

# Glossary of Terms Encountered in Cycad Systematics<sup>1</sup>

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## INTRODUCTION

A large number of terms are encountered in the literature relating directly or indirectly to cycad systematics. Many are technical terms found generally in botanical descriptions but some (*e.g.* omnule, omnel, corruptule, corruptel) are exclusive to cycad literature. Other terms (*e.g.* bulb, endosperm, frond) are used commonly but incorrectly with reference to cycads. Most terms are understood by readers in context, but many have a precise definition which is not readily found in general reference texts. Many terms encountered do not relate to plant descriptions *per se*, but to techniques of statistical and chemical analysis and to the relation of cycads to their environment. In this glossary, we have attempted to list and define all such terms, with cycad-specific examples where appropriate. Common acronyms, abbreviations and some Latin phrases are included.

## GLOSSARY

**Notes:** Primary entries and relevant cross-references are indicated by **bold type**. Terms of the opposite meaning are indicated by ‘*Cf.*’

**abaxial.** Side of an organ facing away from a central axis, *e.g.* the lower side of a leaf or leaflet. *Cf.* **adaxial.**

**abscission.** Process in which a corky cell layer forms across an axis, cutting off water and nutrient supply to the distal portion and resulting in its loss, as in loss of a leaf, leaflike organ or section of stem.

**acaulescent.** Without any evident trunk or stem. *Cf.* **caulescent.**

**acropetal.** Progressing in direction from **promixial** to **distal** zone; from base to apex, *e.g.* as for the pollen dehiscence sequence in most cycad cones. *Cf.* **basipetal.**

**actinomorphic.** Of a radially symmetric structure that can be halved in more than one plane to give two halves that are mirror images of each other; of seeds, **radiospermic.** *Cf.* **zygomorphic.**

**actran optimization.** Optimization technique used in **cladistics**, based on ‘accelerated transformation’ and favoring acquisition of characters, with subsequent **homoplasy** accounted for by reversal. *Cf.* **deltran optimization.**

**aculeate.** Having sharp **prickles**, as for the petiole of *Cycas aculeata*.

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**acuminate.** Tapering to a protracted point, with sides somewhat concave, as for the leaflets of *Zamia acuminata*. *See also acute.*

**acute.** Narrowing to end in a sharp point, as for the leaflets of many cycad species. *See also acuminate.*

**Adansonian.** Using as many unweighted characters as possible to arrive at a natural classification; 18<sup>th</sup> Century naturalist Michel Adanson's philosophy predated modern computer-aided numerical taxonomy.

**adaxial.** Side of an organ facing towards a central axis, e.g. the upper side of a leaf or leaflet. *Cf. abaxial.*

**affinis, affin., aff.** Akin or allied to; used in reference to a specimen similar to, but showing some differences with a known species.

**allele.** One of two or more alternative forms of a gene at a given locus.

**allopatric.** Of two or more taxa not overlapping in their distribution. *Cf. sympatric.*

**alpha-taxonomy.** Descriptive taxonomy, based exclusively on morphological parameters.

**amphistomatic.** Of leaves and leaflets with **stomata** on both surfaces. *Cf. hypostomatic.*

**anatomy.** Study of the internal structure of organisms and their component parts.

**anemophily.** Wind-effectuated pollen transfer. *Cf. entomophily.*

**angle(s) of insertion.** *See leaflet angle(s) of insertion.*

**ANOVA.** Analysis of variance, a tool used in statistics to apportion observed variance into probable causes.

**antherozoid**, more commonly **spermatozoid.** Motile male gamete of lower plants, cycads, *Ginkgo*, etc.

**apex.** Tip; proximal or distal end of an organ such as a shoot, leaf or root.

**apical meristem.** Zone of actively-dividing but as yet undifferentiated tissue at a shoot or root apex.

**apomixis.** Production of viable seeds without any apparent fertilization process.

**apogeotropic, ageotropic, apogravitropic.** Negatively **geotropic**; negatively **gravitropic**; developing in an orientation contrary to gravitational force, as with cycad coralloid roots.

**apomorphy.** Derived character or character state. *See also autapomorphy, homology, plesiomorphy, symplesiomorphy, synapomorphy.*

**arborescent.** Tree-like in **habit**.

**armed.** Having **spines** or **prickles**. *Cf. inerm.*

**articulate.** Separated by a node or joint, e.g. leaflets of *Ceratozamia*, *Chigua*, *Microcycas* and *Zamia* are articulated at their base.

**auctoris, auctorum, auct.** Obsolete term previously used in taxonomy when an author had applied an incorrect name.

**autapomorphy.** Derived character state unique to a terminal taxon in a particular data set. Note that an autapomorphy at a given hierarchical level may be a synapomorphy at a less inclusive level. *See also apomorphy, homology, plesiomorphy, symplesiomorphy, synapomorphy.*

**author/authority.** Person who first publishes a valid name for a taxon. The author's or authors' name accompanies the taxonomic name, usually in abbreviated form, e.g. Karl Peter Thunberg in *Cycas revoluta* Thunb.

**autonym.** Taxonomic name automatically established when a subdivision of a taxon such as a genus or species is published. The infrageneric or infraspecific taxon containing the type of the genus or species carries the same name or epithet as the respective genus or species. E.g. the publication of varieties within *Dioon edule* established the autonym *Dioon edule* var. *edule*.

**axillary.** Arising from tissue in the axil between a stem and leaf, as a lateral branch.

**axis.** Central line of development of a plant; the main stem.

**basionym.** Combination of a name in the same rank as first validly published, e.g. genus and specific epithet in case of a species name, or generic name and infrageneric epithet in case of an infrageneric name. Basionyms are cited only when there is a recombination of genus name and epithet, e.g. the basionym in the publication of *Encephalartos caffer* (Thunb.) Lehm. is *Zamia caffra* Thunb.

**basipetal.** Progressing in direction from **distal** to **proximal**; from apex to base. *Cf. acropetal.*

**bifid.** Deeply notched or cleft for more than half the length.

**bifurcate.** Forked in a Y-shaped manner, usually applying to leaves, leaflets or stems.

**binomial.** Genus name and specific epithet for any species.

**biome.** Broad vegetational subdivision of some biogeographic realm, e.g. forest, grassland, desert.

**bipinnate.** Twice pinnate; of a compound leaf having both first order and second order divisions, i.e. **pinnae** and **pinnules**, as in both *Bowenia* species and some *Cycas* species. *See also multipinnate.*

**BMAA.**  $\beta$ -N-methylamino-L-alanine, a neurotoxin found in cycad tissues.

**bootstrap value.** Statistical estimate of confidence in a **dendrogram** or **phylogenetic** tree, obtained from repeated tree calculations by randomly eliminating selected characters while duplicating others to keep the total number of characters constant.

**bract.** Leaf-like structure subtending an axillary bud or shoot, usually with a protective function. Occasionally misapplied to cycad **cataphylls**.

