

The subgenera, sections, and species of *Cycas*

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Virtually all treatments of the genus *Cycas*, at some level, divide the species into those with serrulate margins of the megasporophyll apex and those with pectinate margins. Thus, Wang (1996 in Wang & Liang, *Cycads in China*: 26 & 28) used two subgenera, *Cycas* (serrulate) and *Panzhihuaensis* Wang (pectinate; *Revoluta* de Laub., 1998, *Blumea* 43: 382). The teeth on serrulate examples can reach 12 or rarely even 15 mm and the longest such teeth (except on four Australian species with peg-like teeth) increase apically.

Where shorter segments on pectinate examples occur these are always found towards the apex as a result of apical decrease and generally the longest segments are at least 18 mm long. Not only are the two subgenera thus morphologically sharply differentiated, but geographically they are also segregated. The two subgenera overlap minimally along the southern fringes of southeastern Asia and in the Philippines. Related *Cycas* Information from the Royal Botanic Gardens

{mospagebreak title=First Section of *Cycas*}

The subgenus *Cycas* consists entirely of small trees reaching to several meters in height, with aerial stems often enlarged at the base. They have large ovoid pollen cones at least 8 cm in diameter. The seed bearing aggregations form a loose globular apical cluster, often spread into a pendant ring by re-growth of the apex. The pinnate leaves grow in large clusters which may die before the next growth episode. The subgenus consists of thirty species which can be divided into three sections (or subgenera) based on differences in the microsporophyll apex. Less successful has been the proposal to divide the subgenus based on the structure of the fruits which, like subterranean bulbs, does not correlate with anything else and would create a great deal of geographic overlap.

The type section of *Cycas* occurs in India and across the Indian Ocean, with an outlier in southern Thailand. It is distinguished by a gradual upward bend of the apical sterile part of the microsporophyll. Pinnae are flat with the midvein strongly marked above, less so or not at all below. Six species have been described with the type being *C. circinalis*.

Cycas circinalis L., 1753 (Sp. Pl.: 1188)

The leaves are up to 3 meters long about a quarter of which is petiole most of which has 2-3 mm thorns. The pinnae are 15-30 cm x 7-10 mm. The apex of the microsporophyll is tapering and more or less broadly acuminate 20-45 mm long. The pollen cone is up to 70 x 18 cm with a 5 cm peduncle. The apex of the megasporophyll is up to about 9 cm x 25-38 mm, the terminal spine is up to 3 cm long with teeth 1-4 mm long along the sides. The fruit is 25-38 x 21-31 mm with a fibrous layer but no spongy layer. Found in southwestern India. In most ways *C. circinalis* resembles a majority of the species in its subgenus, indicating that these slowly growing plants are closely related.

Cycas pranburiensis Yang et al, 1999 (*Brittonia* 51: 44)

Recently discovered in a limestone area of southern Thailand. Morphologically it is essentially identical with *C. circinalis* except for a smaller pollen cone (28 x 10 cm), the much smaller leaves (to 120 cm), and the wider pinnae (to 16 mm). The petiole is reported to have few thorns.

Cycas sphaerica Roxb., 1832 (*Fl. Ind.* 3: 147)

C. nathorstii Schust., 1932 (in Engler, *Pflanzenr.* 99: 76)

Differs from *C. circinalis* in the somewhat wider pinnae (9-14 mm), somewhat longer teeth on the megasporophyll (about 6 mm), and the narrowly acuminate apex of the microsporophyll. Lindstrom & Hill (2002, *Novon* 12: 237) insist that *nathorstii* differs from *sphaerica* especially in that the apical spine of the megasporophyll bears teeth but, in fact, the type of *sphaerica* has the very same character. They say the pinnae are wider (9-14 vs 9-12 mm), the megasporophyll narrower (25 vs 30 mm), and the apical spine of the microsporophyll is longer but give its length as 10 mm while that of *sphaerica* has been reported to at least 17 mm. They say that the male cone is larger but give no dimensions and male cone sizes are notoriously fugitive. That leaves only the megasporophyll teeth which they report to 4 mm while those of *sphaerica* reach at least 6 mm. Can this even be considered a variety? *C. sphaerica* is native to eastern India and *nathorstii* to Sri Lanka.

Cycas beddomei Dyer, 1883 (in Hook. f., *Fl. Brit. India* 5: 658)

Quite distinctive because of the narrow revolute pinnae (9-18 cm x 2-4 mm), not flat, which, unlike the rest of the section, have spinescent tips. Leaves reach 120 cm about 15% of which is a petiole with a few thorns. The apex of the microsporophyll is narrowly acuminate at least half of which is a 10-18 mm spine. The pollen cone is up to 33 x 9 cm. The teeth on the megasporophyll are thorns up to 15 mm long and there is a terminal spine 2-4 cm long. The fruit is

slightly larger than that of *C. circinalis*. *C. beddomei* comes from an area in southern India.

Cycas annaikalensis Singh & Radha, 2006 (*Brittonia* 58: 119)

Recently found in the *C. circinalis* zone and more or less intermediate between that and *C. sphaerica* but distinguished by the fat pollen cone (30-50 x 15-21 cm) and the large fruit (38-49 x 35-43 mm). The fruit, like that of *C. thouarsii*, has no fibrous layer and, being nearly of the same large size, may well also have a spongy layer in the seed. The apex of the microsporophyll is tapering or slightly acuminate, 38-47 mm long. The teeth on the megasporophyll are up to 8 mm long and the terminal spine up to 25 mm. The pinnae are 26-35 cm x 8-12 mm.

Cycas thouarsii Desf., 1826 (ex Gaudich in Freyc., *Voy. Autour du Monde* 19: 434)

C. zeylanica (Schust.) Lindstrom & Hill, 2002 (*Novon* 12: 238); *C. rumphii* var

zeylanica Schust., 1932 (in Engler, *Pflanzenr.* 99: 75)

Distinguished by the spongy layer in the seed but no fibrous layer in the fruit as well as by the long lanceolate apex of the megasporophyll (60-120 x 17-25 mm) with weakly developed small teeth to 2 mm and the triangular sterile apex of the microsporophyll to 20 mm long with a narrow acumen to 10 mm. The leaves are the same as those of *C. circinalis* except the pinnae are 8-15 mm wide. The fruit is large (40-60 x 42-50 mm). The pollen cone reaches 60 x 15 mm with a 5 cm peduncle. Found in and around Madagascar and in Sri Lanka. Hill claims the cataphylls in Sri Lanka are longer (10-18 vs 7 cm) but that is hardly the basis for a distinct species and calling attention to the commonality across the Indian Ocean is an important consideration. Lindstrom & Hill claim to have found their *zeylanica* in the Andaman area but I have seen material from there (including some of their citations) and it is most definitely *C. edentata*, what Hill calls *litalis*. Because Lindstrom & Hill do not report the presence of the latter there, I have to presume there are not two species in the Andaman area and that *zeylanica* is not there.

