siamensis* (Gagnep.) N.Jacobsen & Sookch. ‘Rosanervig’, Flora of Thailand Araceae, 11(2): 125 (2012). — Nomenclatural standard: GERMANY. Cult. Bot. Garten München, *Bogner 1671* (M). [$2n = 102$].

[*Cryptocoryne* “rosanervis” Möhlmann, Aqua-Planta 4: 3 (1979); *Cryptocoryne* spec. “rosanervis” Möhlmann, ZAG Wasserpflanzen 1/79: 8 (1979), cultivar name not established (Latin)].

[*C. siamensis* Gagnep. var. *schneideri* Schöpfel, ZAG Wasserpflanzen 1/79: 8 (1979), nom. inval.: no type].

***Cryptocoryne siamensis* Gagnep. var. *diderici* (de Wit) Ørgaard, comb. nov.** — Basionym: *Cryptocoryne diderici* de Wit, Meded. Bot. Tuinen Belmonte Arbor. Wageningen 13: 279 (1970). — *Cryptocoryne cordata* Griff. var. *diderici* (de Wit) N.Jacobsen, Aqua Planta

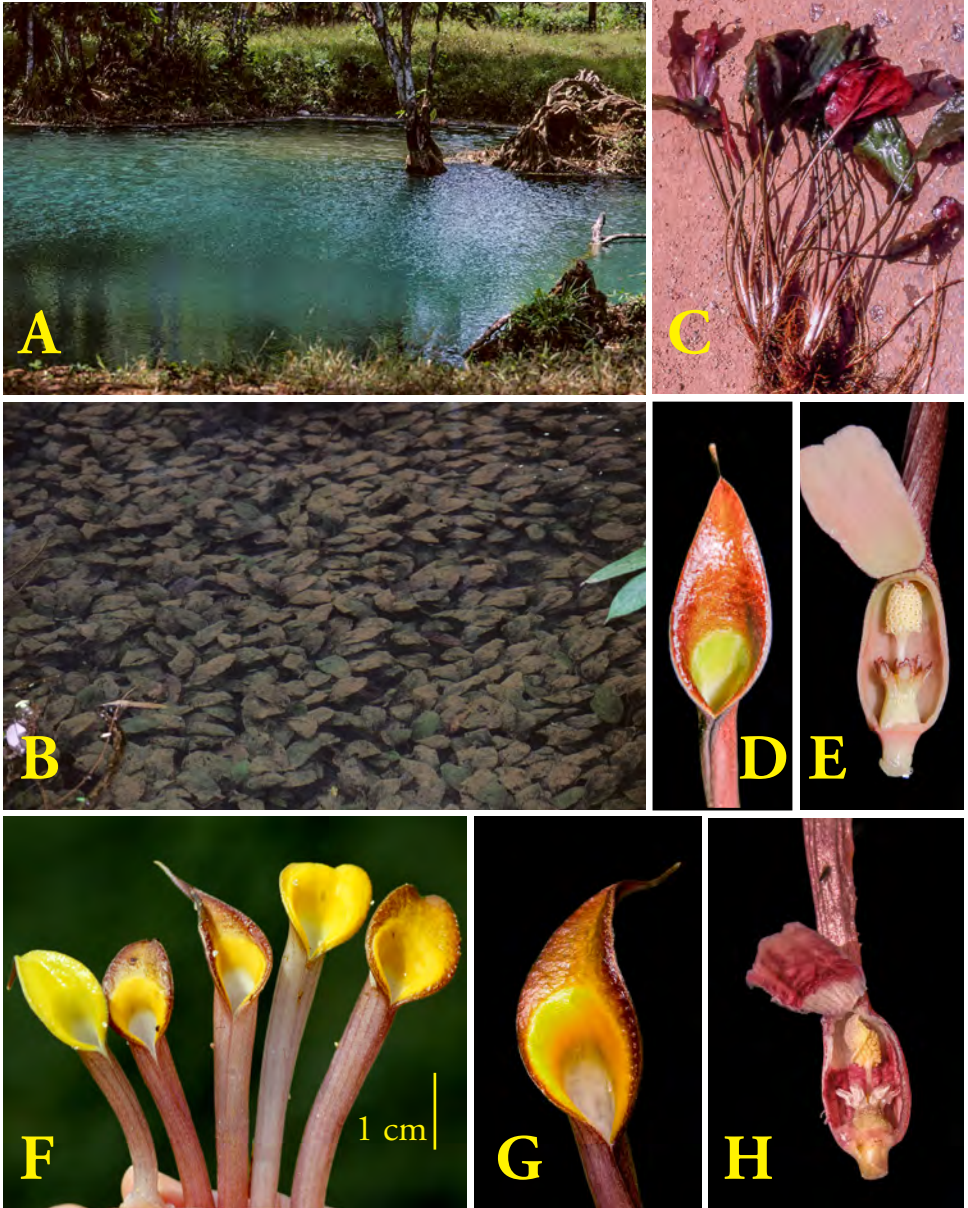


Figure 4: *Cryptocoryne siamensis* Gagnep. var. *siamensis*. (A — E) Peninsular Thailand, limestone spring by Sra Kaew Cave, *NJT 02-15*. (B) Submerged stand. (C) Whole plants. (D) Newly opened spathe limb. (E) Cut open kettle. (F — H) Peninsular Thailand, road to Ton Prai Waterfall, different colour spathe limbs, *NJT 03-01*. (G) Newly opened spathe limb. (H) Cut open kettle with purple colouring in the lower half. — Photos N. Jacobsen

27(4): 151 (2002). — *Cryptocoryne cordata* Griff. var. *diderici* (de Wit) N.Jacobsen, Aqua Planta 27(4): 151 (2002). — Type: NETHERLANDS. Cult. Wageningen, ex Indonesia, Sumatera: “e Malacca boreali”. J. Liet (Amsterdam) misit, October 1960 (holotype WAG, now in L). [$2n = 102$]. **Figure 5.**