**bulb.** Storage stem of limited longitudinal growth enveloped in fleshy leaf bases; misapplied to the **bulbous** trunks of some *Cycas* species; occasionally misapplied to cycad **suckers**.

**bulbous.** Swollen to an almost spherical shape, as for the trunk base of *Cycas pachypoda* and several other Asian cycads.

**bullae**, plural **bullae**. Bubble, blister or vesicle. Commonly also used in reference to the expanded shield-like distal portion of some cycad sporophylls such as *Encephalartos* megasporophylls. Although the derivation is technically incorrect, this term has become widely entrenched in cycad literature and its continued use is recommended.

**caducous**. Deciduous at an early stage or prematurely.

**caespitose**. Turf-shaped and forming a clump, as in many suckering cycads, e.g. *Encephalartos cupidus*.

**callous** (adjective). Of the distinctive swollen tissue, often colored, formed at the point of insertion of *Macrozamia* leaflets onto the rachis. Often confused with **callus**.

**callus** (noun). Mass of hardened, thickened or undifferentiated parenchymatous tissue, e.g. as formed at the base of a cutting prior to root formation; undifferentiated cellular mass arising in tissue culture. *See also* **callous**.

**cataphyll**. Modified leaf, much reduced and thickened, serving to protect the apical meristem in cycads and usually produced in flushes preceding the emergence of cones or leaves.

**caudex**. Thick stem or trunk, often at least partially subterranean.

**caulescent**. Having a trunk or stem. *Cf.* **acaulescent**.

**centromere**. Region of a **chromosome** where spindle microtubules are attached during nuclear division. *See also* **satellite**.

**chalaza**. Proximal end of a seed; its point of attachment. *Cf.* **micropyle**.

**channelled**. With raised longitudinal edges to form a channel, as in the adaxial petiole surface of many cycads.

**character states**. Changeable attribute of any given character, e.g. if sarcotesta color is a character, then red and yellow are character states. Many character states are simply recorded as present or absent.

**character**. Identifiable and heritable trait which can be used in comparing one taxon with another.

**chartaceous**. Papery in texture. *See also* **membranous**, **papyraceous**.

**chlorophyll**. Green plant pigment in the cells of some bacteria and in plant **chloroplasts**, which captures energy from sunlight; an electron donor in **photosynthesis**.

**chloroplast**. Plant cellular organelle in which **photosynthesis** occurs. *See also* **chlorophyll**.

**chromatid**. One of the pair of threadlike forms of each **chromosome**.

**chromosome**. Submicroscopic filamentous strand of **DNA** and associated proteins in the nucleus of all cells, by which hereditary information is transmitted from generation to generation. *See also* **centromere**, **chromatid**.

**CI**. Consistency Index, a measure of the amount of **homoplasy** for a character in a **cladogram**. *See also* **RC**, **RI**.

**circinate.** Rolled in a coil-like manner with the apex innermost, as in leaflets of emerging leaves of *Cycas* species, hence *C. circinalis*. *See also* **conduplicate, inflexed, ptyxis, reflexed, vernation**.

**CITES.** Convention on International Trade in Endangered Species, a United Nations treaty which sets out a conservation regulatory process between the signatory countries.

**clade.** One particular **monophyletic** branch in a **cladogram**.

**cladistics.** Method of classification that groups taxa hierarchically and parsimoniously into nested sets according to their **synapomorphies**; the output conventionally presented in the form of a **cladogram**.

**cladogram.** Tree diagram based on parsimony analysis showing taxa grouped hierarchically in nested sets according to their **synapomorphies**. A cladogram has no connotation of ancestry and has no implied time axis. *See also* **dendrogram, phenogram, phylogram**.

**classification.** Grouping of taxa or taxonomic groups into categories according to an overall plan.

**clone.** Set of genetically-identical individuals produced vegetatively from the same progenitor.

**coevolution.** Concurrent evolution of two different but interdependent organisms, as in the case of a cycad and its insect pollinator.

**collar.** In cycads, a coloured or textured band at base of a rachis, e.g. as seen in *Encephalartos lehmannii* leaves; a glandular swelling at the base of a leaflet e.g. as seen in *Zamia manicata* leaves.

**combinatio nova, comb. nov.** Nomenclatural new combination usually made by transferring a specific epithet from one genus to another. e.g. *Dyerocycas micholitzii* (Dyer) Nakai was a *combinatio nova* from *Cycas micholitzii* Dyer.

**community.** Total of all living species in a particular habitat.

**conduplicate.** Folded together lengthwise, usually in two equal halves, as in leaflets of emergent *Stangeria* leaves. *See also* **circinate, inflexed, ptyxis, reflexed, vernation**.

**cone.** Reproductive structure of gymnosperms; organised collection of sporophylls on a central axis. *See also* **strobilus, megasporangiate** and **microsporangiate strobili**.

**confer, cf.** Latin, meaning ‘compare’.

**congeneric.** Belonging to the same genus; e.g. it is now thought that *Epicycas* is congeneric with *Cycas*.

**consensus tree. Cladogram** representing the clades found in all the most parsimonious trees of an analysis, often from a large number of possible resolutions.

**conspecific.** Belonging to the same species; e.g. some workers believe that *Encephalartos altensteinii* and *E. natalensis* are conspecific.

**contiguous.** Touching or neighboring, as a common border between two countries.

**contractile.** Of roots, and occasionally stems, which contract so as to pull the stem apex lower into the ground.

**convergence.** Evolutionary process where dissimilar organs or organisms show strong superficial similarities.

**coralloid root.** Club-shaped **apogavitropic (apogeotropic)** root with the potential for hosting symbiotic **Cyanobacteria**.

**coriaceous.** Leathery in texture, as for the leaflets of many cycad species.

**corruptel.** Kernel of a **corruptule** (Grobbelaar, 2002).

**corruptule.** Unfertilised ovule that is superficially indistinguishable from a true seed (Grobbelaar, 2002).  
*See also omnule.*

**CSG.** Cycad Specialist Group, a conservation-based group within the **IUCN**.

**cuneate.** Wedge-shaped and attached at the narrow end.

**Curculionidae.** Weevil family of insects.

**cuticle.** In plants, the outer waxy layer of an epidermis, comprising mainly **cutin** with lesser amounts of overlaying waxes and polysaccharides.

**cutin.** Complex polymeric mixture of fatty acids and phenolic compounds; the main component of a plant **cuticle**.

**Cyanobacteria.** Group of bacteria capable of photosynthesis, previously known as blue-green algae, found in **coralloid roots** of cycads.

**Cycad Action Plan.** Series of proposals for cycad conservation drafted by the **CSG**.

**Cycadales.** Gymnosperm plant order containing all extant and extinct cycads.

**cycads.** Members of the plant order **Cycadales**.

**cycasin.** Toxic **MAM** glycoside found only in cycad tissue; methylazoxymethanol- $\beta$ -D-glucopyranoside.  
*See also macrozamin.*

**cymbiform.** Boat-shaped.

**cytology.** Study of the structure, physiology and reproduction of cells.

**DAF.** DNA Amplification Fingerprinting, a technique used in **DNA** analysis.

**decumbent.** Of stems, lying along the ground but turning upwards distally. *See also procumbent, prostrate.*

**decurrent.** Extending basipetally from the point of insertion, as for *Lepidozamia* leaflets where the leaflet base extends downwards along the rachis.