{mospagebreak title=Second Section of Cycas}

The second section of subgenus *Cycas* is section *Rumphiae* (Hill) Wang, 1996 (in Wang & Liang, *Cycads in China*: 28; subsection *Rumphiae* Hill 1994, *Austr. Syst. Bot.* 7: 530; subgenus *Truncata* de Laub., 1998, *Blumea* 43: 367), which occurs across Malesia from the Andaman Islands to Tonga. It is distinguished by the more or less truncated to blunt apical margins of the microsporophylls, sharply bent upwards, usually with a straight apical spike in the center. The sterile part below the bend is 4-10 mm high. In most cases the leaves are up to 3 meters long while the pinnae midrib is raised below, less so or not at all above with the margins slightly bent. In most cases the fruit is large, up to 6 cm long. Most seeds have a spongy layer (buoyant) but some do not and all those with a spongy layer in the seed do not have a fibrous layer in the fruit (easily shed seed coat), which usually becomes orange. It is notable that *C. thouarsii* in section *Cycas* also has a spongy layer but in other ways does not conform to section *Rumphiae*. Eight species are included in the section with the type species *C. rumphii*.

Cycas rumphii Miq., 1839 (*Bull. Sci. Phys. et Nat. Neerl.* 2: 45)

C. bougainvilleana Hill, 1994 (*Aust. Syst. Bot.* 7: 557)

Distinguished by the prominent crest or wings on the apex of the seed with the fruit up to 60 x 45 mm and by pinnae usually more than 15 mm wide (to 18 mm) and distinctly acuminate. It is a coastal plant and often branched. The petiole is about one fifth of the leaf and usually fully equipped with small (3-5 mm) thorns. The pollen cones reach 55 x 29 cm with a long peduncle. The spine on the microsporophyll is only 2-5 mm long. The teeth on the megasporophyll reach at least 5 mm in length and the apical spine is 20-35 mm long. Hill distinguished *C. rumphii* from *bougainvilleana* by the irregular or indistinct teeth on the megasporophyll and the interrupted hypodermis in the pinnae. Irregular or indistinct teeth occur all over the genus *Cycas* on older battered megasporophylls but do not characterize *rumphii*, even for the material cited by Hill thereon. The leaf specimen, which I have seen, illustrated and likely the basis for characterizing the hypodermis distinction is (unlike the type specimen) a sample of *C. celebica* (*seemania*). *C. rumphii* occurs near the coast from the Moluccas along the north coast of New Guinea to the Solomon Islands.

Cycas celebica Miq., 1839 (*Bull. Sci. Phys. et Nat. Neerl.* 2: 45)

C. seemanii A. Braun, 1876 (*Sitzungsber. Ges. Naturf. Fr. Berlin* 268)

C. micronesica Hill, 1994 (*Austr. Syst. Bot.* 7: 554)

Closely resembles *C. rumphii* but differs in the weak apical crest on the seed, narrower pinnae mostly less than 15 mm wide, hardly acuminate, and continuous hypoderm, with a pollen cone more slender (15 cm). The petiole tends to have few or no thorns. Lindstrom (*Brittonia* 54: 308, 2002) is wrong that I based the distinction between *C. celebica* and *C. rumphii* merely on the lack of spines on the petiole. I took note of the fact that Rumphius specifically observed that examples on Celebes were different, including the lack of spines, and selected a specimen from Ambon to illustrate the difference (plate 21), carefully drawing a pinnule that is 15 mm wide. I have further noted several specimens from Celebes (where *C. rumphii* is hardly represented) that conform exactly to the observation by Rumphius. After examining abundant material from the Marianas, New Caledonia, and Fiji variously characterized by Hill as *C. micronesica* and *C. seemanii*, I can find no difference from the original *C. celebica* material. I consider it likely that the broad current distribution of the species has resulted from the dispersal by natives who have certainly similarly dispersed other useful plants. Besides outlying islands, *C. celebica* is found along coasts from Borneo to western New Guinea.

Cycas scratchleyana F. Muell., 1885 (Victorian Naturalist 2: 18)

C. apoa Hill, 1994 (Aust. Syst. Bot. 7: 553)

An inland species that strongly resembles *C. celebica* in almost every way except for the fibrous layer in the fruit, the lack of a spongy layer in the seed, and the short to essentially lacking apical spine on the megasporophyll. Obviously, specimens lacking the female structures could be confused. An abundance of thorns on the petioles is reported. Hill distinguishes *C. apoa* on the basis of undulate pinnae margins and no teeth on the megasporophyll, neither character to be found on two isotypes which I have seen (see comments under *C. rumphii*). His illustration of undulate pinnae margins clearly shows a specimen with pinnae only 6 mm wide (half that reported for the species) and must be considered to be a half developed specimen. *C. scratchleyana*, though inland, otherwise has essentially the same distribution as that of *C. rumphii*.

Cycas edentata de Laub., 1998 (Blumea 43: 373)

C. litoralis Hill, 1999 (in Hill & Yang, Brittonia 51: 70)

A species exceedingly similar to *C. rumphii* (with which it has long been confused) in almost all ways except for the apex of the megasporophyll which is broadly acuminate and toothless, for the lack of wings on the seed, and for a long (12-24 mm) spine on the microsporophyll. Found along coasts from the Andaman Islands to the Philippines and to Timor.

Cycas truncata de Laub. 2007 (Encephalartos 92: 17)

C. inermis auct. non Lour., Hill et al, 2004 (Bot. Rev. 70: 182)

An inland species strongly resembling both *C. celebica* and *C. scratchleyana*, with *C. celebica* the spike on the megasporophyll, with *C. scratchleyana* the lack of a spongy layer in the seed and the thorny petiole, but differing in the 14-23 mm spine on the microsporophyll and the lack of any wings on the seed apex (note that these differences also apply to *C. edentata*). It has been confused with *C. circinalis* and variously with other species. It is found from southern Viet Nam to eastern Sumatra and the Philippines to Timor.

Cycas javana (Miq.) de Laub., 1996 (in Wang & Liang, Cycads of China: 65)

C. circinalis L var *javana* Miq., 1842 (Monogr. Cycad.: 28)

A species resembling *C. celebica* except for the apex of the megasporophyll which is narrow (16-21 mm), broadly acuminate, and has teeth to 9 mm long, for the lack of wings on the seed, and for a 10-15 mm spine on the microsporophyll (note the similarity with the differences between *C. edentata* and *C. rumphii*). *C. javana* has petioles well supplied with thorns. Found along coasts from eastern Sumatra across Java and nearby islands.

Cycas campestris Hill, 1994 (Aust. Syst. Bot. 7: 538)

C. falcata Hill, 1999 (Kew Bull. 54: 209)

An inland species resembling *C. scratchleyana* but differing in the long and spreading teeth on the megasporophyll to at least 9 mm and continuing onto an apical spine, in no wings on the apex of the seed, and in the obtuse apex of the microsporophyll (no apical spine). Hill included material of *C. schumanniana* in his description. In New Guinea the fruits become red. Hill described *C. falcata* for southern Celebes and reported orange-yellow fruits and a spongy layer in the seed but saw no male material. The limited information for *C. falcata* leaves open the possibility that it could be distinct. Besides *falcata*, *C. campestris* extends across the Moluccas and the length of New Guinea.

Cycas schumanniana Lauterb., 1901 (in Schum. & Lauterb., Pl. Deutsch. Schutzgeb. Sudsee: 154)

A small tree of grasslands in eastern New Guinea. The slightly keeled leaves reach only 150 cm in length, about one third petiole which may bear a few small thorns. The pinnae are up to 23 cm long by 6-10 mm wide with a spinescent apex unlike most or all other species of the section. The pollen cone reaches 30 x 12 cm with a 4 cm peduncle. Microsporophylls have an apical spine to 11 mm long. The megasporophyll has an apical spine 10-25 mm long and lateral teeth to at least 4 mm. The fruit is up to 42 x 34 mm with no fibrous layer and the seed has no spongy layer. Hill grouped *C. schumanniana* with the Australian species but the microsporophyll is sharply different.

