

# Expanded Glossary of Cycad Terms

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## INTRODUCTION

Students and growers of cycads will routinely encounter terms that have specific meanings in the context of various scientific subdisciplines—such as biology, ecology, taxonomy, or horticulture. While some such terms are to be expected only in formal botanical descriptions (*e.g.* arcuate, chartaceous, epigeous), a few are exclusive to cycads (*e.g.* omnule, omnel, corruptule, corruptel), and still others are commonly used incorrectly in reference to cycads (*e.g.* bulb, endosperm, frond). The following compilation is based on the “Glossary of Terms Encountered in Cycad Systematics” provided as Appendix 2 in the well-known book, *Cycad Classification: Concepts and Recommendations* (Walters & Osborne, 2004). While this was a wonderfully useful resource, it was specific to taxonomy and systematics and it was somewhat incomplete. The objective of this new ‘expanded glossary’ was to produce a more comprehensive, ever-evolving, and dynamic resource for those interested in cycads and their study and cultivation. The current list includes more than 1,200 terms and will be modified as needed.

## GLOSSARY

The following terms (or the Greek or Latin roots or equivalents) may be encountered in cycad biology, ecology, ethnobotany, evolution, genetics, taxonomy/nomenclature, systematics, and/or cultivation. Cycad-specific examples are provided whenever possible. (NOTE: An illustrated glossary of more than 500 of these terms is provided on the Cycad Society website: [http://www.cycad.org/publications/illustrated\\_glossary.htm](http://www.cycad.org/publications/illustrated_glossary.htm).)

The following notes provide additional useful information for users of the glossary:

1. Items in **boldface** within a definition are defined elsewhere in the list.
2. While *Cf.* literally means ‘to compare’, in most cases it indicates a term of opposite meaning.
3. Rather than providing citations for each new entry in the expanded list of terms, the additional sources used will be included in the References section, with the primary sources—those from which multiple entries were obtained—indicated in **boldface**.
4. Individual citations are included in a few entries for which the terms and/or definitions are specific to, or originally published in, the cited sources.

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**a-**. Prefix meaning ‘not’. *See also in-*.

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

**abaxial face**. Upper side of a **sporophyll**. *Cf.* **adaxial face**.

**abscission**. Physiological 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**, leaf-like organ, or section of **stem**. *See also caducous, deciduous*.

**abscission layer**. Region of tissue designed to separate cleanly, *e.g.* the **leaf bases** of most cycad **species**.

**acanthos**. Greek, meaning ‘**spine**’, *e.g.* the root word for the second part of the **specific epithet** of *Cycas brachyacantha*, referring to the characteristically short **petiolar** spines. *See also brachys*.

**acaulescent**. Without any evident **trunk** or **stem**. *See also hypogeous. Cf. caulescent, epigeous*.

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- acclimate.** To **adapt** to a new environment or to a change in the environment.
- acrocentric.** Of a **chromosome**, having its **centromere** near (but not at) one end. *Cf.* **metacentric**, **telocentric**.
- acropetal**, adj. **acropetally.** Progressing in direction from **promixial** to **distal**; from base to **apex**, *e.g.* as for the **pollen dehiscence** sequence in most cycad **cones**. *Cf.* **basipetal**.
- acroscopic**, adj. **acroscopically.** Facing upwards, towards the **apex** of the **axis** on which it is borne. *Cf.* **basiscopic**.
- acrostichoid.** Having **sporangia** apparently scattered on the surface of the **microsporophyll**.
- 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**, *e.g.* the **petiole** of *Cycas aculeata*.
- acuminate.** Tapering to a protracted point, with sides somewhat concave, *e.g.* the **leaflets** of *Zamia acuminata*. *Cf.* **acute**.
- acute.** Narrowing to end in a sharp point, as for the **leaflets** of many cycad **species**. *Cf.* **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**.
- adaptation**, adj. **adapted.** Any **morphological**, **physiological**, or **developmental character** that enhances survival or reproductive success of an organism. *See also* **natural selection**.
- adaxial.** Side of an organ facing toward a central **axis**, *e.g.* the upper side of a **leaf** or **leaflet**. *Cf.* **abaxial**.
- adaxial face.** Lower side of a **sporophyll**. *Cf.* **abaxial face**.
- adenine (A).** A purine base, C<sub>5</sub>H<sub>5</sub>N<sub>5</sub>, that is the **nucleotide** constituent involved in **base pairing** with **thymine (T)** in **DNA** and with **uracil (U)** in **RNA**. *See also* **cytosine (C)**, **guanine (G)**.
- admixture.** State of being mingled or mixed, *e.g.* a freely breeding **population**.
- adult.** Reproductive **life cycle** stage having a visible **stem** (**erect** in **arborescent species**) and **leaves** arranged in one or more well-developed **cohorts** or **crowns** (*sensu* Yáñez-Espinosa, 2009); **mature**. *Cf.* **juvenile**, **seedling**.
- adult leaf.** **Leaf** of a **mature** plant that is typical in **form** (but different from those of juvenile plants, **offsets**, and/or **suckers** of the same **species**). *Cf.* **juvenile leaf**.
- adventitious.** Structures arising in abnormal positions.
- adventitious bud.** Vegetative **growth** arising on a cycad **stem**, giving rise to **suckers** at the base or **offsets** on the **aerial** stem.
- aemulans.** Latin, meaning ‘equalling’, *e.g.* the **specific epithet** of *Encephalartos aemulans*, referring to its similar **male** and **female cones**.
- aerial.** Above-ground; in cycads, referring to **arborescent stems**. *See also* **caulescent**, **epigeous**. *Cf.* **acaulescent**, **hypogeous**.
- aerial branch.** Uncommonly used term for a well-developed **offset**. *Cf.* **sucker**.
- affinis (affin., aff.).** Latin, meaning ‘akin’ or ‘allied to’, used in reference to a **specimen** that is similar to, but shows some differences from, a known **species**.
- AFLP.** Amplified fragment length polymorphism, a type of **DNA** analysis used to study relationships among **populations** or **species**. *See also* **RAPD**, **RFLP**.