The type specimen, imported by J. Liet, Amsterdam, is stated to originate from NW Malaysia. During our investigations in Peninsular Malaysia (Othman & al. 2009), we have not found any plants matching the type description and photographs (de Wit, 1990) nor unpublished photographs from Wageningen. However, we have in several Sumateran accessions seen plants which match the description of *Cryptocoryne diderici*. One such collection is H. Kishi 09-01 [B 1296], Jambi Prov., near Tanjung on the way from Kotabaru to Muaratebo, 21 June 2009 having a chromosome number of $2n = 102$ (Wongso & al., 2019). Around the 1960's there were other documented imports of *Cryptocoryne* from Sumatera (via Singapore) like *C. bangkaensis* Bastm. from 1959 (Bastmeijer & Jacobsen, 2007). We therefore conclude that var. *diderici* is a hexaploid from Sumatera.

Hybrids

Cryptocoryne × *purpurea* Ridl., Journal of the Straits Branch of the Royal Asiatic Society 41: 44 (1904). — Type: PENINSULAR MALAYSIA. JOHOR: Kota Tinggi (lectotype, SING; isolectotype, BM, designated here). [*Cryptocoryne cordata* Griff. var. *cordata* × *C. griffithii* Schott; $2n = 34$]. **Figure 6.**

[*Cryptocoryne griffithii* auct. non. Schott: e.g., Hook.f., Curtis's Botanical Magazine 126, plate 7719 (1900)].

[*Cryptocoryne aquatica* Hoedeman, Het Aquarium 19: 62 (1948). *nom. inval.* (no Latin, no type)].

[*Cryptocoryne purpurea* Ridl. f. *concolor* de Wit, Aquarienpflanzen, p. 182 (1971), *nom. inval.* (no Latin, no type)].