{mospagebreak title=Third Section of Cycas}

The third section of subgenus *Cycas* is section *Endemicae* (Schuster) Wang, 1996 (in Wang & Liang, Cycads of China: 28; subsection *Endemicae* Schuster, 1932, in Engler, Pflanzenr. 99: 65), which occurs across the northern and northeastern margins of Australia and into a small part of New Guinea closest to Australia. It is distinguished by the erect narrowly acuminate sterile apex of the microsporophyll with a sharp upward bend in the middle of the acumen. The size of the sterile apex varies strongly depending on where on the cone it appears; the erect part is 6-17 mm long while the hooked tip is mostly 6-11 mm long but sporadic reports of 6-20 or even 30 mm have been made. Leaves in almost all species reach about 150 cm long or a little more. The petioles may be thornless or mostly covered with 3-5 mm thorns from one leaf to the next. The midvein is prominent on the lower side of the pinnae but the upper side varies. There is always an apical spine on the megasporophyll which varies substantially in length. The fruit becomes yellowish to orange-brown and does not have a fibrous layer. Sixteen species are included in this section and can be divided into three groups. The type species is *C. media*.

The first group of section *Endemicae* has sharp teeth on the apical margins of the megasporophyll to at least 2 mm long and usually to 6 x nearly 2 mm. It is not unusual for individual specimens here and elsewhere to have few or no teeth due to insect damage or erosion due to age. Typically the apical spine is 8-25 mm long but longer examples are not uncommon. There are nine species in the group four of which could easily be reduced to varieties.

Cycas media R. Br., 1810 (Prodr. Fl. Nov. Holl. & Ins. Van Dieman: 348)

The most common species in Australia, found all along the coast of Queensland. It is distinguished by mostly flat leaves that may surpass 2 meters in length with about one third the petiole and by pinnae 13-26 cm x 6-10 mm not spinescent at the apex. Only *C. silvestris* in this section has leaves so long. The pinnae have little marked midveins above and slightly bent margins. The pollen cones are up to 25 x 15 cm. The apical part of the megasporophyll is about 7 x 3 cm with a spine 15-45 mm long. The fruit is up to about 38 x 32 mm and is not glaucous.

Cycas ophiolitica Hill, 1992 (Telopea 5: 190)

C. megacarpa Hill, 1992 (Telopea 5: 188)

Very similar to *C. media* but with smaller leaves to 140 cm long that are moderately keeled and about one quarter petiole. *C. megacarpa* and *C. ophiolitica* grow south of *C. media* with the former further south and intermediates are seen between all three. *C. megacarpa* is distinguished by slightly larger fruits and *C. ophiolitica* by a wooly apex and glaucousness on early growth. These kinds of variation can be seen all over the *Cycas* area of Australia.

Cycas silvestris Hill, 1992 (Telopea 5: 181)

Differs from *C. media* only in the wider pinnae (9-15 mm) and the smooth trunk due to complete shedding of all lateral structures. Such differences often merit erection of no more than a variety. Found at the northern end of *C. media* distribution.

Cycas arenicola Hill, 1993 (Telopea 5: 419)

C. arnhemica Hill, 1994 (Telopea 5: 693)

C. maconochiei Chirgwin & Hill, 1996 (Telopea 7: 181)

Differs from *C. media* in the spinescent apex of the pinnae and the more elongated pollen cones as well as the more or less dense wooly tomentum around the stem apex and the orange brown tomentum on the underside of the pinnae which are 7-19 cm x 4-7 mm. The fruit and the leaves are at least slightly glaucous. Like most of the section, the leaves are smaller than those of *C. media* and their petiole is up to one quarter their length. Teeth tend to appear on the apical spine of the megasporophyll. Leaves can be slightly keeled as well as the pinnae, The brown tomentum on the pinnae underside is shared with neighboring *C. calcicola* and suggests an introgression. Hill makes much of the soft and not spine tipped cataphylls here and elsewhere associated with dense wooly shoot apices but a close inspection reveals that these are actually quite sharp. Variations in the glaucousness and the wool have been used to separate several species. Endemic to the northern edge of Northern Territory.

Cycas yorkiana Hill, 1996 (Telopea 7: 18)

C. badensis Hill, 1996 (Telopea 7: 20)

C. tuckeri Hill, 1996 (Telopea 7: 20)

C. semota Hill, 1996 (Telopea 7: 23)

Differs from *C. arenicola* in the lack of brown tomentum on the pinnae underside and the lack of glaucousness. Such differences should probably merit no more than varietal status. Differences in the wool and the length or width of the megasporophyll have been used to separate several species. Endemic to the northernmost part of Queensland.

Cycas armstrongii Miquel, 1868 (Archiv. Neerland. Sci. Exact. Et Naturelles 3: 235)

Distinguished by the flat pinnae 7-18 cm x 4-10 mm with the midvein equally prominent on both sides and with a spinescent apex. The leaves are also flat and up to 120 cm long with one quarter as petiole. The pollen cones are ovoid and up to 23 x 12 cm. The fruit is up to 43 x 38 mm and not glaucous. The apical spine on the megasporophyll is quite variable (about 10-25 mm or even longer). The apex of the stem is orange wooly. The trunk itself is no more than 10 cm in diameter. Endemic to the area around Darwin.

Cycas papuana Muell., 1878 (Papuana Pl. 4: 71)

C. lane-poolei Gardner, 1923 (For. Dept. Bull. Perth 32: 30)

C. orientis Hill, 1994 (Telopea 5: 696)

C. canalis Hill, 1994 (Telopea 5: 698)

C. xipholepis Hill, 1996 (Telopea 7: 32)

Differs from the nearby *C. armstrongii* only in the more robust trunk (at least 14 cm in diameter) and a tendency for emerging pinnae and fruit to be somewhat glaucous. It is doubtful that such differences merit more than varietal status under *C. armstrongii* which was first to be described. *C. papuana* is the northern equivalent to *C. media* being spread across the northern fringes of Australia and into the nearby part of New Guinea. It is divided into five separate populations and each one has been named a separate species. *C. xipholepis* is said not to have a wooly apex.

Cycas conferta Chirgwin, 1993 (in Chirgwin et al, Jour. Adelaide Bot. Gard. 15: 147)

The crowded flat pinnae give this tree a very distinct look but, otherwise, there is really no detectable difference from *C. papuana*. It occupies an area just south of *C. armstrongii* which it also resembles substantially. Is a noticeable difference sufficient to support a distinct species?

Cycas angulata R. Br., 1810 (Prodr. Fl. Nov. Holl. & Ins. Van Dieman: 348)

C. platyphylla Hill, 1992 (Telopea 5: 193)

C. coutsiana Hill, 1992 (Telopea 5: 197)

C. brunnea Hill, 1992 (Telopea 5: 200)

Distinguished by small teeth to 2 mm long on the megasporophyll and the strongly keeled leaves to 170 cm long about one quarter petiole with narrow spinescent tipped more or less keeled pinnae to 27 cm x 4-7 mm, glaucous when new. The ovoid pollen cones reach some 25 x 15 cm in size. The fruits reach 49 x 39 mm and are usually glaucous. The midvein of the pinnae is raised on the lower side only and the apex of the stem is wooly. Endemic to the southern margins of the Gulf of Carpentaria and to the east in the mountains in Queensland.