- after-ripening period.** Period of time after the **seeds dehisce** from the **female cone** during which the **pro-embryo** continues to **grow** and **develop** into a **mature embryo**.
- age class.** Category comprising individuals of a given age within a **population**. *See also cohort.*
- age of cycads.** That period of Earth's history dominated by cycads; the Jurassic period.
- age structure.** Number or percentage of individuals in each **age class** of a **population**.
- alate, aliferous. Winged,** *e.g.* the thin appendage of tissue below the **terminal facet** of *Encephalartos pterogonus* **microsporophylls** or *Macrozamia douglasii* **megasporophylls**.
- allele.** One of two or more alternative forms of a **gene** at a given **locus** on a **chromosome**.
- allelopathic.** Inhibition of **growth** of one plant **species** by another via the release of chemical substances.
- allopatric.** Of two or more **taxa** not overlapping in their **distribution**. *Cf. sympatric.*
- allopatric speciation.** Differentiation and attainment of **reproductive isolation** of **populations** that are geographically separated. *Cf. sympatric speciation.*
- alpha-taxonomy.** Descriptive **taxonomy**, based exclusively on **morphological parameters**.
- alternate. Leaflets** borne singly and not spaced **opposite** each other along the **rachis**. *Cf. paired.*
- alternation of life phases, less correctly alternation of generations.** Having distinct sporophytic (**diploid**), *e.g.* **stems, roots, leaves, cones**, etc., and gametophytic (**haploid**), *e.g.* tissue within the **seeds** of cycads and all other seed plants, phases in the **life cycle**.
- amblys.** Greek, meaning 'blunt', *e.g.* the root word of the first part of the **specific epithet** of *Zamia amblyphyllidia*, though technically referring to **leaves**, this epithet actually refers to the **obovate leaflets** which lack a sharp point at the **apex**. *See also phyllon.*
- amend.** To add beneficial nutritive or other **amendments** to improve the quality or **drainage** capacity of a soil.
- amendment.** Any beneficial material that improves the quality or **drainage** capacity of a soil, *e.g.* pumice, perlite, and other inorganic amendments are often added to soil to improve drainage, while organic (sometimes living) components that improve soil quality include beneficial microbes, **humus**, or **mycorrhiza**.
- amphistomatic.** Of **leaves** and **leaflets** with **stomata** on both surfaces. *Cf. hypostomatic.*
- amplus.** Latin, meaning 'ample' or 'large', *e.g.* the root word of the first part of the **specific epithet** of *Zamia amplifolia*, while originally intended to refer to the very large **leaflets**, the epithet actually refers to the **leaves** but is really not a misnomer. *See also folium.*
- amyotrophic lateral sclerosis (ALS).** A wasting **neurological** disease (Lou Gehrig's disease), which some think can be caused by ingestion of cycad **seeds**, *e.g.* the Chamorro people of Guam who traditionally ate the seeds of *Cycas micronesica* have exhibited symptoms of this disease. *See also Parkinsonian dementia.*
- ana.** Latin suffix meaning 'a connection'; in cycads, the ending of a **specific epithet** that connotes a connection with the first part of the epithet, *e.g.* *Cycas cairnsiana* honors Sir William Wellington Cairns (1828-1888), governor of Queensland, Australia.
- Analysis of Variance (ANOVA).** Tool used in statistics to apportion observed **variance** into probable causes, *e.g.* when used to determine the significance of variances between measurable items in different populations.
- anastomosing.** Connecting with one another, particularly applied to **veins**, *e.g.* some veins in the **leaves** of *Stangeria eriopus*. *Cf. parallel-veined.*
- anatomy.** Study of the internal structure of organisms and their component parts; because plants, in general, have few organs (**stems, roots, leaves**, reproductive structures, etc.), 'plant anatomy'

typically refers to the study of tissues and tissue structures (**epidermis, parenchyma, collenchyma, phloem, xylem**, etc.) and their origins.

**anemophily.** Wind-effected **pollen** transfer. *Cf.* **entomophily, hand pollination.**

**angiosperm.** Division of **seed** plants with the **ovules** borne in an ovary; flowering plants. *Cf.* **gymnosperm.**

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

**angular.** Having evident ridges; angled. *See also facet.*

**angulatus.** Latin, meaning ‘angled’, *e.g.* the root word of the **specific epithet** of *Cycas angulata*, referring to the strong **leaflet angle of insertion.**

**angustus, angusti-.** Latin, meaning ‘narrow’, *e.g.* the root word of the **specific epithets** of *Dioon angustifolium* and *Zamia angustifolia*, though technically referring to **leaves**, these epithets actually refer to the narrow **leaflets.** *See also folium.*

**anonymous (anon.).** Pertaining to an **author** whose name is not known.

**antheridium.** Structure of a plant’s **gametophyte** that forms male **gametes.**

**antherozoid,** more commonly **spermatozoid.** Male **gametes** of plants.

**anthesis.** **Developmental** stage in flowering, in which a flower is at its most receptive state, when the anthers release their **pollen** and **pollination** occurs; could also be used to refer to cycad **cones** that are **dehiscing pollen (male cones)** or **receptive to pollen (female cones).**

**anthropogenic.** Caused or produced through the agency of man; common threat to cycad **populations.**

**apex,** plural **apices.** Tip; **distal** end of an organ such as a **shoot, leaf, or root**; in cycads, also the growing point of the **caudex.**

**apical.** Arising from or positioned at the tip; **terminal,** *e.g.* the most **distal leaflets** on a cycad **leaf.** *Cf.* **basal, median, proximal.**

**apical dominance.** Dominance of the **apical** growing **shoot** which produces hormones and prevents **offset** or **suckers** from developing while it is still actively growing.