**dehiscence.** Rupturing process where the contents of a plant structure are released, as in pollen shedding.

**deltran optimization.** Optimization technique used in **cladistics**, based on ‘delayed transformation’ and favouring independent gains rather than acquisition and reversal. *Cf. actran optimization.*

**dendrogram.** Generic term for any kind of tree diagram, including **cladograms**, **phenograms** and **phylograms**.

**dentate.** Having sharp indentations or **teeth** along the edge of a structure and perpendicular to its margin.  
*See also serrate.*

**denticulate.** Finely **dentate**. *See also serrate, serrulate.*

**determinate.** With growth of an axis ceasing at a particular stage. *Cf. indeterminate.*

**dichotomous.** Branching into two equal parts, as in forked branching of stems of *Cycas elongata*, leaflets of *Macrozamia stenomera* or megasporophyll lobes of *Cycas segmentifida*. Also used in reference to branching patterns in **dendrograms**.

**dimorphic.** Having two different forms. *See also homomorphic, monomorphic, polymorphic.*

**dioecious.** Having male and female reproductive parts on different plants. All extant cycads are dioecious.

**diploid.** Having a pair of **chromosomes** of each kind. *Cf. haploid.*

**discriminant analysis.** Statistical technique used in separating discreet sets of objects.

**disjunct.** Separated geographically, pertaining to populations of the same taxon occurring in more than one geographical area.

**distal.** Furthest away from the center of a structure or, more commonly, furthest from its point of attachment; terminal; apical. *Cf. proximal.*

**DNA.** Deoxyribonucleic acid; desoxyribonucleic acid, the molecule in which an organism's genetic definition is determined by the sequence of nitrogenous bases projecting along a 'backbone' of sugar moieties linked by phosphodiester bonds.

**ecology.** Study of relationships of living organisms to each other and to their physical and chemical environment.

**ecosystem.** Sum of all biological, chemical and physical components of an area and their interaction.

**edaphic.** Relating to the soil environment, e.g. soil quality, pH, etc.

**electrophoresis.** Analytical technique in which an electrical gradient is used to separate compounds, especially proteins, according to their charge and molecular mass.

**elliptic.** Of a two-dimensional structure that is widest near the middle but narrowed towards each rounded end. *See also obovate, ovate.*

**elongate.** Lengthened or drawn out, e.g. as for the megasporophyll apical spines of *Cycas elongata*.

**embryo.** In seeds, diploid tissue arising from the **zygote**, until the time of germination.

**embryology.** Study of the morphology and development of **embryos**, **pollen**, **megagametophytes** and microgametophytes.

**endemic.** Restricted in occurrence to a particular area; e.g. *Microcycas calocoma* is endemic to Cuba.

**endocarp.** Internal layer of a fruit wall; misapplied to the **endotesta** in cycads.

**endosperm.** Triploid (or more) nutritive tissue within angiosperm seeds; misapplied to the **megagametophyte** of cycad seeds.

**endotesta.** Inner layer of a seed coat.

**ensiform.** Sword-shaped, as approximated by the leaflets of some cycads, e.g. *Cycas media* subspecies *ensata*.

**entire.** With a continuous margin; not toothed or lobed; without incisions of any kind.

**entomophily.** Pollen transfer brought about by insects. *Cf.* **anemophily.**

**eophyll.** First leaf produced by a seedling. *See also* **euphyll.**

**epidermis.** Outermost primary cellular layer of an organism. *Cf.* **hypodermis.**

**epigeous.** Occurring above soil level, as for the stems of **arborescent** cycads. *Cf.* **hypogeous.**

**epiphytic.** Growing on another plant non-parasitically, or on some other elevated support.

**epithet.** Second word of a botanical binomial; the specific or subspecific epithet.

**etymology.** Dealing with the origin of words. Species descriptions commonly give the etymology for the specific **epithet.**

**eukaryote.** Organism having cells with a true **nucleus**, as for all plants and animals.

**euphyll.** Conventional foliage leaf, not modified in any way. *See also* **eophyll.**

**ex situ.** Of plants or plant collections in cultivation outside their natural habitat.

**exclamation mark, !** Used in taxonomic literature to signify that a particular herbarium specimen has been examined by the writer. *Cf.* **non visus (n.v.).**

**exsiccatum**, plural **exsiccata.** Dried specimen material; **plantae exsiccatae** refers to herbarium specimens.

**extant.** Existing at the present time. *Cf.* **extinct.**

**extinct.** No longer existing; e.g. *Encephalartos woodii* is believed to be extinct in the wild. Amongst the very many extinct cycad genera are: *Ceratozamites*, *Crossozamia*, *Dioonites*, *Eostangeria*, *Palaeocycas*, *Pseudoctenis*, *Ticoa* and *Zamites*. *Cf.* **extant.**

**facet.** Flattened terminal, median or lateral section of a sporophyll **bullae** defined by ridges; in cycads the terminal facet is often rhombic in outline.

**falcate.** Curved in a sickle shape, as for the leaflets of *Cycas falcata*.

**family.** Taxonomic rank below **order** but above **genus**. Cycad families comprize the Cycadaceae, Stangeriaceae and Zamiaceae, with some authors separating Boweniaceae as a fourth family.

**farinaceous.** Having the texture of flour or similar starchy material; sometimes referring to a dusty covering.

**fasiculate.** Arranged in a whorl, as for the leaflets of the common form of *Ceratozamia hildae*.

**ferrugineous.** Rusty brown in appearance, as for the **tomentum** at the stem apex of *Cycas ferruginea*.

**fertilization.** Union of male and female **gametes** resulting in a **zygote**.

*fide.* According to; by the assurance of. *See also sensu.*

*filius, fil.* or *f.* Son of, used in reference to father-and-son **authors** of taxa.

**flabellate.** Fan-shaped, as in the megasporophyll blade of some *Cycas* species.

**flavonoid.** Large range of plant secondary metabolites comprising specific phenolic compounds, usually occurring as glycosides, often coloured as in many plant pigments.

**flexuose.** In a zig-zag shape, as used in allusion to the much twisted rachis of *Macrozamia flexuosa* leaves.

**floccose.** Bearing soft, uneven hairs.

**foliiform.** Leaf-like.

**Fourier transformation.** Mathematical process converting state space to frequency space, usually applied to time series data to find periodic signals.

**frond.** Having the form of a fern leaf; commonly misapplied to other pinnately-compound leaves, as in palms and cycads.

**funiculus**, plural **funiculi.** Attachment stalk of an **ovule**.

**furfuraceous.** Covered with bran-like scales or powder, as for the emergent foliage of *Cycas furfuracea* and *Zamia furfuracea*.