Cryptocoryne hejnyi Rataj, Folia Geobotanica et Phytotaxonomica 9: 313 (1974). — Type: CZECH REPUBLIC. Cult. Bot. Inst. Sumperk, 21 August 1973, K. Rataj (holotype, PR 319737).

[*Cryptocoryne purpurea* Ridl. f. *nana* de Wit, Aquariumplanten, p. 225 (1983), *nom. inval.* (no Latin, no type)].



Figure 5: *Cryptocoryne siamensis* Gagnep. var. *diderici* (de Wit) Ørgaard. (A — C) Indonesia, Sumatera, southeast of Muara Bungo, ditch in oil palm plantation, SW1609. (B) Spathe limb. (C) Cut open kettle. (D — E) Indonesia, Sumatera, north of Muara Bungo, secondary forest, SW1608. (D) Spathe limb. (E) Cut open kettle with a purple spadix appendix. — Photos S. Wongso

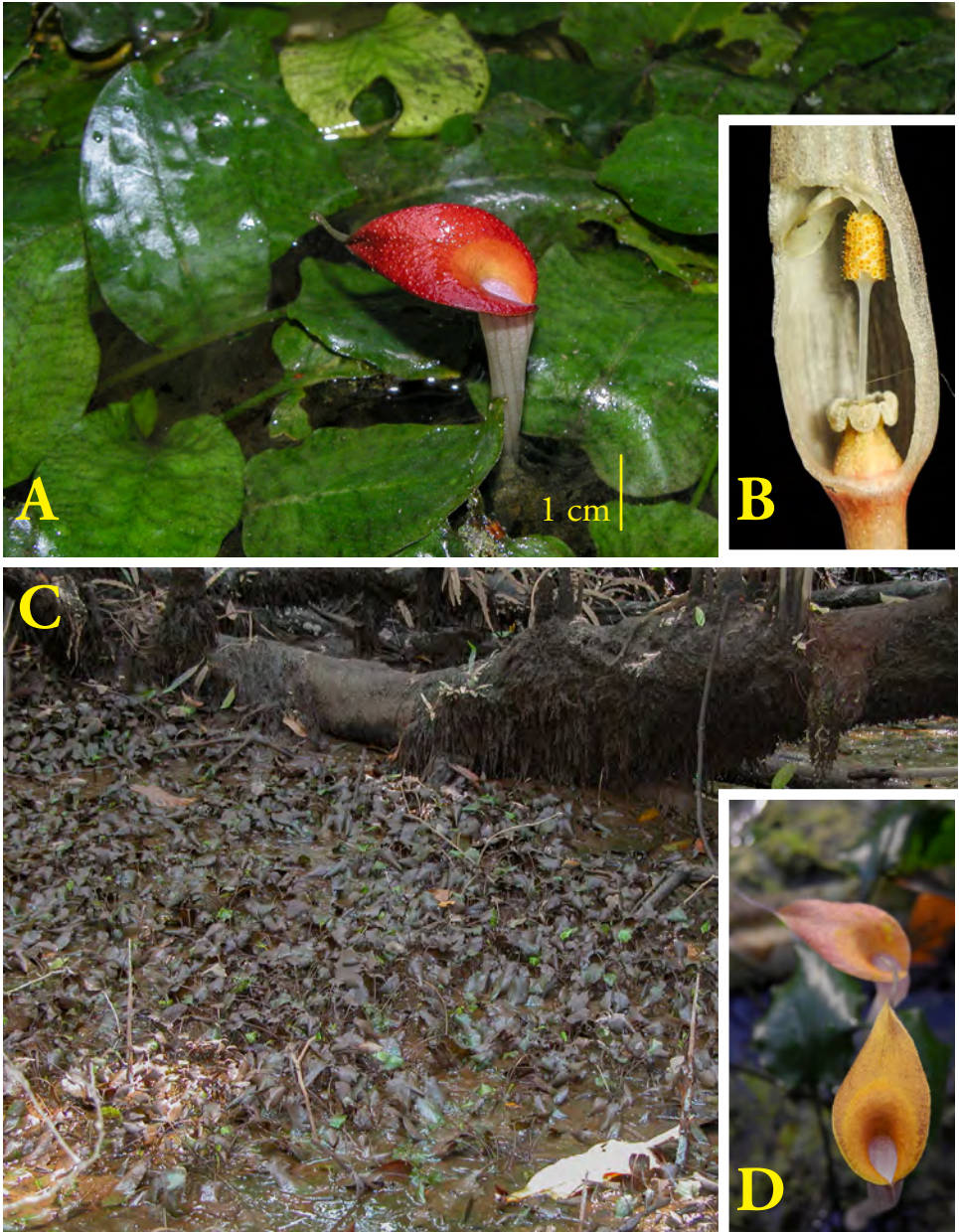


Figure 6: *Cryptocoryne x purpurea* Ridl. (A — B) Cultivated, submerged stand, HBH 1671/2 (P 1912/92), probably representing the type from Kota Tinggi, Ridley 4214. (B) Cut open kettle with flap closing the exit. (C — D) Malaysia, Johor, Sg. Sedeli Kechil, stand in inner tidal zone, NJM 11-28. (D) Spathe limb. — Photos N. Jacobsen

***Cryptocoryne* × *borneoensis* (N.Jacobsen, Bastm. & Yuji Sasaki) Wongso, stat. et comb. nov.** — Basionym: *Cryptocoryne* × *purpurea* Ridl. nothovar. *borneoensis* N.Jacobsen, Bastm. & Yuji Sasaki., Aqua-Planta 27(4): 152 (2002). — Type: DENMARK. Cult. Copenhagen, ex Indonesia, Kalimantan, collected there 23 May 1999, cultivated specimen collected April 2002, *Sasaki no. sp. 2* (holotype L). [*C. grabowskii* Engl. × *C. griffithii* Schott; $2n = 51$]. **Figure 7.