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

**apiculate.** Having a short, sharp, flexible point (= apiculum), *e.g.* as in the **female cones** of *Ceratozamia matudae.*

**apogeotropic, ageotropic, apogravitropic.** Developing in an orientation contrary to gravitational force, *e.g.* cycad **coralloid roots.**

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

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

**appressed.** Pressed closely to another organ but not united, *e.g.* the exposed portion of the **sporophylls** of **female Dioon cones.**

**arborescent.** **Tree-like** in **habit,** *e.g.* all cycads in the **genus Dioon.** *See also caulescent, epigeous.* *Cf.* **acaulescent, hypogeous.**

**archegonial neck.** Narrow, **terminal** part of an **archegonium** through which **sperm** enter during the process of **fertilization.**

**archegonium.** Structure in a plant’s female **gametophyte** in which an **egg** cell is formed.

**arching.** Forming an arch; in cycads, used to describe the natural orientation of a **leaf** or the most recent **crown** or **flush** of leaves, *e.g.* the crown of *Ceratozamia kuesteriana.* *Cf.* **ascending, erect, spreading.**

- arcuate.** Having the form of a bow; curved, *e.g.* the **leaves** of *Zamia sandovalii* when growing on level ground (as opposed to the typical **pendent habit** of the leaves of this primarily cliff-dwelling **species**). *See also arching. Cf. ascending, erect, spreading.*
- area of endemicity.** Geographic region that encompasses the entire **distribution** of a **species** or **taxon**.
- argenteus.** Latin, meaning ‘of silver’, *e.g.* the root word of the **specific epithet** of *Dioon argenteum*, referring to the **persistent** silvery **tomentum** on the **leaves**.
- armed.** Having **spines** or **prickles**, *e.g.* the prickles of some cycad **petioles** and the **serrations** or **teeth** of some cycad **leaflets**. *Cf. inerm.*
- armor.** Colloquial, referring to a collection of **persistent leaf bases** that ‘protect’ a **caudex**. *Cf. caducous.*
- articulate.** Separated by a **node** or joint, *e.g.* the **leaflets** of *Ceratozamia*, *Chigua*, *Microcycas*, and *Zamia* are articulated at the base.
- ‘artificial dwarfing’ hypothesis.** Premise which suggests that individual cycads can sometimes attain **maturity** at a smaller than normal size as a result of **anthropogenic** forces (*sensu* Taylor *et al.*, 2009), *e.g.* in a particular **population** of *Zamia neurophyllidia* near Changuinola, Panama—in which the **stem** of every plant is routinely cut by the local inhabitants, and the **mucilage** produced at the wound site used as a type of glue—plants attain sexual maturity at an uncharacteristically small size, thus appearing **dwarfed**. *See also neoteny, precocious.*
- artificial propagation.** *Ex-situ* production of new plants from **seed** or **division** of **offsets** or **suckers**. *See also hand pollination.*
- artos.** Greek, meaning ‘bread’, *e.g.* the last part of the **generic** name *Encephalartos*, in reference to the flour obtained from the **trunks** of some **species** used to make bread by the indigenous tribespeople of Africa. *See also cephal.*
- ascending.** Arched upwards in the lower part and becoming **erect** in the upper part; in cycads, used to describe the natural orientation of the most recent **crown** or **flush** of **leaves** (*e.g.* as in *Encephalartos heenanii*) or the exposed tip of **microsporophylls** (*e.g.* as in *Cycas wadei*). *Cf. arching, erect, spreading.*
- attenuate.** Tapering gradually, *e.g.* the **median leaflets** of *Zamia tuerckheimii*. *Cf. acuminate.*
- auctoris, auctorum (auct.).** Latin, obsolete term previously used in **taxonomy** when an **author** applied an incorrect name.
- aurea.** **Horticulturally** desirable **mutation** in which the **leaflet** tips are bright yellow instead of green.
- 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 **scientific name**, usually in abbreviated form, *e.g.* Karl Peter Thunberg in *Cycas revoluta* THUNB.
- autochory.** Process of fruit or **seed dispersal** by means of some kind of physical expulsion, often explosive; **discharge dispersal**, *e.g.* as in *Dioon spinulosum*.
- 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*.
- auxin.** **Growth**-promoting hormone of plants, *e.g.* IAA, IBA.
- axil.** Angle between a branch or **leaf** and the **axis** from which it arises.

- axillary.** In cycads, relating to the **cones** of certain **species** that arise from between the **leaves** rather than at the **stem apex**, *e.g.* many species of *Encephalartos* and *Macrozamia*.
- axillary bud.** Structure arising from tissue in the **axil** between a **stem** and **leaf**, as a **lateral** branch; absent in cycads.
- axis.** Central line of development of a plant or organ, *e.g.* the main **stem** of a plant or the **rachis** of a **leaf**.
- azaniae.** Greek, meaning ‘pine **cone**’, *e.g.* the root word of the **generic** name *Zamia*, referring to the pine cone-like reproductive structures.
- azoxyglycoside.** Toxic molecule specific to cycads, *e.g.* **cycasin** or **macrozamin**.
- ‘baggie method’.** Method of cycad **seed germination** in which seeds are stored in slightly damp **peat moss** inside ziplock baggies until the **hypocotyl** emerges, at which time they are removed and potted.
- bare-root.** Process of removing soil from the **roots** of a plant in preparation for shipping; any such plant that has been bare-rooted.
- barrel-shaped.** In the shape of a barrel, widest in the middle and tapering at both ends; often used in reference to **cones** or **trunks**, *e.g.* the **female cones** of *Encephalartos laevifolius*.
- basal.** Arising from or positioned at the base; used in reference to the most **proximal leaflet(s)** on a cycad **leaf**. *Cf.* **distal, median, terminal**.
- basal blotch.** Light-colored tissue at the point of **articulation** of a **leaflet**, *e.g.* as in most **species** of *Macrozamia*.
- base pair.** Complementary couplet of **nucleotides** in **DNA**, *e.g.* **adenine (A)** pairs with **thymine (T)**, and **cytosine (C)** pairs with **guanine (G)**.
- 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 genus 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 caffra* (THUNB.) LEHM. is *Zamia caffra* THUNB.
- basipetal**, adj. **basipetally.** Progressing in direction from **distal** to **proximal**; from **apex** to base. *Cf.* **acropetal**.
- basisopic**, adj. **basisopically.** Facing the base of the **axis** on which it is borne. *Cf.* **acroscopic**.
- Bennettitales.** Order of **extinct cycadophytes** resembling cycads in **morphology** but differing in the arrangement of the **sporophylls**. *See also* **cycadeoid**.
- bicornate.** With two **horns**, *e.g.* the **sporophylls** of *Ceratozamia* **cones**.
- bifid.** Deeply notched or cleft for more than half the length, *e.g.* the **leaflets** of *Cycas bifida*.
- bifoliolate.** Having two **leaflets**, *e.g.* the **eophylls** of many cycad **species**.
- bifurcate.** Forked in a Y-shaped manner, usually applying to **leaves, leaflets, or stems** (*e.g.* the **leaflets** of *Cycas micholitzii*); with two **terminal, long lobes** (*e.g.* the **apices** of some *Encephalartos hildebrandtii* **leaflets**).
- bijugate.** Of a **pinnate leaf** with two pairs of **leaflets**, *e.g.* the **eophylls** of some cycad **species**. *See also* **jugate**.
- bilateral.** Having or formed of two sides; two-sided, *e.g.* the **seeds** of *Cycas*.
- binomial.** **Scientific** (or **botanical**) **name** consisting of a **genus** and **specific epithet**.
- binomial nomenclature.** Standard convention, developed by Carolus Linnaeus, that identifies each **species** by a **scientific** (or **botanical**) **name** consisting of a unique combination of two words, Latin in form and usually derived from Greek or Latin roots. *See also* **nomenclature**.
- biodiversity.** Variety and variability among living organisms and the **ecosystems** in which they occur.
- biogeography.** The study of the geographical **distributions** of organisms, their **habitats**, and the historical and biological factors which produced them.