**fusiform.** Spindle-shaped; narrowed at each end and swollen centrally.

**gamete.** Mature male (sperm) or female (egg) cell able to take part in reproduction.

**gametophyte.** **Haploid** structure or tissue; that component of the life cycle which produces **gametes**.

**gene.** Specific part of the **DNA** molecule which comprizes the basic unit of inheritance, each prescribing a code for the synthesis of a specific protein.

**genealogy.** Line of descent from an ancestor through its derivatives; the ‘pedigree’ of an organism. *See also lineage.*

**genetics.** Study of genes and genetic processes.

**genome.** Entire genetic complement of an organism or clone, as defined by its **haploid** chromosome complement. *See also* **genotype**.

**genotype.** Genetic constitution of an organism or clone. *See also* **genome**. *Cf.* **phenotype**.

**genus novum, gen. nov.** Citation at the time a new genus is first described. *See also* **species nova**.

**genus, plural genera.** Taxonomic rank below **family** but above **species**. Extant cycad genera comprise *Bowenia, Ceratozamia, Chigua, Cycas, Dioon, Encephalartos, Lepidozamia, Macrozamia, Microcycas, Stangeria* and *Zamia*. *Aulacophyllum* is now considered **congeneric** with *Zamia* while *Dyerocycas* and *Epicycas* are **congeneric** with *Cycas*.

**glabrous.** Of a smooth surface, without hair of any kind.

**glaucous.** Of a surface covered by a bluish grey waxy or powdery bloom, as for the foliage of *Macrozamia glaucophylla*. *See also* **pruinose**.

**GPS.** Global Positioning System; worldwide electronic satellite-linked system for establishing latitude, longitude and altitude.

**gymnosperms.** Loosely-related (**polyphyletic**) group of seed-bearing but non-flowering plants, including cycads, conifers, *Ephedra, Ginkgo, Gnetum, Welwitschia* together with various extinct taxa. All bear ovules, later seeds, without any enveloping pericarp.

**habit.** Growth form of an organism.

**habitat.** Environment where a plant or animal exists naturally.

**haploid.** Having only one set of **chromosomes**. *Cf.* **diploid**.

**hirsute.** Covered with short coarse hairs, as for the leaves of *Encephalartos hirsutus*. *See also* **lanate, pilose, pubescent, sericeous, tomentose**.

**histology.** Study of biological tissues.

**holotype, holo.** Single herbarium specimen or illustration of the type collection used or designated by the author of the name. *See also* **isotype, lectotype, neotype, paratype**.

**homology.** Features having a common origin but not necessarily the same function, e.g. cycad leaves, cataphylls and sporophylls. *See also* **apomorphy, autoapomorphy, homoplasy, plesiomorphy, symplesiomorphy, synapomorphy**.

**homomorphic.** Of a population, uniform in morphology. *See also* **dimorphic, monomorphic, polymorphic**.

**homoplasy.** Mistaken homology; superficial similarity between characters or character states due to convergent or parallel evolution or by reversal; e.g. the occurrence of bipinnately compound leaves in *Bowenia* and *Cycas*.

**hybrid.** Natural or artificially produced plant resulting from a cross of genetically-dissimilar parents, commonly between two different species.

- hypocotyl.** Embryonic axis at the time of seed germination; that part from which the first leaf emerges.  
See also **radicle**.
- hypodermis.** Cellular layer immediately internal to an **epidermis**.
- hypogeous.** Occurring below soil level; subterranean, as for the stems of *Stangeria eriopus*, many *Zamia* species and most *Macrozamia* Section *Parazamia* species. *Cf.* **epigeous**.
- hypostomatic.** Of leaves and leaflets with **stomata** on the **abaxial** surfaces only. *Cf.* **amphistomatic**.
- ICBN.** International Code of Botanical Nomenclature, e.g. St Louis Code of 2000.
- idioblast.** Specialized cell with inclusions, in cycads storing toxins possibly as a herbivore deterrent; a cell without known function.
- imbricate.** Overlapping, as for leaflets of many *Encephalartos* species. See also **incubous**, **succubous**.
- imparipinnate.** Of a leaf or leaflet where the rachis or rachilla terminates in a solitary pinna or pinnule.  
*Cf.* **paripinnate**
- incertae sedis.** Of uncertain placement in a classification system.
- incubous.** Arrangement in which a leaflet partially shields the leaflet above (the next distal leaflet) when viewed from above (adaxially). *Cf.* **succubous**.
- incurved.** With apex bent or curving adaxially. *Cf.* **recurved**.
- indeterminate.** With growth of the axis continuing indefinitely. *Cf.* **determinate**.
- indumentum.** Covering of **trichomes** or scales. *See also* **tomentum**.
- ineditus, ined.** Unpublished, often in reference to an anticipated new species description.
- inerm.** Without spines or prickles; unarmed, as for the leaves of *Zamia inermis*. *Cf.* **armed**.
- inflexed.** Bent longitudinally inwards (adaxially) as in emerging leaves of many *Zamia* species. See also **circinate**, **conduplicate**, **inflexed**, **ptyxis**, **reflexed**, **vernation**.
- insertion angle(s).** See **leaflet angle(s) of insertion**.
- integument.** Outer covering of an ovule, forming the layers of seed coat at maturity. See also **sarcotesta**, **sclerotesta**.
- interstitial region.** Intervening zone between areas of defined structure.
- involute.** With margins rolled inwards (adaxially). *Cf.* **revolute**.
- isoenzymes, isozymes.** Differing molecular forms of an enzyme that serve the same function.
- isotype, iso.** Herbarium specimen that is a duplicate of (having the same collection details as) the **holotype**. This term also has other applications, e.g. in immunology. *See also* **lectotype**, **neotype**, **paratype**.

**ITS.** Internal transcribed spacer region of a gene. ITS2 is often used for cycad DNA analysis.

**IUCN.** The World Conservation Union. Originally, the International Union for Conservation of Nature and Natural Resources, a United Nations organization.

**juvenile.** Not fully developed; not yet capable of sexual reproduction. *Cf.* **mature.**

**karyology.** Dealing with the characteristics of **chromosomes**, commonly in terms of their number and morphology.

**lamina**, plural **laminae.** Flattened and expanded portion of a leaf, sporophyll or similar structure; blade.

**lanate.** Woolly with long, intertwined curly hairs, as for the stem apex, emergent leaves and cones of *Encephalartos lanatus*. *See also* **hirsute**, **pilose**, **pubescent**, **sericeous**, **tomentose**.

**lanceolate.** Lance-shaped, much longer than broad, with a wide base, tapered apex and widest below the center. *See also* **oblanceolate**.