The second group under section *Endemicae* is made up of three very rare species with tiny 1 mm teeth on the megasporophyll which is not more than 25 mm wide. Otherwise, there is nothing particularly unusual about these plants. The leaves are up to about 120 cm long or somewhat longer roughly one quarter of which is petiole. The pinnae are up to about 20 cm long and not more than 8 mm wide. What little is known about the pollen cone suggests elongated ovoid something like 30 x 10 cm. The fruits are maybe 40 x 35 mm. They are endemic to Queensland among the other cycad species there. (Perhaps this group could be expanded to include *C. angulata*.)

Cycas normanbyana Muell., 1874 (Fragm. Phytogr. Austr. 8: 164)

Distinguished by the long and narrow (70-100 x 13-20 mm) lanceolate apex of the megasporophyll. The pinnae are 6-8 mm wide. The megasporophyll apex is ever so slightly acuminate. Australian botanists insist that there is no such species because they have not seen living material and yet it has been collected twice by competent collectors, once by Fitzalen in 1874 near the Burdekin R. estuary and once by Brass in 1948 at the northern end of the Cape York Peninsula. Hill (1992, *Telopea* 5: 184) reported to have seen a photo of the type and asserted that the distinguishing characters used by Mueller (curled fronds and [not even] 4-seeded megasporophylls) occur widely among *C. media* populations and placed the species in synonymy. He did not address the strikingly distinct apex of the megasporophyll. He placed the other collection into *C. semota* where it also has a strikingly distinct megasporophyll apex.

Cycas cairnsiana Muell., 1876 (Fragm. Phytogr. Austr. 10: 63)

Distinguished by the strongly glaucous keeled leaves with spinescent tipped pinnae up to 18 cm x 2-4 mm. The triangular apex of the megasporophyll is up to 25 mm wide and the apical spine is 15-24 mm long. The apex of the stem is dense wooly and the petioles are partly to completely covered with thorns. Endemic to northeastern Queensland and long cultivated but the wild population only recently identified.

Cycas desolata Forster, 1995 (*Austrobaileya* 4: 345)

Differs from nearby *C. cairnsiana* by slightly wider pinnae (18-21 cm x 3.5-5 mm) and by the apical spine of the megasporophyll 5-15 mm long. The petioles bear few or no thorns. Recently "rediscovered" (Leichardt apparently saw it in 1845 along the upper Burdekin R.). With more material, it may come to be seen as virtually the same taxon or perhaps a variety of *C. cairnsiana*.

The third group under section *Endemicae* is distinguished by short blunt peg-like teeth on the megasporophyll 2-3 mm wide and the individual teeth diminishing apically. That is to say, they differ fundamentally from the rest of the subgenus and yet the microsporophylls are typical thereby. The upper corner of the "peg" is acute. There is a distinct apical spine on the megasporophyll. The leaves are up to 150 cm or a little more long about one sixth of which is petiole which has thorns to about half way down. The pinnae have spinescent tips, have curved margins, and diminish basally. The pollen cones are tapering spindle-shaped (fusiform) no more than about 9 cm in diameter but at least 34 cm long. The fruits are approximately 36 x 32 mm and glaucous. Endemic to a small area in northeastern West Australia and nearby parts of Northern Territory. In a very real way this group of species constitutes a bridge between the two subgenera of *Cycas*.

Cycas furfuracea Fitzgerald, 1918 (Jour. & Proc. Royal Soc. W. Aust. 3: 108)

Distinguished by the apex of the megasporophyll 79-95 x 20-32 mm with a terminal spine 25-65 mm long and peg teeth 2-5 mm long. The leaves are strongly keeled and the pinnae 6-20 cm x 6-8 mm, usually glaucous. The most western of its group of species.

Cycas basaltica Gardner, 1923 (Bull. Woods & Forests Dept. W. Austr. 32: 31)

Distinguished by the apex of the megasporophyll 50-90 x 14-19 mm with a terminal spine 20-35 mm long and peg-teeth 3-4 mm long. The leaves are flat and the pinnae 9-12 cm x 5-9 mm, not glaucous. Located in the northernmost part of West Australia. Except for the flat leaves, close enough to *C. furfuracea* to be considered a variety.

Cycas pruinosa Maconochie, 1978 (Jour. Adelaide Bot. Gard. 1: 177)

Distinguished by the apex of the megasporophyll 95-190 x 18-40 mm with a terminal spine 10-45 mm long and peg teeth 5-12 mm long. The leaves are strongly keeled and the revolute pinnae 11-20 cm x 2.5-4 mm, often glaucous. Mostly near

and crossing into Northern Territory.

Cycas calcicola Macanochie, 1978 (Jour. Adelaide Bot. Gard. 1: 175)

Distinguished by the apex of the megasporophyll 20-30 x 15-20 mm with a terminal spine 6-16 mm long and peg teeth 2-4 mm long. The leaves are flat and the revolute pinnae 5-14 cm x 2.5-4 mm, brown tomentose on the underside. Located in the northwestern part of Northern Territory.

{mospagebreak title=Fourth Section of *Cycas*}

The subgenus *Panzhuhuaensis* Wang, 1996 (in Wang & Liang, *Cycads in China*: 26; *Revoluta de Laub.*, 1998, *Blumea* 43: 382, based on *C. revoluta*) consists of those species having pectinate segments on either side of the apex of the megasporophyll to at least 15 mm long, either all of the same size or diminishing towards the apex. The leaves are pinnate and develop to at least one meter in length, usually much longer. Thorns are very common on the petioles but this condition is quite variable. The ovoid or spindle-shaped pollen cones are at least 20 cm long, often much longer with a short 3-4 (occasionally to 6) cm peduncle. The seed bearing aggregations form a tight globular cluster with a central projection of the tips of the uppermost megasporophylls, remaining compact with new leaf growth from the center. Confined to the southeastern part of Asia to the Philippines and the Ryukyu Islands. The type species is *C. panzhuhuaensis*. The 25 species of the subgenus can be subdivided into three sections based on characters of the fruit, the sporophylls, and the pinnae.

The section *Panzhuhuaensis* Wang (*Asiorientales* Schuster, 1932 in Engler, *Pflanzenr.* 99: 65. based on *C. revoluta*) is a group of more or less relicts on the northern and eastern geographic margins of its subgenus, both specialized and intermediate between the other two sections. It is distinguished by the fruits not having a fibrous layer, by the seed not verrucose, by the blunt (to 10 mm) sterile apex of the rigid microsporophylls sharply deflexed with a small (to 10 mm) acumen or apical spine, and by the midvein in the spinescent tipped pinnae prominent below but flat or even depressed above. The pinnae are up to 8 mm wide, the margins bent. Small trees that reach to over three meters high. Flat to slightly keeled leaves to about 150 cm long with a petiole mostly to about one sixth to one tenth the length and at least half covered by thorns. Pollen cones fusiform (tapering-spindle shape), at least 50 cm long a 8-12 cm in diameter. Segments of the apical part of the megasporophyll are up to about 40 mm long x 3 mm wide at the base but diminishing slightly towards the apex and then with a few shorter segments on the apical spine which projects slightly above the lateral segments. The lack of a fibrous layer in the fruit, the fusiform pollen cone, and the blunt apex of the microsporophyll, as well as the shape of the megasporophyll resemble section *Stangerioides*. The distinct spine on the microsporophyll, the spinescent tipped pinnae, and the absence of a verrucose surface on the seed relates to section *Indosinensis*. There are five species in the section.