- 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**, *e.g.* both *Bowenia* **species** and some *Cycas* species. *See also* **multipinnate**.
- biserrate.** Doubly **serrate**; with smaller regular, asymmetric **teeth** on the **margins** of larger teeth, *e.g.* the **leaflet** margins of *Zamia disodon*.
- bisulcate.** Cleft or cloven, as a hoof, *e.g.* the **adaxial** side of the **rachis** of some *Ceratozamia* **species**.
- black market.** Illegal trade in **poached** plants or animals.
- blade.** **Lamina**; part of the **leaf distal** to the sheath or **petiole**.
- blue-green algae.** *See* **cyanobacteria**.
- 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.
- borer.** *See* **stem borer**.
- botanical name.** *See* **scientific name**.
- bottom heat.** In **propagation**, application of heat below a **seed** or cutting.
- brachys.** Greek, meaning ‘short’, *e.g.* the root word of the first part of the **specific epithet** of *Cycas brachyacantha*, referring to the characteristically short **petiolar spines**. *Cf.* **acanthos**.
- bract.** **Leaf-like** structure subtending an **axillary** bud or **shoot**, usually with a protective function; occasionally misapplied to cycad **cataphylls**.
- branched, branching.** Possessing **lateral** or **aerial branches**, *e.g.* the **trunks** of some *Cycas* **species**. *Cf.* **solitary, unbranched**.
- breeding colony.** Group of plants of the same **species** grown for the purpose of producing **seeds** by **artificial propagation**; **seed colony**.
- brevis.** Latin, meaning ‘short’, *e.g.* the root word of the first part of the **specific epithet** of *Encephalartos brevifoliolatus*, referring to its relatively short **leaflets**. *See also* **foliola**.
- brunneus.** Latin, meaning ‘brown’, *e.g.* the root word of the **specific epithet** of *Cycas brunnea*, referring to the brownish **trichomes** on the new **growth**.
- bubalinus.** Latin, meaning ‘buff’, *e.g.* the **specific epithet** of *Encephalartos bubalinus*, referring to the buff-colored **tomentum** on the **cataphylls** and **leaf bases**.
- bulb.** Storage **stem** of limited longitudinal **growth** enveloped in fleshy **leaf bases**; misapplied to the **bulbous trunks** of some *Cycas* **species**, and occasionally misapplied to cycad **suckers** or leafless and rootless cycad **caudices** ready to be shipped.
- bulbous.** Swollen to an almost spherical shape, *e.g.* the **trunk** base of *Cycas pachypoda* and several other Asian cycads.
- bullae, plural bulla.** Bubble, blister or vesicle; commonly used in reference to the expanded **shield-like distal** portion of some cycad **sporophylls**, *e.g.* *Encephalartos sporophylls* (Melville, 1957); 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. *Cf.* **persistent**.
- caespitose.** Turf-shaped and forming a **clump**, as in many **suckering** cycads, *e.g.* *Ceratozamia norstogii* or *Encephalartos cupidus*.
- calcareous.** Composed of calcium carbonate or calcium phosphate or both, as a soil, *e.g.* the predominant soil in the **habitat** of *Cycas calcicola*.

- 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.
- calos**. Greek, meaning ‘beautiful’, *e.g.* the root word of the first part of the **specific epithet** of *Microcycas calocoma*, referring to its beautiful **crown** of **leaves**. *See also come*.
- cambium. Meristem** between the **xylem** and **phloem** that gives rise to both tissues. *See also procambium*.
- campestris**. Latin, pertaining to plains or meadows, *e.g.* the **specific epithet** of *Cycas campestris*, referring to its occurrence in open, grassy country.
- canaliculate**. Longitudinally **channeled** or grooved, *e.g.* the **leaflets** of *Ceratozamia mirandae*.
- candida**. Greek, meaning ‘white’, *e.g.* the **specific epithet** of *Cycas candida*, referring to the white **seeds**.
- canescent**. Gray or white in color due to a covering of short, fine, gray or white hairs, *e.g.* the **male cones** of *Zamia cupatiensis*.
- carinate**. Shaped like or having a carina or keel; **ridged**, *e.g.* the **sclerotesta** of *Cycas wadei*. *See also ribbed*.
- 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**.
- caudate**. Having a tail or tail-like appendage, *e.g.* the **leaflet apices** of *Cycas multipinnata* and both **species** of *Chigua*. *Cf. drip tip*.
- caudex**. Thick **stem** or **trunk**, often at least partially subterranean.
- caulescent**. Having an above-ground **trunk** or **stem**. *See also arborescent, epigeous. Cf. acaulescent, hypogeous*.
- centriole**. **Cylindrical** body in **centromeres** composed of nine triplet fibers arranged in a circle.
- centromere**. Region of a **chromosome** where spindle **microtubules** are attached during nuclear division. *See also satellite*.
- cephale**. Greek, meaning ‘head’, *e.g.* the root word of the middle part of the **generic** name *Encephalartos*, in reference to the flour obtained from the **trunks** (or ‘heads’) of some **species** by the indigenous tribespeople of Africa. *See also artos*.
- ceratos**. Greek, meaning ‘horn’, *e.g.* the root word of the first part of the **generic** name *Ceratozamia*, in reference to its characteristic **bicornate sporophylls**.
- cerina**. Latin, meaning ‘wax’, *e.g.* the root word of the **specific epithet** of *Encephalartos cerinus*, referring to the heavy waxy coating that gives the **leaves** a bluish color.
- chalaza**. **Proximal** end of a **seed**; its point of attachment, *e.g.* the seeds of *Dioon mejiae* have a **characteristic** enlarged chalaza. *Cf. coronula, micropyle*.
- chamal**. **Vernacular name** for *Dioon edule* by the *xi’iuy* **indigenous** people in San Luis Potosí, Mexico, who use the **seeds** to make a variety of foodstuffs (Yáñez-Espinosa, 2009). *See also ethnobotany*.
- channeled**. With raised longitudinal edges to form a channel, as in the **adaxial** surface of many cycad **petioles** and the **leaflets** of certain cycad **species**, *e.g.* the **leaflets** of *Ceratozamia kuesteriana*.
- character**. Identifiable and heritable **morphological** feature that can be used in comparing one **taxon** with another; **trait**. *Cf. characteristic*.
- character state**. 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. *See also characteristic*.