**lateral.** At or on the side of an organ.

**leaf stalk.** Stalk of a leaf; **petiole**.

**leaflet.** Primary division of a compound leaf; **pinna**.

**leaflet angle(s) of insertion. Pinna-pinna (pp) angle:** angle on adaxial side of a compound leaf subtended by leaflets on opposite sides of the rachis. **Pinna-rachis (pr) angle:** distal angle between leaflet and rachis. **Shielding (s) angle:** Angle by which a leaflet is transversely twisted often to result in overlapping. If leaflets overlap incubously, the *s*-angle is nominally positive; if leaflets overlap succubously, the *s*-angle is nominally negative (Grobbelaar, 2002).

**lectotype, lecto.** Herbarium specimen chosen from the original material to replace a missing **holotype** or **isotype**. A duplicate of a lectotype is an isolectotype (isolecto.). *See also* **isotype**, **neotype**, **paratype**.

**Lepidoptera.** Order of insects that includes moths and butterflies.

**lignified.** Of cell walls impregnated with **lignin**.

**lignin.** Complex insoluble polysaccharide mixture serving to strengthen and protect cell walls. *See also* **xylem**.

**lineage.** Line of descent of an organism; ancestry. *See also* **genealogy**.

**linear.** Long and narrow, the sides parallel or nearly so.

**lit(t)oral.** Of the coast or shore, as for the habitat for *Cycas littoralis*.

**lobe.** Deeply incised segment of a flattened organ such as a leaf, leaflet or sporophyll.

**macrozamin.** Toxic **MAM** glycoside found only in cycad tissue; methylazoxymethanol- $\beta$ -primeveroside. *See also* **cycasin**.

**MAM.** Methylazoxymethanol, the toxic principle found as its glycoside in **cycasin**, **macrozamin** and structurally-related compounds in cycad tissues.

- manoxylic.** Having a small amount of secondary xylem or woody tissue with relatively abundant **parenchyma**, as in cycad stems.
- masting.** Simultaneous reproductive activity by all or most plants in a particular area, typically seasonal and separated by long periods of low reproductive activity.
- mature.** Capable of sexual reproduction. *Cf.* **juvenile.**
- megagametophyte.** Mass of **haploid** cellular tissue surrounding the embryo in a gymnosperm seed; analogous in function but not in origin to the **endosperm** of angiosperm seeds.
- megasporangiate strobilus**, less correctly **megastrobilus.** Female **strobilus**; female cone; seed cone, **ovulate cone.** *Cf.* **microsporangiate strobilus.**
- megaspore.** Spore that gives rise to a female gametophyte. *Cf.* **microspore.**
- megasporophyll.** Sporophyll bearing one or more ovules or later seeds, or potentially so. *Cf.* **microsporophyll.**
- membranous**, less commonly **membranaceous.** Thinly textured, as in a membrane. *See also* **chartaceous**, **papyraceous.**
- micropyle.** Orifice in the **integuments** and later seedcoats, at the distal end of a cycad ovule, through which the pollen or pollen tube enters. *Cf.* **chalaza.**
- microsporangiate strobilus**, less correctly **microstrobilus.** Male **strobilus**; male cone; pollen cone. However, in *Ceratozamia microstrobila* the allusion is to the small size of cones. *Cf.* **megasporangiate strobilus.**
- microsporangium**, plural **microsporangia.** Structure on the abaxial surface of **microsporophylls** containing **microspores**; pollen sacs.
- microspore.** Spore that gives rise to a male gametophyte; **pollen** grain. *Cf.* **megaspore.**
- microsporophyll.** Sporophyll bearing **microsporangia.** *Cf.* **megasporophyll.**
- monomorphic.** Having only one form. *See also* **dimorphic**, **homomorphic**, **polymorphic.**
- monophyletic.** Derived from a single ancestor. *See also* **paraphyletic**, **polyphyletic.**
- monospecific.** Of a genus with only one species, as for *Microcycas* and *Stangeria*.
- monothetic.** Of a group sharing all features. *See also* **polythetic.**
- monotypic.** Of a family with only one genus, or a genus with only one species. Cycadaceae is a monotypic family while *Microcycas* and *Stangeria* are monotypic (and monospecific) genera.
- montane.** Of mountains or high places, as for the localities for *Macrozamia montana* and *Zamia montana*.
- morphogeographic.** Combining aspects of shape and distribution, i.e. morphology and geography.
- morphology.** Study of the external architecture of any entity.

**morphometric.** Involved with the measurement of morphological characters.

**mucilage canal.** Passage within an organ which allows for the transport of **mucilage**.

**mucilage.** Gelatinous substance; in cycads comprising complex water-soluble carbohydrates and produced in response to stress, e.g. to wounding.

**mucronate.** Ending abruptly in a sharp point or spur known as a mucro.

**multipinnate.** Of a compound leaf, having more than two orders of division, as in *Cycas multipinnata*.  
*See also bipinnate.*

**multivariate analysis.** Simultaneous statistical analysis of two or more variables.

**mycorrhiza**, plural **mycorrhizae.** Web of root-like structures arising from a symbiotic association of a fungus and a plant, and facilitating nutrient uptake by the host plant.

**neotype, neo.** New material designated to replace a missing **holotype** when no original material remains in a herbarium collection. *See also isotype, lectotype, paratype.*

**nomen dubium, nom. dub.** Name of doubtful taxonomic validity. E.g. the name *Encephalartos tridentatus* (Willdenow) Lehmann (*Pugillus* 6, 1834) is a *nomen dubium* which may refer to several species of *Encephalartos* or *Macrozamia*.

**nomen illegitimum, nom. illeg.** Name published in contravention of the rules of nomenclature. E.g. *Zamia brongniartii* Weddell is a *nomen illegitimum*, being a superfluous name for *Ceratozamia boliviana* Brongniart.

**nomen novum, nom. nov.** New name designated when a name cannot be used for nomenclatural purposes and no type or original material exists.

**nomen nudum, nom. nud.** or **nomen solum, nom. sol.** Avowed new name unaccompanied by a description or diagnosis. E.g. Linden's name *Cycas neocaledonica* (*L'Illustration Horticole* 28, 1881).

**nomenclature.** Assignment of names to taxa; in botany in accordance with the International Code of Botanical Nomenclature.

**non visus, n.v.** In reference to an item not seen, as in the case of a herbarium specimen that could not be examined. *Cf. exclamation mark (!).*

**nucleus.** Core part of any eukaryotic cell, a membrane-encased organelle containing the genetic material.

**oblanceolate.** Lance-shaped, much longer than broad, with a wide apex, tapered base and widest above the center. *See also lanceolate.*

**obligate.** Restricted to only one taxon or activity, as in an obligate pollinator.

**obovate.** Of a two-dimensional structure that is egg-shaped in outline but broadest above the middle. *See also elliptic, ovate.*

**obovoid.** Of a three-dimensional structure that is **obovate** in longitudinal section. *See also ovoid.*

**obtuse.** Blunt or rounded at the apex.

**omnel.** Kernel of an **omnule**; a ‘cleaned cycad seed’ (Grobbelaar, 2002).

**omnule.** Collective term for mature cycad seeds and fully-expanded unfertilised ovules that are externally indistinguishable; ‘cycad seed’ (Grobbelaar, 2002).