**

***Cryptocoryne* × *decus-silvae* de Wit** [emend. N. Jacobsen et al., 2020], Het Aquarium 46(7): 177(1976). — Type: NETHERLANDS. Cult. Wageningen ('legit in calidario vadensi'), [ex Malaysia, Johor, originally collected by Schultz 6 April 1971], 28 August 1971, *de Wit 12.12.698* (holotype WAG, now in L). [*C. cordata* Griff. var. *cordata* × *C. nurii* Furtado var. *nurii*; $2n = 34$]. **Figure 8.**

C. jacobsenii de Wit, Het Aquarium 46(7): 177. — Type: DENMARK. Cult. Copenhagen Bot. Gard. ex Peninsular Malaysia, 24 December 1974, *N. Jacobsen 2864* (holotype WAG, now in L, isotype C).

***Cryptocoryne* × *batangkayanensis* Ipor, Ørgaard & N.Jacobsen**, Willdenowia 45(2): 185 (2015). — Type: MALAYSIA. SARAWAK: Batang Kayan basin, near Kampong Stungkor Baru. 29 Nov 2004, *I.B. Ipor & N. Jacobsen NJS 04-07* (holotype SAR, isotypes B, C, L). [*C. grabowskii* Engl. × *C. ferruginea* Engl. var. *ferruginea*; $2n = 85$]. **Figure 9.**

***Cryptocoryne* × *zukalii* Rataj**, Folia Geobotanica et Phytotaxonomica (Praha) 9: 313 (1974). — Type: CZECH REPUBLIC. Cult. in Bot. Inst. Sumperk ex Peninsular Malaysia (exact locality unknown), 15 July 1973, *K. Rataj* (holotype, PR 319738). [*Cryptocoryne cordata* Griff. var. *cordata* × *C. minima* Ridl.; $2n = 34$]. **Figure 10.**