- characteristic.** Distinguishing feature; often used loosely as a **synonym** of **character**, although, more precisely, it refers to the distinctive state or expression of that character. *See also* **character state**. *Cf.* **character**.
- chartaceous.** Papery in texture, *e.g.* the **leaflets** of *Zamia vazquezii*. *See also* **membranous**, **papyraceous**. *Cf.* **coriaceous**.
- chemotactic.** Responding to certain chemical attractants, as **sperm** or other **motile** cells.
- chiera.** Greek, meaning ‘hand’, *e.g.* the second part of the **specific epithet** of *Zamia macrochiera*, referring to the large, gland-like **collar** separating the **leaflets** from the **petiolules**. *See also* **macros**.
- chlorophyll.** Green plant pigment in the cells of some bacteria and in plant **chloroplasts** that captures energy from sunlight; an electron donor in **photosynthesis**.
- chloroplast.** Plant cellular **organelle** in which **photosynthesis** occurs. *See also* **chlorophyll**.
- chloroplast DNA (cDNA).** DNA constituting the ‘**chromosome**’ of a **chloroplast**.
- chromatid.** One of the pair of threadlike forms of each **chromosome**.
- chromatin.** Complex of nucleic acids and proteins, primarily histones, in the cell **nucleus** that stains readily with basic dyes and condenses to form **chromosomes** during cell division.
- 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* **chromatid**, **chromatin**, **genome**.
- CI.** Consistency Index, a measure of the amount of **homoplasy** for a character in a **cladogram**. *See also* **RC**, **RI**.
- circa (ca.).** Latin, meaning ‘about’ or ‘approximately’, often referring to an approximate date.
- circinate.** Rolled in a coil-like manner with the **apex** innermost, *e.g.* the **leaflets** of **emerging leaves** of *Cycas* **species** (hence *C. circinalis*). *See also* **conduplicate**, **inflexed**, **ptyxis**, **reflexed**, **vernation**.
- circumscribe, circumscription.** Defined limits of a **taxon** as determined by an **author**; sum of individuals within those limits.
- CITES.** Convention on International Trade in **Endangered Species** of Wild Flora and Fauna, a United Nations treaty which sets out a **conservation** regulatory process between signatory countries.
- clade.** Group of organisms, such as a **species**, whose members share **homologous** features derived from a common ancestor; one particular **monophyletic** branch in a **cladogram**.
- cladistics.** Method of **classification** that groups **taxa** **hierarchically** and **parsimoniously** into nested sets according to their **synapomorphies**; output is 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**; used to illustrate **phylogenetic** relationships and show points at which various **species** have diverged from common ancestral forms. *See also* **dendrogram**, **phenogram**, **phylogram**.
- class.** **Taxonomic rank** below **division** but above **order**.
- classification.** Grouping of **taxa** or **taxonomic groups** into categories according to an overall plan.
- cline, adj. clinal.** **Character** gradient over a geographical area where one or several **morphological** features gradually change over a part or the entire **distribution**.
- clivis.** Latin, meaning ‘cliff’, *e.g.* the root word of the first part of the **specific epithet** of *Cycas clivicola*, referring to the cliff-dwelling **habit** and **habitat**.
- clone.** Set of genetically-identical individuals produced vegetatively from the same progenitor. *See also* **vegetative propagation**.
- clumping.** Vegetative production of **suckers** or **offsets**; **habit** of such a plant, often forming a clump; **suckering**. *Cf.* **solitary**.