Cycas panzhuhuaensis Shou & Yang, 1981 (*Acta Phytotax. Sin.* 19: 335)

C. hongheensis Yang & Yang, 1996 (in Wang & Liang, *Cycads in China*: 62)

Distinguished by the pinnae 12-23 cm x 5-7 mm, by segments of the megasporophyll up to 40 mm, by smooth seeds, and by not pruinose red to orange fruits. The gray-green pinnae do not reduce basally. The fruit reaches to 35 x 30 mm. *C. hongheensis* is incompletely known and can not be ruled distinct from *panzhuhuaensis*. Endemic where Szechuan, Yunnan, and Guizhou Provinces come together, the most northerly of all Chinese cycads.

Cycas zambalensis Madulid & Agoo, 2005 (*Blumea* 50: 520)

Distinguished by pinnae 12-21 cm x 5-8 mm, by segments of the megasporophyll to 15 mm, and by smooth seeds. The keeled leaves reach 105 cm long. The dark green pinnae do not reduce basally. The spine on the microsporophyll is 5-10 mm long. The fruits reach 35 x 30 mm and are reported to be yellow. It superficially resembles nearby *C. riuminiana* but is actually very close to *C. panzhuhuaensis* from which it differs by the short segments of the megasporophyll, by small leaves, and by the longer spine on the microsporophyll.

Cycas revoluta Thunb., 1783 (*Nova Acta Soc. Sci. Upsal.* 4: 40)

C. miquelii Warb., 1900 (*Monsunia* 1: 179)

Distinguished by revolute pinnae 6-20 cm x 3-5 mm, by ribbed seeds, and by pruinose red to orange fruits, tomentose at first, reaching 39 x 28 mm. The green pinnae reduce in size basally into thorns. Endemic to the Ryukyu Islands. Warburg based his species on a megasporophyll clearly of *C. revoluta* illustrated by Miquel by mistake with his description of *C. inermis* which otherwise was of material of *C. clivicola* (see under that species).

Cycas taitungensis Shen, Hill, Tsou, & Chen, 1994 (*Bot. Bull. Acad. Sin.* 35: 135)

Distinguished by pinnae 12-23 cm x 4-8 mm, by ribbed seeds, by pruinose fruits, tomentose at first, becoming red to orange and up to 40 x 33 mm. The green pinnae reduce in size basally to thorns. Endemic to southeastern Taiwan and reportedly from nearby mainland China where its presence could be the result of cultivation. Long thought to be *C. taiwaniana* which is a substantially different species.

Cycas wadei Merr., 1936 (*Philipp. Jour. Sci.* 60: 234)

Distinguished by pinnae 14-26 cm x 5-8 mm, by ribbed seeds, and by non pruinose fruit not tomentose at first and becoming orange and up to 40 x 30 mm. The green pinnae do not reduce in size basally. The apex of the microsporophyll

is a narrow lobe rather than a spine. Endemic to Culion Island in the Philippines.

{mospagebreak title=Fifth Section of Cycas}

The second section of subgenus *Panzhihuaensis*, section *Indosinensis* Schuster, 1932 (in Engler, *Pflanzenr.* 99: 65; subgenus *Pectinata* de Laub., 1998, *Blumea* 43: 375, based on *C. pectinata*), is distinguished by the fruits having a fibrous layer, by the seeds not having a verrucose surface, by the 5-15 mm rigid sterile apical part of the microsporophyll more or less erect and blunt to triangular with a sharply deflected apical spine, and by the midvein of the pinnae prominent on both sides. The pinnae are flat or the margins slightly bent. Lateral segments on the apex of the megasporophyll are 18-25 mm or a little longer and 2-3 or sometimes 4 mm at the base, diminishing in size slightly towards the apical spine which projects prominently and generally bears a few reduced lateral segments. The yellow to orange fruits are not pruinose. Distributed from eastern India across all of southeastern Asia and over the border a bit into China and in the Philippines. There are seven species and the type is *C. siamensis*.

Cycas siamensis Miquel, 1863 (*Bot. Zeit.* 21: 334)

C. immersa Craig, 1912 (*Kew Bull.* 1912: 434)

C. nongnoochiae Hill, 1999 (*Brittonia* 51: 60)

C. pachypoda Hill, 2004 (*Bot. Rev.* 70: 176)

Distinguished by the huge subterranean bulb eventually giving way to a robust trunk to several meters high. The flat leaves are up to 130 cm long or a little more and about one sixth thorny petiole. The spinescent tipped pinnae are 6-18 cm x 4-9 mm and diminish basally in size to thorns. The pollen cones are barrel-shaped and up to 30 x 10 cm. The apical spine on the microsporophyll is 5-15 mm long. The lateral segments on the megasporophyll are up to 20 mm long with an apical spine to 45 mm long. The fruits are up to 37 x 37 mm. The corky bark becomes split and checkered due to environmental stress. The grey-green leaves of *C. nongnoochiae* with longer petioles and larger pinnae (to 23 cm x 12 mm) suggest introgression with *C. clivocola* and could be considered a variety. The grey-green leaves of *C. pachypoda* whose pinnae reduce only weakly basally with pollen cones up to 49 x 15 cm also suggest some kind of introgression. Distributed from the borders of Burma across most of Thailand and into Viet Nam. A specimen from Bhutan is probably from a cultivated specimen.

Cycas pectinata Buch.-Ham., 1825 (*Mem. Wern. Soc.* 5: 322)

Distinguished by huge ovoid acute pollen cones to 69 x 22 cm whose microsporophylls have apical spines up to 40 mm long. The smooth trunk has a greatly swollen base and can reach to 15 meters high with branches. The flat grey-green leaves are up to 240 cm long and about one fifth mostly thorny petiole. The pinnae are up to 32 cm x 6-10 mm. The segments of the megasporophyll are up to 25 mm long with an apical spine up to 75 mm long. The fruits are up to 45 x 45 mm. Distributed from eastern India across northern Burma and western Thailand and just across the border into China.

Cycas macrocarpa Griff., 1854 (*Not. Pl. As.* 4: 11)

Distinguished by the large fruits to 53 x 45 mm and by the not spinescent tipped pinnae 18-45 cm x 12-20 mm. The trunk may be lightly fissured and up to 12 meters high, but no more than slightly enlarged at the base. The flat green leaves may reach 320 cm long about a quarter of which is mostly thorny petiole. The pinnae gradually reduce basally in size to thorns. The ovoid pollen cones reach 35 x 12 cm. The apical spine of the microsporophyll is up to 28 mm long. The segments on the megasporophyll are up to 18 mm long with an apical spine to 60 mm. Endemic to Penninsular Thailand and nearby parts of Penninsular Malaysia.