**ontogeny.** Developmental cycle or ‘life-history’ of an individual from its inception until its sexual maturity.

**opere citado, op. cit.** In reference to a publication already cited. This phrase is no longer used in modern scientific writing.

**order.** Taxonomic rank below division or class but above **family**.

**orthostichy**, plural **orthostichies**. Row created by intersection of contact **parastichies**. Sporophylls in *Ceratozamia* and *Zamia* cones show well-defined orthostichies in a near-vertical arrangement.

**OTU.** Operational Taxonomic Unit. Any convenient taxonomic unit used in **cladistics** and **phenetics**.

**outgroup.** In **cladistics**, an organism or group, closely related to, but not included within the group under analysis, and used for comparative purposes with respect to character polarity determination. *See also sister group*.

**ovate.** Of a two-dimensional structure that is egg-shaped in outline but broadest below the middle. *See also elliptic, ovate*.

**ovoid.** Of a three-dimensional structure that is **ovate** in longitudinal section. *See also obovoid*.

**ovulate cone/strobilus.** Female cone; **megasporangiate strobilus**.

**ovule.** Female reproductive structure; in seed plants comprising a **megaspore**, or megaspore-derived tissue, one or more **integuments** and an attachment stalk (**funiculus**).

**pachycaulous.** Thick-stemmed and columnar but without any substantial secondary wood, as for the stems of arborescent cycads.

**paleoendemic, palaeoendemic.** Referring to a taxon that is a geographical remnant of a taxon formerly of much wider geographical distribution.

**paleontology, palaeontology.** Study of organisms from former geological periods, typically fossilized plants or animals or their parts.

**palyology.** Study of all aspects of pollen from extant and extinct plants.

**papyraceous.** Papery in texture. *See also chartaceous, membranous*.

**paraphyletic.** Of an artificial group comprising a single ancestor and some, but not all, of its descendants. *See also monophyletic, polyphyletic*.

**parastichy**, plural **parastichies**. Spiral arrangement of leaves on an axis (or sporophylls in a cone). *Encephalartos*, *Lepidozamia* and *Macrozamia* cones show well-defined clockwise and anticlockwise parastichies. *See also orthostichy*.

**paratype, para.** Herbarium specimen cited in a description together with the **holotype** and any **isotypes**.  
*See also lectotype, neotype.*

**parenchyma.** Thin-walled cells in storage tissues such as the cortex zone between the epidermis and vascular tissue. The starch-rich stems of *Stangeria eriopus* and similar cycads are mainly parenchymatous.

**paripinnate.** Even-pinnate; of a leaf or leaflet where the rachis or rachilla does not terminate in a solitary pinna or pinnule. *Cf. imparipinnate.*

**PCR.** Polymerase Chain Reaction, a technique for duplicating a small amount of DNA into a large number of DNA fragments of identical sequence, selectively controlled by a chosen DNA primer. *See also RAPD.*

**pectinate.** Comb-like; with closely-spaced, narrow segments, as in the megasporophyll of *Cycas pectinata*.

**pedicel.** Supporting stalk of a flower or gymnosperm sporophyll. *See also peduncle.*

**peduncle.** Supporting stalk of an inflorescence or gymnosperm cone. *See also pedicel.*

**peltate.** With a stalk positioned centrally on the surface of a lamina or sporophyll, as for most cycad **bullae**.

**pendent, pendulous.** Hanging downwards, as for the female cones of many *Dioon* species.

**petiole.** Stalk of a leaf; in a compound leaf, that part of the axis below the lowermost leaflets, pinnacanth or spines. *See also rachis.*

**petiolule.** Stalk of a leaflet, that part of the axis below the leaflet blade, as seen clearly in *Zamia manicata*. *See also rachilla.*

**phenetic.** Condition of an overall similarity of chosen characters between taxa but without regard to whether the characters are derived or due to convergence. *See also Adansonian.*

**phenology.** In plants, the study of recurrent phenomena, such as episodes of reproduction, in relation to seasonal patterns.

**phenogram.** Tree diagram showing taxa arranged hierarchically on the basis of phenotypic similarities without any regard for ancestry. *See also cladogram, dendrogram, phylogram.*

**phenotype.** Sum total of morphological or other characters defining an organism or group. *Cf. genotype.*

**pheromone.** Volatile chemical substance emitted by an organ and acting as a signal to other organisms, as in cycad cone emissions attracting insect pollinators.

**photosynthesis.** Fundamental process in biosynthesis, by which carbon dioxide and water are converted to simple sugars using sunlight as an energy source. *See also chlorophyll.*

**phylogram, phylogenetic tree. Cladogram** where branch lengths are proportional to the number of changes that occur at each branch. *See also dendrogram, phenogram.*

**phylogeny.** Evolutionary history of an organism or group.

**physiographic.** Relating to physical geography.

**physiology.** Study of the functioning of organisms and their parts.

**phytochemistry.** Study of plant chemistry, particularly in relation to secondary metabolites.

**phytogeography.** Study of plants and their distribution in relation to geographic factors.

**pilose.** With soft hairs. *See also lanate, hirsute, pubescent, sericeous, tomentose.*

**pinna, plural pinnae.** Primary division of a compound leaf; **leaflet.**

**pinnacanth.** Sharply-pointed structure intermediate between a leaflet and a **spine**, usually green and hence photosynthetic, as seen in on the rachises of some species of *Dioon*, *Encephalartos* and *Macrozamia*. *See also prickle, tooth.*

**pinnate.** Feather-shaped; typically a leaf with **leaflets** or **pinnae** on either side of a **rachis**. *See also bipinnate, multipinnate, pinnule.*

**pinnule.** Secondary division of a compound leaf. *See also pinna.*

**planche.** French term used in some of the older botanical literature to denote illustrative plate. *See also tabula.*

**platyspermic.** Of seeds, flattened so as to be not radially symmetrical, as in *Cycas* seeds. *See also actinomorphic, zygomorphic. Cf. radiospermic.*

**plesiomorphy.** Ancestral or underived character or character state. Note that a plesiomorphy at a given hierarchical level may be an **apomorphy** at a more inclusive level. *See also autapomorphy, homology, symplesiomorphy, synapomorphy.*

**plicate.** Pleated or folded longitudinally to give as corrugated appearance, as for the leaflet surface of *Zamia roezlii*.

**plumose.** Feathery in a whorled appearance.

**pollen.** Fine powdery material (**microspores**) shed from the **microsporangia** of seed plants; in cycads sometimes referred to as **prepollen**; microspores containing a male gametophyte (microgametophyte).