- coevolution.** Concurrent **evolution** of two different but interdependent organisms, as in the case of a cycad and its insect **pollinator**.
- cohort.** A group of individuals of the same age recruited into a **population** at the same time; also pertaining to a group of **leaves** produced at the same time or in the same growing season. *See also* **crown, flush, age class**.
- cola.** Latin suffix meaning ‘dweller’ or ‘inhabitant’; in cycads, the ending of a **specific epithet** that refers to the typical **habit** or **habitat** of the named **species**, *e.g.* *Cycas calcicola* is so named because it grows on limestone (= **calcareous**) outcrops.
- colchicine.** Alkaloid used experimentally to suspend the division of a plant cell; used to study the **karyology** and determine the **chromosome** number of a plant **species**.
- cold-hardy.** Resistant to cold temperature, *e.g.* *Cycas revoluta* and *Dioon edule* are relatively cold-hardy.
- coleorrhiza.** Hard disk or cap of cells covering the **shoot apex** of a cycad **embryo**.
- collar.** In cycads, a colored or textured band at the base of a **leaf** (*e.g.* as in *Encephalartos lehmannii*), or a glandular swelling at the base of a **leaflet** (*e.g.* as in *Zamia manicata*).
- collenchyma.** First-formed strengthening tissue of plants, composed of **elongate** cells thickened mainly at angles of the cell walls.
- collinus.** Latin, pertaining to hills, *e.g.* the root word of the **specific epithet** of *Cycas collina*, referring to its occurrence at moderate to high elevations in mountainous country of Vietnam.
- colony.** Group of organisms of the same **species** living or growing together in the same place or locality; often used in reference to small distinct and/or isolated cycad **populations**. *See also* **breeding colony**.
- columella.** Central mass of tissue of a **root cap**.
- columnar.** In cycads, referring to the column-shaped **trunk** of some **arborescent species**.
- combinatio nova (comb. nov.).** Latin, pertaining to a **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.
- come.** Greek, meaning ‘hair’, *e.g.* the root word of the second part of the **specific epithet** of *Microcycas calocoma*, alluding to its beautiful **crown** of **leaves**. *See also* **calos**.
- common garden experiment.** Classic study designed to control for many of the **variables** that would otherwise creep into an experiment, such as day length, sunlight, rainfall, temperature, etc., in an effort to determine the relative effects of **genetics** and environment on **morphology, growth**, etc.
- common name.** Colloquial or **vernacular** name; it should be noted that many cycad **species** do not have common names.
- communis.** Latin, meaning ‘common’, *e.g.* the **specific epithet** of *Macrozamia communis*, referring to its abundance in dense stands.
- community.** Total of all living **species** in a particular **habitat**.
- compound leaf.** **Leaf** composed of a **rachis** and some number of **opposed blades (leaflets or pinnae)**.
- compressed.** Flattened, *e.g.* the **sporophylls** of *Dioon* **female cones**, or the old **trunk bases** of large, **arborescent** cycads.
- concinus.** Latin, meaning ‘neat’ or ‘trim’, *e.g.* the **specific epithet** of *Encephalartos concinns* and *Macrozamia concinns*, referring to the compact and attractive **habit**.
- concolorous.** Uniformly colored, as in upper and lower surfaces, *e.g.* the **leaflets** of most cycad **species**. *Cf.* **discolorous**.
- conduplicate.** Folded together lengthwise, usually in two equal halves, *e.g.* the **leaflets** of **emerging** *Stangeria* **leaves**. *See also* **circinate, inflexed, ptyxis, reflexed, vernation**.

- cone.** Reproductive structure of **gymnosperms**; organized collection of **sporophylls** on a central **axis**. *See also strobilus, megasporangiate and microsporangiate strobili.*
- cone dome.** **Vascular tissue** located **transversely** in cycad **pith**; remnant of an earlier **cone's** vascular supply, laterally displaced so as to form a dome of **xylem** in the **pith**.
- cone scale.** Colloquial for **sporophyll**.
- confer (cf.).** Latin, meaning 'compare'.
- conferted.** Closely **crowded**, *e.g.* the **leaflets** of *Macrozamia conferta* and *Encephalartos sclavoi*.
- confluent.** Remaining united and not separating.
- congeneric.** Belonging to the same **genus**, *e.g.* it is now thought that *Epicycas* is congeneric with *Cycas* (Osborne & Walters, 2004), and some have argued that *Chigua* is congeneric with *Zamia* (Lindström, 2009).
- conic, adj. conical.** Of a 3-dimensional structure that is cone shaped, attached at the broader end, *e.g.* the shape of some cycad **strobili**.
- coning.** Act of producing a **cone**; of a plant that is producing a cone. *See also phenology. Cf. flushing.*
- connate.** Joined or united with a structure of the same kind, *e.g.* the **terminal leaflets** of *Stangeria leaves*.
- consensus tree.** **Cladogram** representing the **clades** found in all the most **parsimonious** trees of an analysis, often from a large number of possible resolutions.
- conservation.** Planned management of natural resources; retention of natural balance, diversity, and **evolutionary** change in an environment. *Cf. preservation.*
- conservation status.** Estimation of rarity of a **species**; **threatened status**. *See also Red List.*
- conspecific.** Belonging to the same **species**, *e.g.* some workers believe that *Encephalartos altensteinii* and *E. natalensis* are conspecific.
- contiguous.** Touching or neighboring, *e.g.* a common border between two countries.
- contracted.** Narrowed, reduced in size, or pulled together, *e.g.* the **leaflet bases** of *Macrozamia pauli-guilielmi* and many other cycad **species**.
- contractile.** Of **roots**, and occasionally **stems**, which contract to pull the stem **apex** into the ground.
- convergence.** **Evolutionary** process where dissimilar organs or organisms show strong superficial similarities. *Cf. homology.*
- coralloid root.** Club-shaped **apogavitropic (apogeotropic) root** with the potential for hosting symbiotic **cyanobacteria**; specific to the **Cycadales**.
- coriaceous.** Leathery in texture, *e.g.* the **leaflets** of *Encephalartos laurentianus*. *Cf. chartaceous, membranous, papyraceous.*
- cork.** Nonliving tissue composed of cells with wax- or fat-impregnated walls forming a covering over **stems**, branches, **roots**, or sometimes **leaves**.
- corniculate.** Having **horn-like** projections, *e.g.* the **sporophylls** of *Ceratozamia*, which are characteristically **bicornate**.
- coronula.** **Crown-like**, segmented cap over the **embryo-containing** cavity of a cycad **seed**. *See also micropyle. Cf. chalaza.*
- corrugated.** Shaped into wrinkles or folds, or alternating ridges and grooves, *e.g.* the **leaflets** of *Zamia skinneri*. *See also plicate.*
- corruptel.** Kernel of a **corruptule**.
- corruptule.** Unfertilized **ovule** that is superficially indistinguishable from a true **seed**. *See also omnule.*
- cortex.** Region of tissue in a **root** or **stem** lying between the **epidermis** and the **vascular tissue**.
- cotyledon.** **Seed leaf**; the first embryonic leaf of a plant **embryo**. *See also eophyll. Cf. euphyll.*