Cycas riuminiana Porte, 1863 (in Regel, *Gartenfl.* 12: 16)

C. chamberlainii Br. & Kienholz, 1925 (*Philipp. Jour. Sci.* 26: 47)

Distinguished by the spinescent tipped pinnae 16-32 cm x 7-11 mm and by the ovoid pollen cones to 32 x 8 cm. The sturdy trunk up to 8 meters tall is not swollen at the base. The flat green leaves are up to 230 cm long and about one quarter mostly thorny petiole. The ovoid pollen cones apparently reach to about 32 x 16 cm. The apical spine on the microsporophyll is up to 11 mm long. The segments on the megasporophyll are up to 18 mm long with an apical spine up to 57 mm long. The fruits are up to 50 x 36 mm. Restricted to two small areas on Luzon.

Cycas elongata (Leandri) Yang, 1996 (in Wang & Liang, *Cycads in China*: 51; *C. pectinata* Buch.-Ham. *Var elongata*

Leandri, 1931 in Lecompt & Gagn., *Fl. Gen Indo-chine* 5: 1091)

C. tansachana Hill & Yang, 1999 (*Brittonia* 51: 65)

C. condacensis Hill & Yang, 2004 (*Bot. Rev.* 70: 178)

C. petrea Lindstrom & Hill, 2002 (*Brittonia* 54: 299)

C. currani (Schust.) Hill, 1995 (*Proc. Third Int. Conf. Cycad Biol.*: 150; *C. circinalis*

L subsp. *riuminiana* Porte *var curanni* Schust., 1932 in Engler, *Pflanzenr.* 99: 69)

C. changjiangensis Liu, 1998 (*Acta Phytotax. Sin.* 36: 552)

Distinguished by barrel-shaped slightly tapering pollen cones to 45 x 13 cm or even larger, by megasporophyll segments to 25 mm with an apical spine to 60 mm or even longer, and by not spinescent tipped pinnae 13-30 cm x 7-13 mm. Trunks corky and often becoming cracked and checkered, with a greatly enlarged base which starts out as a bulb. Slightly keeled leaves to 180 cm or longer with about one quarter petiole usually provided with some thorns. Apical spine

on the microsporophyll to 8 mm or more. Fruit to 50 x 40 mm. Distributed across the southern parts of Thailand to Viet Nam and Hainan Island. Populations in particularly stressed environments (*tansachana* and *condaoensis*) have the checkered bark. *C. petrea*, in central Thailand, has longer segments on the megasporophyll (to 40 mm), fatter pollen cones (to 18 cm), and flat leaves, as well as longer (to 20 mm) apical spines on the microsporophyll. These are not strong differences but could well be the basis for a variety. The case of *C. curanni* is puzzling. It involves a small population on Palawan Island directly across the South China Sea from the widely distributed *C. elongata* and is a perfect match except for the report of grooved seeds. It has been poorly known but, because it occurs in the Philippines and has pectinate apices of the megasporophyll, it has been likened to *C. wadei* which has grooved seeds. I suspect that somehow this character became erroneously attached to *C. curanni*. Apparently *C. elongata* widely overlaps the distribution of *C. clivicola* which it resembles. For example, Tang et al (1997, *Cycads of Thailand*: 14) under *C. clivicola* illustrates a tree with keeled leaves and checkered bark with a barrel-shaped pollen cone, the leaves having the typical ragged look of *C. elongata*, in the southernmost part of Thailand. But Tang also (2001, *Encephalartos* 67: 12) illustrates a typical *C. clivicola* pollen cone from the same area. Likewise, both kinds of pollen cone have been illustrated for southern Viet Nam where *C. elongata* originates (see under *C. clivicola*).

Cycas clivicola Hill, 1999 (*Brittonia* 51: 62)

C. chamaoensis Hill, 1999 (*Brittonia* 51: 58)

C. elephantipes Lindstrom & Hill, 2002 (*Brittonia* 54: 301)

C. inermis Lour., 1790 (*Fl. Cochinchina* 1: 632), illeg., given in synonymy with *C. revoluta* Thunb.

Distinguished by the ovoid-lanceolate pollen cones to 63 x 16 cm and by the flat grey-green leaves to 250 cm long with spinescent tipped pinnae 9-30 cm x 7-11 mm. The stem is corky, becoming checkered in severe environments, and enlarged at the base. The petiole is about one quarter of the leaf and usually has some thorns. The apical spine on the microsporophyll reaches 14 mm long. The lateral segments on the megasporophyll reach 40 mm long and the apical spine to 75 mm long. The fruits are up to 40 x 35 mm. Distributed across southernmost Thailand and Viet Nam and into Peninsular Malaysia. *C. elephantipes* from central Thailand has checkered bark, longer segment on the megasporophyll (55 mm), and a longer spine on the microsporophyll (30 mm). Vietnamese botanists have identified examples of *C. clivicola* as *C. pectinata* because of the similar looking pollen cones, tapering to an acute apex, but these are noticeably more slender than those of *C. pectinata*. Vorstar illustrates this pollen cone from cultivation in Viet Nam (identified, however, as *C. elongata*, 2002, *Encephalartos* 72: 20, and Osborne et al, 2007, *Cycads of Viet Nam*: 84). That both *C. clivicola* and *C. elongata* occur in this part of Viet Nam is indicated by the report of Osborne et al (79) that pinnae here are "spinescent or not spinescent" and by the remark of T. Walters to me that he found some megasporophylls in this area to be elongated (that would be *elongata*) and others more like *C. siamensis* (that would be *clivicola*). Miquel (1851, *Analecta Bot. Indica* II: 40-46, plates III-IV) extensively described *C. clivicola* from cultivated material he got from Bogor identified as *C. inermis* from China. Surely Bogor had *inermis* from Lourero himself and shortened Cochinchina, from where *inermis* originated, to "China." Smitinand (1971, *Nat. Hist. Bull. Siam Soc.* 24: 170; 1972, *Flora of Thailand*: 187), under *C. pectinata*, clearly illustrated a *C. clivicola* pollen cone (he included *C. clivicola* collections under his *C. pectinata*; see also under *C. elongata*).

Cycas lindstromii Yang & Hill, 1997 (*Novon* 7: 213)

Distinguished by a subterranean branched bulb with no aerial growth whatsoever, by slightly keeled leaves to 100 cm long and one quarter of which is thorny petiole, and by not spinescent tipped pinnae which are 10-17 cm x 7-11 mm. Pollen cones barrel-shaped and 16-29 x 4-5 cm. The apical spine on the microsporophyll reaches 8 mm long. Segments on the apical part of the megasporophyll reach at least 15 mm and the apical spine up to 50 mm long. The fruit reaches 37 x 33 mm. Endemic to a small area in southern Viet Nam.

{mospagebreak title=Sixth Section of Cycas}

The third section of subgenus *Panzhihuaensis*, section *Stangerioides* Smitinand, 1971 (*Nat. Hist. Bull. Siam Soc.* 24: 168; genus *Dyerocycas* Nakai, 1943, *Ordines, familiae, tribi, genera, etc.*: 208; *Epicycas* de Laub., 1998, in de Laub. & Adema, *Blumea* 43: 388) is distinguished by yellow fruits that are not pruinose, have no fibrous layer, but have verrucose seeds, and by spindle-shaped to fusiform pollen cones, mostly to 60 x 8-13 cm, with flexible blunt (rounded) not deflexed apices to the microsporophylls. There is ridge on the upper side of the microsporophyll apex and sporadically one or more prickles 3-6 mm long. The stem is subterranean at first, usually bulbous, and in most cases eventually developing an above ground trunk. The flat leaves reach more than two meters long and are at least one third and sometimes more than one half a thorny petiole. The midvein is prominently raised on the upper side of the pinnae, equally or less so below. Restricted to southern China to northern Viet Nam and Thailand. There are thirteen species which can be separated into two groups. The type species is *C. micholitzii*.