***Cryptocoryne* × *sumateraensis* (W.Reichert) N.Jacobsen, stat et comb. nov.** — Basionym: *Cryptocoryne* × *zukalii* Rataj nothovar. *sumateraensis* W.Reichert, Taiwania 64(3): 334 (2019). — Type: DENMARK. Cult. Copenhagen, ex Indonesia, Sumatera: exact locality unknown. *K. Nakamoto, Sumatera sp. 2, via W. Reichert, B 1617*, 22 Dec. 2014 (holotype BO, isotype C). [*Cryptocoryne siamensis* Gagnep. var. *diderici* de Wit × *C. minima* Ridl.; $2n = 68$]. **Figure 11.**

***Cryptocoryne* × *ikezewaldiae* Bastm.**, Aqua Planta 45(2): 47 (2020). — Type: INDONESIA. W. KALIMANTAN; Kapuas Hulu Regency, S of Putussibau, Nanga Kalis, 8 May 2018, *Wongso SW1841* (holotype BO; isotypes C, L). [*Cryptocoryne grabowskii* Engl. × *C. pallidinervia* Engl.; $2n = 51$]. **Figure 12.**



Figure 7: *Cryptocoryne xborneoensis* (N.Jacobsen, Bastm. & Yuji Sasaki) Wongso. (A — B) Indonesia, C Kalimantan, Sampit, Sg. Lawak, cultivated specimen, *B* 961. (B) Spathe limb. (C) C Kalimantan, Pelantaran Hulu, *B* 994, spathe limb. (D) C Kalimantan, Pangkalanbun, *B* 993, cut open kettle showing a purple zone in the upper part. — Photos N. Jacobsen