- crack.** Colloquial, in reference to the spaces between **megasporophylls** occurring when a **female cone** becomes **receptive** to **pollination**.
- cracking.** Colloquial, the act or process of **megasporophylls** separating at **receptivity**.
- crampy.** Disabling neurological disease of cattle caused by ingesting cycad **toxin**. *See also* **staggers**, **wobbles**.
- crassus.** Latin, meaning ‘thick’, *e.g.* the root word of the first part of the **specific epithet** of *Macrozamia crassifolia*, though technically referring to **leaves**, this epithet actually refers to the thick-textured **leaflets**. *See also* **folius**.
- creeping.** Colloquial for **procumbent** or **prostrate**. *Cf.* **erect**.
- cremnophyte**, adj. **cremnophilous**. Cliff-dwelling plant, *e.g.* *Zamia cremnophila*.
- crenate.** Having rounded **teeth**, *e.g.* the **megasporophyll margins** of *Cycas micronesica*. *See also* **crenulate**. *Cf.* **spinose**.
- crenulate.** Having minute rounded **teeth**, *e.g.* the **megasporophyll margins** of *Cycas thouarsii*. *See also* **crenate**. *Cf.* **spinulose**.
- crested, cristate.** **Mutation** that causes **leaves** and **cones** to be produced in a **linear** rather than **radial symmetry**.
- Critically Endangered (CR).** **IUCN Red List** category in which the best available evidence indicates that a **taxon** is facing an extremely high risk of **extinction** in the wild. *See also* **Data Deficient**, **Endangered**, **Extinct**, **Extinct in the Wild**, **Least Concern**, **Near Threatened**, **Vulnerable**.
- cross-pollination.** Transfer of **pollen** from **male** to **female cone**, usually in reference to unintentional **hybridization**.
- crowded.** Clustered close together, *e.g.* the **leaflets** of *Cycas conferta* and *Encephalartos sclavoi*.
- crown.** Group of **leaves** produced at the same time or in the same growing season; sometimes referring to the entire set of leaves held by a plant, or to the **apex** of the **caudex** bearing the leaves. *See also* **cohort**, **flush**.
- CSG.** Cycad Specialist Group, a **conservation**-based group within the **IUCN**.
- cultivar.** Horticultural **variety**, *e.g.* the many ‘**forms**’ or ‘**varieties**’ of *Cycas revoluta*.
- cultivation.** **Growth** of plants by humans outside the native **habitat**; *ex situ*. *Cf.* *in situ*.
- cuneate.** Wedge-shaped and attached at the narrow end, *e.g.* the point of attachment of many cycad **leaflets**.
- cupidus.** Latin, meaning ‘desirable’, *e.g.* the **specific epithet** of *Encephalartos cupidus*, referring to its striking **form**, thought by the **author** to render it desirable to cycad collectors.
- Curculionidae.** Weevil **family** of insects, many of which are cycad **pollinators**.
- cuspidate.** Terminating in or tipped with a sharp, firm point, *e.g.* the **leaflets** of *Macrozamia heteromera*, the **female cones** of *Zamia tuerckheimii*, and the **microsporophyll apices** of *Cycas revoluta* and *C. taitungensis*.
- 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; often found in **coralloid roots** of cycads.
- cycad.** Member of the plant order **Cycadales**.
- Cycad Action Plan.** Set of proposals for cycad **conservation** drafted by the **CSG**.

- cycad aulacaspis scale (CAS).** *Aulacaspis yasumatsui* TAKAGI, a pest of cycads, especially of the **genus** *Cycas*, that has been widely introduced around the world and has resulted in the destruction of cycads *in situ* as well as in *ex situ* collections, *e.g.* **populations** of *Cycas micronesica* in Guam and *C. taitungensis* in Taiwan have been devastated by CAS.
- Cycadales.** **Gymnosperm plant order** containing all **extant** and **extinct** cycads; defined by the absence of **axillary buds** and the presence of **cycasin**, **girdling leaf traces**, simple **megasporophylls**, and **primary thickening meristem** which gives rise to the **pachycaul habit**.
- cycadeoid.** Any of several **extinct cycadophytes** resembling a cycad in **morphology** but differing in the arrangement of the **sporophylls**; a member of the **Order Bennettitales**, **Class Cycadeoideae**.
- Cycadeoideae.** **Class** of plants in the **Order Bennettitales** that resemble cycads. *See* **cycadeoid**.
- cycadologist.** One who studies cycads.
- cycadophyte.** Member of the **Division Cycadophyta**.
- Cycadophyta.** **Division** of plants that includes the cycads and **cycadeoids**.
- cycasin.** Toxic **MAM** glycoside found only in cycad tissue; methylazoxymethanol- $\beta$ -D-glucopyranoside. *See also* **macrozamin**.
- cylindric**, adj. **cylindrical.** Of a 2-dimensional structure that is tubular or rod-shaped, *e.g.* many cycad **microstrobili**.
- cymbiform.** Boat-shaped, *e.g.* the shape of cycad **pollen**.
- cytology.** Study of the structure, physiology, and reproduction of cells.
- cytoplasm.** Liquid surrounding the **nucleus** of a cell.
- cytosine (C).** A pyrimidine base,  $C_4H_5N_3O$ , that is the **nucleotide** constituent of **DNA** and **RNA** involved in **base pairing** with **guanine (G)**. *See also* **adenine (A)**, **thymine (T)**, **uracil (U)**.
- cytoskeleton.** Supporting structure of a plant cell, consisting of a framework of **microtubules**.
- DAF.** **DNA Amplification Fingerprinting**, a technique used in DNA analysis.
- damping off.** Any of various diseases of **seedlings** caused by oomycete fungi, especially of the **genus** *Pythium*, that result in wilting and death.
- Data Deficient (DD).** **IUCN Red List** category in which a **taxon** lacks adequate information to make a direct, or indirect, assessment of its risk of **extinction** based on its **distribution** and/or **population** status. *See also* **Critically Endangered**, **Endangered**, **Extinct**, **Extinct in the Wild**, **Least Concern**, **Near Threatened**, **Vulnerable**.
- deciduous.** Used of structures shed at regular intervals, or at a given stage of **development**, *e.g.* the **leaves** of *Cycas beddomei*.
- declinate.** Gently curving downward (**abaxially**), *e.g.* the **leaflets** of *Dioon tomasellii*. *Cf.* **deflexed**, **inflexed**, **reflexed**.
- decumbent.** Of **stems**, lying along the ground but turning upwards **distally**, *e.g.* *Ceratozamia decumbens* and the newly described *Zamia decumbens*. *See also* **procumbent**, **prostrate**. *Cf.* **erect**.
- decurrent.** Extending **basipetally** from the point of insertion, *e.g.* *Lepidozamia* **leaflets**, where the leaflet base extends downward along the **rachis**.
- decussate.** Of leaves or other **lateral** organs, in **opposite** pairs, the successive pairs being borne at right angles to each other. *Cf.* **alternate**, **opposite**.
- deflexed.** Bent abruptly downward (**abaxially**), *e.g.* the **microsporophylls** of *Cycas panzhihuaensis* and the **apical leaflets** of *Dioon rzedowskii*. *Cf.* **declinate**, **inflexed**, **reflexed**.
- degraded.** Having been reduced in quality or value, *e.g.* the **habitat** of many cycad **species**.