**pollen cone/strobilus.** Male cone; **microsporangiate strobilus.**

**pollination.** Transfer of pollen towards ovules. *See also anemophily, entomophily.*

**polymorphic.** Persistently variable in form, as for populations of *Macrozamia polymorpha* and *Zamia polymorpha*. *See also dimorphic, homomorphic, monomorphic.*

**polyphyletic.** Of an artificial group comprising members that have originated independently from more than one ancestor. *See also monophyletic, paraphyletic.*

**polythetic.** Referring to a group sharing many, but not all, features. *See also monothetic.*

**population.** Group of individuals of a species occupying a particular area.

**prepollen. Microspore** with a proximal aperture but without a distal aperture. Cycad **pollen** is considered an intermediate form between prepollen and ‘conventional’ pollen.

**prickle.** Small sharp protuberance of epidermal origin, usually green, usually somewhat irregularly distributed, as seen on the petioles of most *Ceratozamia* and *Zamia* species. **Pinnacanth**s in *Encephalartos* have also been called prickles, but they are not epidermal in origin. *See also* **spine, tooth.**

**procumbent, prostrate.** Trailing or lying along the ground but not rooting; typically referring to stems. *See also* **decumbent.**

**proximal.** Nearest to the point of attachment of a structure; basal. *Cf.* **distal.**

**pruinose.** With surface covered by a waxy bloom, as for the foliage of *Cycas pruinosa*. *See also* **glaucous.**

**ptyxis.** Manner of folding of a leaf and leaflets at emergence. *See also* **circinate, conduplicate, inflexed, reflexed, vernation.**

**pubescent.** Densely covered with fine short hairs. *See also* **lanate, hirsute, pilose, sericeous, tomentose.**

**pungent.** Terminating in a stiff, sharp point.

**r(h)achilla, plural r(h)achillae.** A diminutive of **rachis**; a secondary axis, in particular, in the grasses or sedges, the axis that bears the florets. Sometimes used in reference to the axis along which **pinnules** are attached in cycads having compound leaflets, e.g. *Bowenia*.

**r(h)achis, plural r(h)achides, r(h)achises.** That portion of the axis of a compound leaf where leaflets are attached and excluding the **petiole**, as alluded to in the flattened rachis of *Macrozamia platyrachis* and the dark purple rachis of *Zamia melanorrhachis*.

**radicle.** Embryonic root; often misapplied to the emergent **hypocotyl** in germinating cycad seeds.

**radiospermic.** Of seeds, radially symmetric as for seeds of cycad genera except *Cycas*. *See also* **actinomorphic, zygomorphic. Cf. platyspermic.**

**RAPD.** Random Amplified Polymorphic DNA; a technique in DNA analysis based on patterns obtained in **electrophoresis** after **PCR** amplification using randomly selected primers. *See also* **RFLP.**

**RC.** Rescaled consistency index, the product of the consistency index (CI) and the retention index (RI) for a character in a cladogram.

**recruitment.** Increase in a population due to migration, vegetative proliferation or reproduction from seed.

**recurved.** Bent or curving abaxially. *See also* **reflexed. Cf. incurved.**

**Red List.** IUCN-published listing of plant and animal taxa in terms of perceived **threatened status.**

**reflexed.** Abruptly **recurved** or bent sharply abaxially, as in the emerging leaves of some *Dioon* species. *See also circinate, conduplicate, inflexed, ptyxis, vernation.*

**relictual.** Remaining relatively small portion of a previously larger population or taxon, as for *Encephalartos relictus*.

**revolute.** With margins rolled downwards (abaxially), as in leaflets of *Cycas revoluta* and *Encephalartos ghellinckii*. *Cf. involute.*

**RFLP.** Restriction Fragment Length Polymorphism; a technique used in DNA analysis based on pattern of bands obtained in **electrophoresis** of DNA fragments produced after digestion of sample material by restriction endonuclease enzymes. *See also RAPD.*

**RI.** Retention index, a measure of the amount of similarity in a character that can be interpreted as a **synapomorphy** in a given **cladogram**. *See also CI, RC.*

**ribosome.** Cellular organelle in which protein synthesis occurs.

**sarcotesta**, plural **sarcotestae.** Fleshy outer layer of the **integument** of a cycad seed, brightly-coloured in many cycad genera. *See also sclerotesta.*

**satellite.** Minute chromosome portion separated from the main body by the **centromere** or primary constriction.

**sclerotesta**, plural **sclerotestae.** Hard or stony inner layer of the **integument** of a cycad seed. *See also sarcotesta.*

**scurfy.** Covered with small papery scales.

**section, subsection, series.** Taxonomic ranks used within some genera, e.g. the genus *Macrozamia* comprises two sections, *Macrozamia* and *Parazamia*, while the genus *Cycas* has the four sections *Asiorientales*, *Stangerioides*, *Indosinensis* and *Cycas*, the last having one or more subsections within which may be one or more series.

**seed.** Fully mature **ovule** after fertilization, with an **embryo**, storage tissue and all **integuments**. *See also omnule, corruptule.*

**SEM.** Scanning electron microscope (instrument) or micrograph (image produced by the instrument).

**senescence.** Natural ageing processes leading to the death of an organ or organism.

*sensu lato.* In a broad or all-encompassing sense.

*sensu stricto.* In the narrow or restricted sense.

*sensu.* According to; in the sense of. *See also fide.*

**sericeous.** With fine hairs giving a silky texture. *See also lanate, hirsute, pilose, pubescent, tomentose.*

**series.** *See section.*

**serrate.** With a margin of saw-toothed, sharply-tipped protrusions pointing forwards apically. *See also dentate, tooth, serrulate.*

**serrulate.** Minutely **serrate**, as for leaf margins in *Bowenia serrulata*.

**sessile.** Without any apparent stalk, as for the cones of many cycads; also used in reference to cycad leaves without petioles, e.g. *Encephalartos villosus*.

**sine numero, s.n.** Of a herbarium or other specimen accession that is without any collector's accession number.

**sister group.** In **cladistics**, the group most closely-related to a specific individual or group. *See also outgroup.*

**sorus, plural sori.** Cluster of fern sporangia; term misapplied to groups of microsporangia sharing a common vascular supply in some cycads.

**speciation.** Evolutionary process in which taxa accumulate sufficient genetic change to be recognized as individual species.

**species, sp., plural species, spp.** Basic taxonomic rank; taxonomic rank below **genus** but above **subspecies** and **varietas**. A working definition for cycads is 'one or more populations where individuals are morphologically similar, interfertile, but sometimes geographically and hence reproductively isolated from other such populations'. [*See also the discussions of species concept in this volume.*]

**species complex.** Variable group of closely-related members known or suspected to represent different species but often difficult to circumscribe; usually resolved as a discreet **clade** in taxonomic analysis; e.g. the *Ceratozamia norstogii* complex comprises *C. norstogii*, *C. alvarezii* and *C. mirandae*.