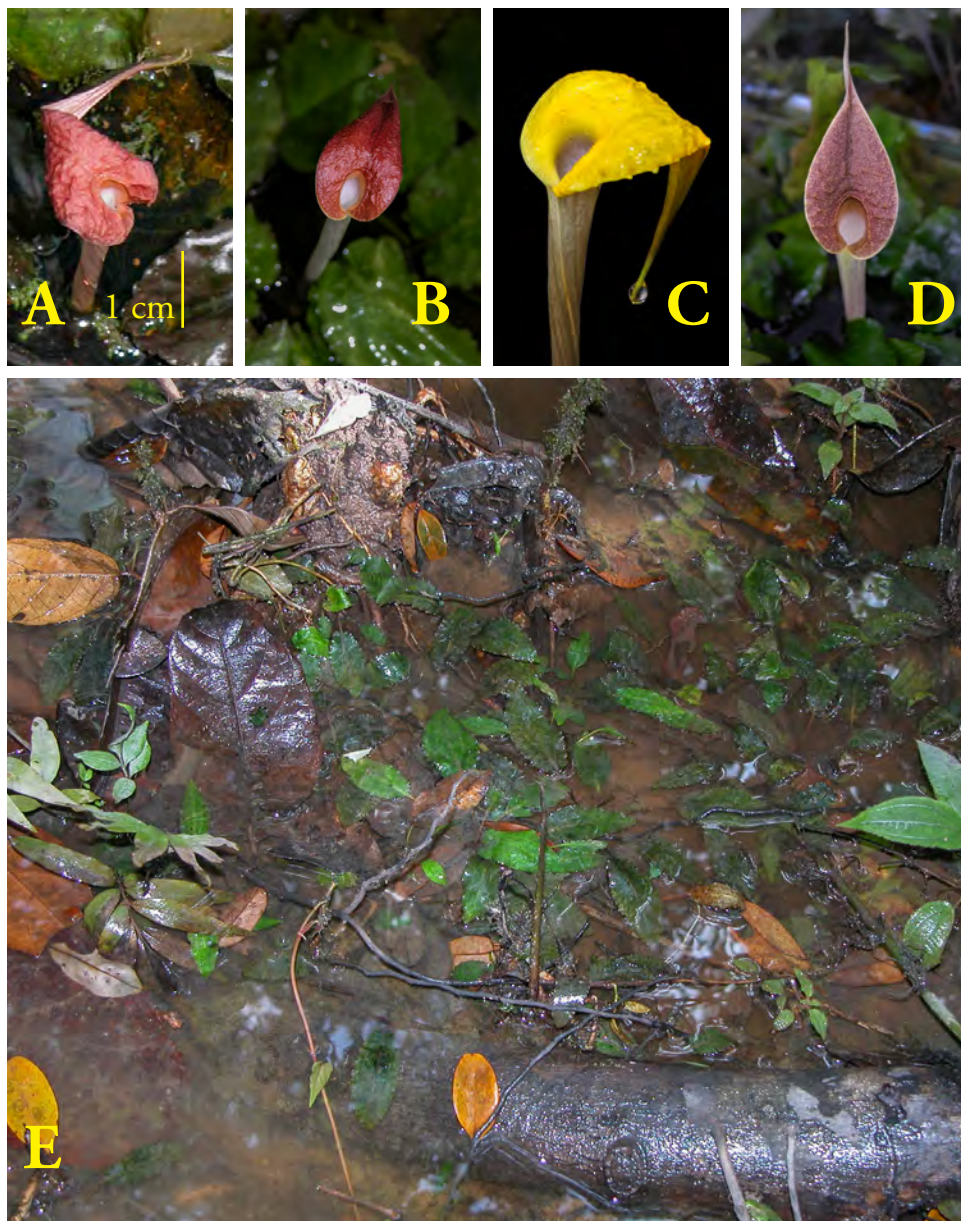


Figure 8: *Cryptocoryne x decus-silvae* de Wit, Peninsular Malaysia. (A — D) Spathe limbs from (A) Johor, N of Kota Tinggi, B 1142. (B) Johor, E of Kulai, NJM 01-04. (C) Pahang, S of Tasik Chini, B 1400. (D — E) Spathe limb and stand in secondary forest, Johor, Pantı Bird Sanctuary, NJM 11-32. — Photos N. Jacobsen