The first group of section *Stangerioides* is characterized by flat acuminate not pungent undulate pinnae, in most cases with the midvein flat or weakly raised below. The leaves reach to at least 250 cm with nearly half to sometimes more than half petiole. The stems are mostly subterranean but may eventually produce a stubby or weak growth above ground to as much as a meter high. The sterile apical part of the microsporophyll extends for 2-6 mm. There are nine species in this group three of which have dichotomizing pinnae.

Cycas micholitzii Dyer, 1905 (Gard. Chron. 38: 142)

C. bifida (Dyer) Hill, 2004 (Bot. Rev. 70: 161; *C. rumphii* Miq. Var. *bifida* Dyer, 1903, Jour. Linn. Soc. Bot. 26: 560)

C. multifrondis Wang, 1996 (in Wang & Liang, *Cycads in China*: 80)

Distinguished by dichotomizing pinnae somewhat dispersed and subtended by an unbranched secondary rachis up to 35 mm long bearing up to three unequal dichotomizing blade segments, one near its base and one or a pair terminally. Blade dichotomies occur variously from one sixth to nearly half way from their base and individual blade segments may dichotomize twice. Apically the pinnae progressively become less complex. The pinnae are up to at least 41 cm long and each segment is 17-25 mm wide. The aerial stem, if present, dwindles to 4-5 cm in diameter and up to 60 cm long. The leaves are few in number and up to at least 350 cm long up to nearly half petiole. The long tapering pollen cone is 35-55 x 6-8 cm. The apex of the microsporophyll bears serrations or rudimentary prickles. The segments on the megasporophyll are up to 50 mm long with an apical spine to 70 mm and bearing a few shorter lateral segments. The fruit is up to 25 x 20 mm. Osborne et al (2007, *Cycads of Vietnam*: 57) report in northern Viet Nam giant *C. bifida* leaves up to 7 meters long with pinnae up to 60 cm long, but these are not the sizes ordinarily encountered in nearby China. Perhaps these are examples of *C. longipetiolula* (see photo of pinnule in *Encephalartos* 72: 19, 2002). Occurs in the highlands of central Viet Nam a short way into China.

Cycas longipetiolula Wang, 1996 (in Wang & Liang, *Cycads in China*: 68)

C. debaoensis Zhong & Chen, 1997 (*Acta Phytotax. Sin.* 35: 571)

Distinguished by dichotomizing pinnae somewhat dispersed and subtended by a secondary rachis up to about 125 mm long bearing up to half a dozen unequal dichotomizing blade segments the lowermost of which may have an up to 25 mm petiolule and may dichotomize twice, the dichotomies being in the lower third of the segment. Apically the pinnae progressively reduce in size. The blade segments are up to at least 56 cm long, each segment of which is 11-19 mm wide. The leaves are few in number and reach to well over four meters long up to half of which is petiole. The bulb may protrude up to 20 cm above ground. The long tapering pollen cone is 36 x 6 cm (perhaps more). The apex of the microsporophyll is serrulate. The segments on the megasporophyll are up to 50 mm long with a more or less protruding apical spine bearing a number of shorter lateral segments. The fruit is up to 27 x 22 mm. Endemic to Yunnan and nearby parts of Guangxi just north of Viet Nam, and possibly there too.

Cycas multipinnata Chen & Yang, 1994 (*Acta Phytotax. Sin.* 32: 239)

Distinguished by dichotomizing pinnae, the compound primary divisions spaced 16-20 cm apart on the rachis, the longest at or near the base with a secondary rachis up to about 60 cm long or more bearing up to about 9 lateral and terminal compound divisions the lowermost of which can have a tertiary rachis up to something like 15 cm and bear up to at least half a dozen unequal blade segments the lower and terminal of which may dichotomize twice, the lower may have a petiolule to about 40 mm long. The divisions become progressively less complex apically (the larger primary divisions are equivalent to a whole *C. longipetiolula* leaf). The blade segments are up to about 30 cm x 15-22 mm. The leaves are few in number, moderately keeled, and at least 6 meters long, at least half of which is petiole. The bulb may protrude aurally to as much as 40 cm with a diameter of 10-20 cm. The spindle-shaped pollen cones are up to 40 x 6-8 cm. The apex of the microsporophyll is slightly serrate. The segments on the megasporophyll are up to 40 mm long with a somewhat longer apical spine which bears a few shorter lateral segments. The fruit is up to 32 x 28 mm. Endemic to a small area in northernmost Viet Nam and nearby parts of China.

Cycas fugax Hill, Nguyen, & Loc, 2004 (Bot. Rev. 70: 145)

Distinguished by the long (up to 90 mm) segments on the apical part of the megasporophyll and pinnae 40-50 cm x 18-27 mm. The stem is completely subterranean. The flat leaves are few in number and at least 450 cm long, somewhat more than half of which is petiole. The spindle-shaped pollen cones are about 60 cm long. The apical spine of the megasporophyll is little if at all different from the lateral segments. The fruit is about 27 x 21 mm. Endemic to a small area north of Hanoi.

Cycas tonkinensis (Linden & Rodigas) Linden & Rodigas, 1886 (Ill. Hort. 33: 27; *Zamia tonkinensis* Linden & Rodigas, 1885, Ill. Hort. 32: 27)

C. collina Hill, Nguyen, & Loc, 2004 (Bot. Rev. 70: 142)

Distinguished by pinnae 28-45 cm x 15-28 mm, by flat leaves few in number up to 350 cm long about half of which is petiole, and by spindle-shaped pollen cones up to 60 x 11 cm. Thorns on the petioles are 4-10 mm long (a trait apparently shared by *C. chevalieri*). The subterranean stem emerges to form a weak trunk, often procumbent, up to a meter long and 20 cm in diameter. The apex of the microsporophyll is blunt. Segments of the megasporophyll are up to 35 mm long and the apical spine is not distinct but may be partially fused with adjacent segments. The fruit is up to 27 x 22 mm. *C. tonkinensis* is based on a plate with a description which make a clear match for *C. collina* up to and including the prominent thorns on the petiole. To argue that the rendition shows more tapered pinnae than any known *Cycas* has (the description gives lanceolate and acuminate) invalidates the name is pedantic and inappropriate. Material from Yunnan described under various names including *C. siamensis* (because the locals call it the Siamese cycad), *C. balansae*, and the unpublished name, *C. yunnanensis*, belong here. Endemic to northwestern Viet Nam to the southernmost part of Yunnan.