**species nova, sp. nov.** Citation at the time a new species is first described, e.g. *Zamia macrochiera* D.W. Stevenson *species nova* (Chapter 14 this volume). (*Species novum*, whilst often seen in the literature, is grammatically incorrect). *See also genus novum.*

**spermatophyte.** Any seed-bearing plant, including all gymnosperms and angiosperms.

**spermatozoid, sometimes antherozoid.** Motile male gamete of lower plants, cycads, *Ginkgo*, etc.

**spine.** Hard, sharp and non-photosynthetic protuberance with vascular connections and not of epidermal origin. Spines on many cycad rachises and sporophylls are reduced leaflets. *See also pinnacanth, prickle, tooth.*

**spinescent.** Terminating in a sharp point.

**spinulose.** With many small spines, as incorrectly alluded to in reference to the leaflet margins of *Dioon spinulosum* - that are in fact **teeth**.

**sporophyll.** Modified leaf bearing reproductive structures. *See megasporophyll, microsporophyll.*

**SSC.** Species Survival Commission, an agency of the **IUCN**.

**staminate cone/strobilus.** Incorrectly-derived term for male cone; pollen cone; **microsporangiate strobilus**.

**status novus, stat. nov.** New status or rank. E.g. *Encephalartos manikensis* (Gilliland) Gilliland was a *status novus* for the taxon previously named *E.gratus* Prain var. *manikensis* Gilliland.

**stipule.** Appendage at the base of a **petiole**. In *Stangeria*, a hood-like stipule subtends each leaf base.

**stoma**, sometimes **stomate**, plural **stomata**. Orifice allowing gaseous exchange across a plant **epidermis**, structurally defined by guard and subsidiary cells.

**striate.** With longitudinal lines, grooves or ridges.

**striolate.** Finely striate.

**strobilus**, plural **strobili**. Reproductive structure of gymnosperms and some cryptogams such as *Selaginella*; organised collection of sporophylls on a central axis. *See also* **cone, megasporangiate strobilus, microsporangiate strobilus**.

**subspecies, subsp.** Taxonomic rank immediate below species; group of individuals which differ morphologically from another group but insufficiently so to justify separate specific status, e.g. *Cycas media* subsp. *banksii*. Subspecies are reproductively compatible but are reproductively isolated from each other. The usefulness of infraspecific taxonomic categories in cycads is questioned in this volume. *See also* **varietas**.

**succubous.** Arrangement in which a leaflet partially shields the leaflet below (the next proximal leaflet) when viewed from above (adaxially). *Cf.* **incubous**.

**sucker.** Vegetative axis originating from an adventitious bud and giving rise to an aerial branch or a ‘clumping’ effect if subterranean.

**sulcate.** Having a longitudinal groove or furrow. Cycad pollen grains are characteristically monosulcate.

**suture.** Line of opening or dehiscence of a closed structure such as a cycad microsporangium.

**symbiont.** Organism living in a symbiotic relationship with another, e.g. the **cyanobacteria** in cycad **coralloid roots**.

**sympatric.** Of two or more taxa which exist naturally together in the same geographical area. *Cf.* **allopatric**.

**symplesiomorphy.** Ancestral or underived character state shared by several members of a **monophyletic** group that does not define a monophyletic subset of that more inclusive group and has not experienced reversal. *See also* **apomorphy, autapomorphy, pleisomorphy, synapomorphy**.

**synapomorphy.** Shared derived character state that unites two or more members of a **monophyletic** group. E.g. the presence of a glandular collar at the leaflet base is a synapomorphy for a monophyletic group comprising *Zamia macrochiera* and *Z. manicata*. A synapomorphy at one level is an **autoapomorphy** at a more inclusive level. *See also* **apomorphy, pleisomorphy, sympleisomorphy**.

**systematics.** Description and classification of life forms and the study of their relationships.

**tabula.** Latin term used in some of the older French botanical literature to denote a black and white plate. *See also* **planche**.

- taxon**, plural **taxa**. Any group of individuals, in any rank, having characteristics in common and of the same evolutionary origin.
- taxonomy**. Circumscription, classification and naming of organisms; in plants, systematic botany.
- terete**. Solid structure which is circular in transverse section; cylindrical or nearly so.
- thermogenesis**. Self-heating through respiratory activity, as in cones, especially male cones, of many cycads.
- threatened status**. Perceived degree of threat, determined by conservation agencies, to the continued natural existence of individual taxa, e.g. in categories such as Critically Endangered, Endangered and Vulnerable.
- tomentose**. Densely woolly in a finely matted fashion. *See also* **lanate**, **hirsute**, **pilose**, **pubescent**, **sericeous**.
- tomentum**. Covering of fine hairs. *See also* **indumentum**.
- tooth**. Sharply-tipped protrusion along a leaf or leaflet (or analogous structure) margin pointing away at an angle of 90°. *See also* **serrate**.
- topographic**. Relating to physical features, usually of the landscape but also used in reference to the surfaces of structures such as pollen grains, leaves, etc.
- trichome**. Small hair or scale of epidermal origin.
- trnL-F**. Spacer region of the maternally-inherited **chloroplast** genome.
- truncate**. With an abrupt ending, as though cut off terminally.
- t-test** or **Student's t-test**. Statistical tool to assess if the mean values from two sets of data are the same or not.
- tuberculate**. Covered with small raised protuberances, as for the bulla surface of some cycad megasporophylls. *See also* **verrucose**.
- type**, **T**. Herbarium specimen or other element (e.g. illustration) to which the name of a **taxon** is permanently attached, whether as a correct name or a synonym. The type is not necessarily the most typical or representative element of a **taxon**. *See also* **holotype**, **isotype**, **lectotype**, **neotype** or **paratype**.
- undulate**. With wavy margins, usually of leaflets.
- variegated**. Having two or more colours in a blotched or mottled pattern, as for the leaflets of *Zamia variegata*.
- varietas**, **variety**, **var.** Taxonomic rank below **species**; group of individuals which differ morphologically from another group but insufficiently so to justify separate specific status, e.g. *Dioon edule* var. *angustifolia*. Varieties are reproductively compatible, not reproductively isolated from each other and may occur together in mixed stands. The usefulness of infraspecific taxonomic categories in cycads is questioned in this volume. *See also* **subspecies**.

**vascular plant.** Plant having phloem or xylem as conducting tissues, i.e. any Pteridophyte (ferns and their allies) or Spermatophyte (gymnosperms and angiosperms).

**venation.** Pattern of veins in a leaf or leaflet.

**vernation.** Manner of folding of a leaf prior to emergence. *See also* **circinate, conduplicate, inflexed, reflexed, ptyxis.**

**verrucose.** Warty in appearance, as for the **bulla** surface of many cycad sporophylls. *See also* **tuberculate.**

**Wilks-Lambda test.** Statistical test comparing the centroids of a distribution of means; a multivariate analysis of variance. *See also* **ANOVA.**

**xylem.** Water-conducting tissue in vascular plants, comprizing vessels and tracheids, dead at maturity and having a secondary layer of **lignin.**

**zygomorphic.** Of a bilaterally symmetric structure that can be halved only in one plane to give two halves that are mirror images of each other; of seeds, **platyspermic.** *Cf.* **actinomorphic.**

**zygote.** Cell resulting from the fusion of male and female gametes; the first cell of an embryo.

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