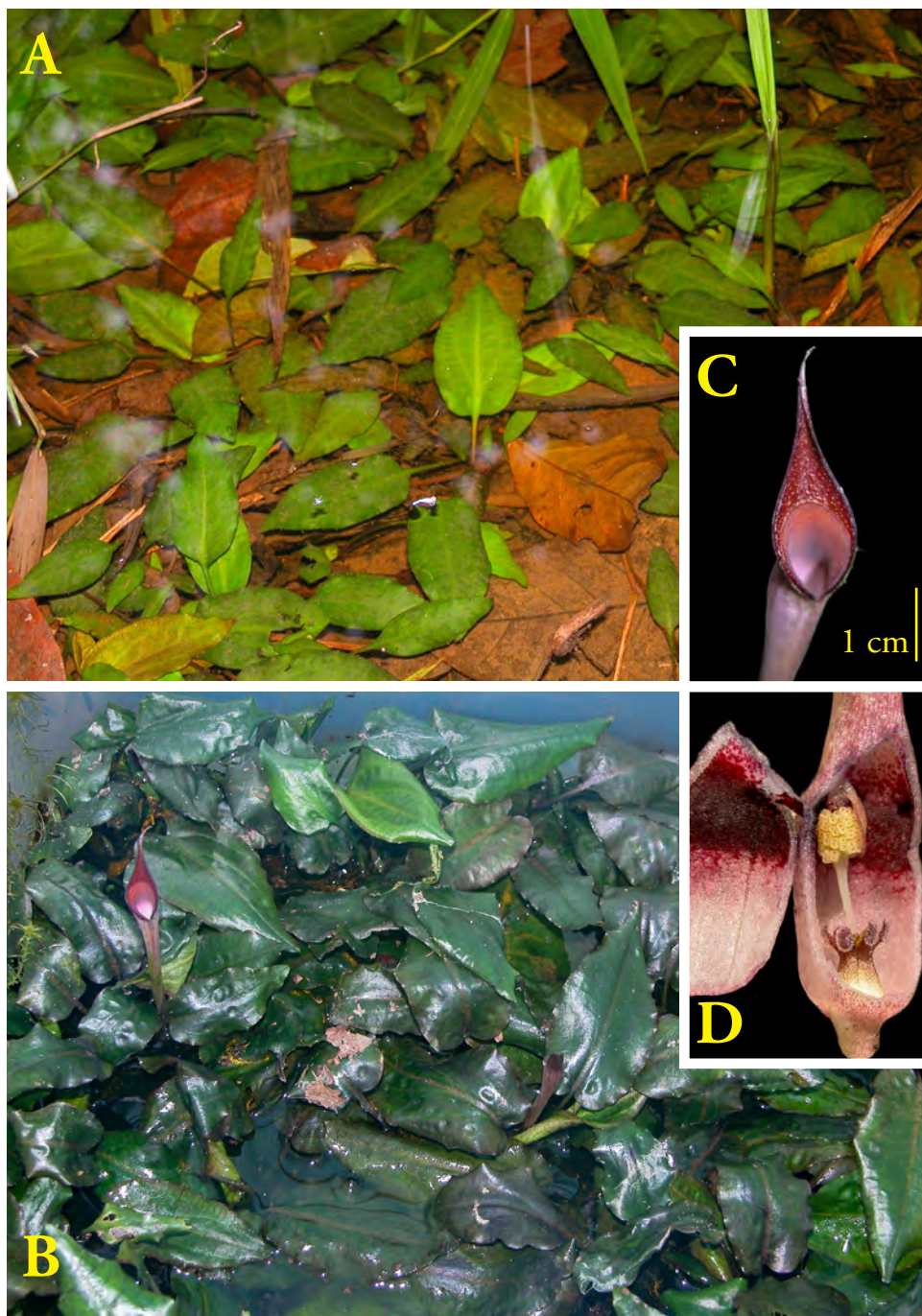


Figure 9: *Cryptocoryne* × *batangkayanensis* Ipor, Ørgaard & N.Jacobsen. Malaysia, Sarawak, Kpg. Tenggang, NJS 04-07. (A) Natural habitat. (B) Cultivated plants. (C) Spathe limb. (D) Cut open kettle with a purple zone in the upper part. — Photos N. Jacobsen



Figure 10: *Cryptocoryne xzukulii* Rataj. (A) Peninsular Malaysia, only known from cultivated specimens, representing type collection, B 908. (B) Spathe limb upright. (C) Spathe limb recurved. (D) Cut open kettle with flap closing the exit. — Photos N. Jacobsen



Figure 11. *Cryptocoryne xsumateraensis* (W.Reichert) N.Jacobsen. Indonesia, Sumatera, *B 1617*. (A — C) Cultivated type specimen. (B) Spathe showing tube entrance. (C) Cut open kettle with flap closing the exit; (D — F) Riau, ROKAN HULU, cultivated, *SW18R4*. (E) Re-curved spathe limb. (F) Cut open kettle with a purple spadix appendix. — Photos N. Jacobsen



Figure 12. *Cryptocoryne ×ikezewaldiae* Bastm. Indonesia, W Kalimantan, Kapuas Hulu Regency, S of Putussibau, Nanga Kalis, SW1841. (A) Habitat at type locality in secondary swamp forest. (B) Emergent cultivated plants. (C) Spathe limb with the purple markings at the tube opening. (D) Spathe with the long tube and short kettle. (E) Cut open kettle purple inside and a short naked spadix part between female and male flowers. — Photos S. Wongso.

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