Cycas simplicipinna (Smitinand) Hill, 1995 (Proc. Third Int. Conf. Cycad Biol.: 150; *C. micholitzii* Dyer var *simplicipinna* Smitinand, 1971, Nat. Hist. Bull. Siam Soc. 24: 164)

C. hoabinhensis Loc & Nguyen, 2004 (Bot. Rev. 70: 153)

C. brachycantha Hill, Nguyen, & Loc, 2004 (Bot. Rev. 70: 155)

Distinguished by pinnae 20-28 cm x 14-20 mm, by flat leaves few in number up to 250 cm about half of which is petiole, and by spindle-shaped pollen cones up to 24 x 4-6 cm. The subterranean stem emerges to form a weak trunk often procumbent, up to about a meter long and 8-14 cm in diameter. The apex of the microsporophyll is usually blunt. Segments on the megasporophyll are up to 25 mm long, the apical spine not distinct but may be partially fused with adjacent segments. The fruit is up to 27 x 20 mm. Widely distributed across northern Thailand into northeastern Viet Nam.

Cycas chevalieri Leandri, 1931 (in Lecomte & Gagnepain, Fl. Gen. Indo-chine 5: 1085)

C. aculeata Hill & Nguyen, 2004 (Bot. Rev. 70: 149)

Distinguished by pinnae 27-52 cm x 14-20 mm, by slightly keeled leaves, numerous in number, up to 250 cm long, about half of which is petiole, and by spindle-shaped pollen cones up to 25 x 7 cm. The subterranean stem emerges to form a weak trunk, often procumbent, up to a little more than a meter long and up to 18 cm in diameter. The apex of the microsporophyll is blunt. Segments on the megasporophyll are up to 35 or 40 mm long. The apical spine is not distinct but may partially fuse with adjacent segments. The fruit is up to 27 x 20 mm. Distributed in northern Viet Nam south of Tonkin.

Cycas balansae Warburg, 1900 (Monsunia 1: 179)

C. guizhouensis Lan & Zou, 1983 (Acta Phytotax. Sin. 21: 209)

Distinguished by pinnae 17-39 cm x 10-15 mm, by slightly keeled leaves, numerous, and up to at least 250 cm long, about half of which is petiole, and by spindle-shaped pollen cones up to 53 x 11 cm. The subterranean stem emerges to form a weak trunk up to about one meter and 10-15 cm in diameter. The apex of the microsporophyll is usually blunt. Segments of the megasporophyll are up to 40 or 45 mm long, the apical spine hardly distinct but may be partly fused with adjacent segments. The fruits are up to 29 x 23 mm. Distributed from northeastern Viet Nam northward into China.

Cycas szechuanensis Chen & Fu, 1975 (Acta Phytotax. Sin. 13: 81)

C. segmentifida Wang & Deng, 1995 (Encephalartos 43: 11)

C. fairylakea Wang, 1996 (in Wang & Liang, Cycads in China: 54)

C. tanqingii Wang, 1996 (in Wang & Liang, Cycads in China: 134)

C. xilingensis Chang & Zhong, 1997 (Acta Sci. Nat. Univ. Sunyatseni. 36: 69)

C. dolichophylla Hill, Nguyen, & Loc, 2004 (Bot. Rev. 70: 157)

Distinguished by pinnae 18-42 cm x 14-20 mm, spindle-shaped pollen cones 60 x 10 cm, and by fruits up to 40 x 36 mm. The subterranean stem emerges to form a trunk more than a meter long and 25-30 cm in diameter. The numerous flat leaves are up to at least 360 cm long nearly half of which is petiole. The midvein of the pinnae is raised both above and below. The apex of the microsporophyll usually has a 2-3 mm spine. Segments of the megasporophyll are up to 50 mm long and the apex is often somewhat disorganized with fused segments with or without a distinct slightly longer apical spine. Distributed half in northern Viet Nam and half in nearby China. Long cultivated and thought to be native to Szechuan where it was extinct in the wild. More recently found in areas further south. The segments of the megasporophyll in *C. segmentifida* may reach 65 mm long due to a reduced undivided central area.

The second group of section *Stangerioides* is characterized by lanceolate pungent pinnae with the margins slightly bent and the midvein raised both above and below. The numerous flat to slightly keeled leaves in most cases reach to at least two meters long about one third of which is petiole. The subterranean stems regularly emerge to form a trunk several meters tall. The sterile apical part of the microsporophyll usually extends 4-10 mm and may have an apical spine 3-4 mm long. There are four species in this group.

Cycas sexseminifera Wei, 1996 (Guihaia 16: 1)

C. longlinensis Chang & Zhong, 1997 (Acta Sci. Nat. Univ. Sunyatseni 36: 68)

C. tropophylla Hill & Loc, 2004 (Bot. Rev. 70: 168)

Distinguished by segments on the apex of the megasporophyll not reducing apically and reaching 40 mm in length and by fruits up to 28 x 25 mm. The leaves are up to 210 cm long. The pinnae are 13-38 cm x 6-13 mm. The spindle-shaped pollen cones are up to 45 x 6-8 cm. The apical spine on the megasporophyll is slightly longer than the segments and usually is partly fused with the adjacent segments. Often growing on limestone or sandstone cliffs in northeastern Viet Nam and an unknown distance eastward into China (possibly as far as Hong Kong). Because Warburg gave China as the origin for *C. miquelii* (see under *C. elongata* and *C. clivicola*), Chinese botanists attempted to fit it to their native species thus leading *C. sexseminifera* to be identified as *C. miquelii*. *C. ferruginia* does not occur in Viet Nam and material identified as such belong here.

Cycas hainanensis Chen, 1975 (Acta Phytotax. Sin. 13: 82)

Distinguished by segments on the apex of the megasporophyll not reducing apically and reaching 35 mm in length and by fruits up to 40 x 36 mm. The leaves are up to 230 cm long. The pinnae are 13-32 cm x 6-12 mm. The pollen cones are spindle-shaped. The apical spine on the megasporophyll is longer than the segments and often irregularly fused with adjacent segments. Endemic to the eastern part of Hainan.

Cycas taiwaniana Carruth., 1893 (Jour. Bot. 31: 2)

Distinguished by segments on the megasporophyll decreasing apically to a triangular toothed projection. The leaves are up to three meters long. The pinnae are 12-40 cm x 6-18 mm. The fusiform (tapering) pollen cones are up to 70 x 13 cm. The fruits are up to 45 x 36 mm. Endemic to Guangdong. The original population at Takow (Kaohsiung), Taiwan, by the harbor, has since been eliminated (as testified by letters at Kew).

Cycas diannanensis Guan & Tao, 1995 (Sichuan Forestry Survey & Design 4: 1)

C. multiovula Wang, 1996 (in Wang & Liang, *Cycads in China*: 83)

C. parvula Yang, 1996 (in Wang & Liang, *Cycads in China*: 93)

C. shiwandashanica Chang & Zhong, 1997 (*Acta Sc. Nat. Univ. Sunyatseni* 36: 67)

C. multifida Chang & Zhong, 1997 (*Acta Sci. Nat. Univ. Sunyatseni* 36: 70)

Distinguished by segments on the megasporophyll decreasing apically all the way to the slightly projecting apex. The leaves are up to 330 cm long. The pinnae are 13-32 cm x 9-16 mm. The pollen cones are up to 65 x 13 cm. The fruits are up to 40 x 32 mm. It may be that the megasporophyll differences are no more than variations within a population or even an individual and that *C. diannanensis* is the same as *C. taiwaniana*. Spread out in southern Yunnan and western Guangxi all along the Viet Nam border (and therefore likely in Viet Nam).