- dehiscence**, adj. **dehiscent**. Rupturing process where the contents of a plant structure are released, *e.g.* pollen shedding from a **mature male cone**, or **seeds** dropping from a mature **female cone**. *Cf.* **indehiscent**, **receptive**.
- deltoid**. Of a 3-dimensional structure that is triangular or delta-shaped, *e.g.* the **microsporophylls** of many *Cycas* **species**.
- deltran optimization**. Optimization technique used in **cladistics**, based on ‘delayed transformation’ and favoring independent gains rather than acquisition and reversal. *Cf.* **actran optimization**.
- demography**. Study of **populations**, especially **growth rates** and **age structure**.
- 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**, *e.g.* the **leaflet** margins of *Encephalartos nubimontanus*. *See also* **serrate**.
- denticulate**. Finely **dentate**, *e.g.* the **leaflet margins** of *Zamia amazonum*. *See also* **serrulate**.
- derived**. **Character** or **character** state not present in ancestral stock; **apomorphic**. *Cf.* **plesiomorphic**.
- descending**. To slope, extend, or incline downward (**abaxially**), *e.g.* the **megasporophylls** of *Encephalartos sclavoi*. *Cf.* **ascending**.
- description**. In **taxonomy**, original published work containing a new **species**, **genus**, or **nomenclatural** combination; requires a brief Latin **diagnosis**.
- desiccate**. To lose or cause to lose moisture.
- desolatus**. Latin, meaning ‘ruinous’ or ‘desolate’, *e.g.* the root word of the **specific epithet** of *Cycas desolata*, referring to its austere habitat near Charters Towers, northeastern Australia.
- determinate**. With **growth** of an **axis** ceasing at a particular stage. *Cf.* **indeterminate**.
- development**. Regulated **growth** and **differentiation** of an individual, including cellular differentiation, histogenesis, and organogenesis; **ontogeny**.
- diagnosis**. Formal statement (in Latin) of the **character states** which distinguish one **taxon** from another; an integral part of a **description**.
- diagnostic key**. *See* **dichotomous key**.
- dichotomous**. Branching into two equal parts, *e.g.* the forked branching of *Cycas elongata* **stems**, *Cycas bifida* **leaflets**, or *Cycas segmentifida* **megasporophyll lobes**; also used in reference to branching patterns in **dendrograms**.
- dichotomous key**. Structured system of deducing the correct **species** assignment among a number of related species, also known as a **diagnostic** or **taxonomic key**.
- differentiation**. Integrated cellular specialization during **embryonic development**.
- dimeric**. Two-parted; of two kinds, *e.g.* two **alleles** at a **locus**.
- dimorphic**. Having two different **forms**, *e.g.* the distinctly different **male** and **female cones** of most cycad **species**. *Cf.* **homomorphic**, **monomorphic**, **polymorphic**.
- dioecious**. Having **microsporangia** and **megasporangia** (less correctly male and female reproductive organs) on different plants, *e.g.* all **extant** cycads.
- diplo-**. Greek, meaning ‘double’, *e.g.* the first part of the **specific epithet** of *Macrozamia diplomera*, referring to the **dichotomously** divided **leaflets**. *See also* **-merus**.
- diploid**. Having a pair of **chromosomes** of each kind. *Cf.* **haploid**.
- diplospermous**. Having one pair of **spermatozoids** per **microgametophyte**.
- dis**. Greek, meaning ‘two’, *e.g.* the root word for the first part of the **generic** name *Dioon*, referring to the paired **seeds** on each **megasporophyll**. *See also* **oon**.

- disarticulate.** To separate at the joints; to become disjointed, *e.g.* the process of a **mature female cone** opening to allow the **seeds** to drop. *See also* **dehisce**. *Cf.* **indehiscent**, **receptive**.
- discharge dispersal.** *See* **autochory**.
- discolorous.** Having two colors, often referring to the lower (**abaxial**) **leaf** or **leaflet** surface being distinctly different in color from the upper (**abaxial**) surface, *e.g.* the **leaflets** of *Ceratozamia fuscoviridis* and *Encephalartos transvenosus*. *Cf.* **concolorous**.
- discriminant analysis.** Statistical technique used in separating discrete sets of objects.
- disjunct.** Separated geographically, pertaining to **populations** of the same **taxon** occurring in more than one geographical area.
- dispersal.** Act or process of dispersing, or the condition of being dispersed; movement of **seeds** by mechanical processes or **dispersal agents** (usually animals). *See also* **gene flow**.
- dispersal agent.** Organism or process that disperses **seeds**. *See also* **dispersal**.
- dissected.** Composed of numerous segments, as a **compound leaf** and its **leaflets** (or **pinnae**).
- distal.** Furthest away from the center of a structure or, more commonly, furthest from its point of attachment. *See also* **apical**, **terminal**. *Cf.* **basal**, **proximal**.
- distribution.** **Geographical range** of a **taxon** or group; spatial pattern or arrangement of the members of a **population** or group.
- divaricate.** Widely **spreading**, *e.g.* the **horns** on the **microsporophylls** of *Ceratozamia mixeorum*.
- divided.** Separated down to the point of attachment, *e.g.* the **leaflets** of *Cycas bifida*. *See also* **bifid**, **compound leaf**, **pinnate**.
- division.** Separation into parts, *e.g.* the removal of **suckers** and **offsets** for the purpose of **vegetative propagation**; **taxonomic rank** below **phylum** but above **order**.
- DNA, deoxyribonucleic acid.** 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. *Cf.* **RNA**.
- dominant.** In **genetics**, a **gene** that appears to inhibit or suppress the action of its **recessive** partner.
- dormant.** Inactive, but capable of reactivation.
- dolichos.** Greek, meaning 'long', *e.g.* the root word of the first part of the **specific epithet** of *Cycas dolichophylla*, referring to its long **leaves**. *See also* **phyllon**.
- drainage.** Natural or artificial removal of excess water over or through the soil; extremely important in cycad **cultivation**.
- drip tip.** Thin, protracted tip of the **leaves** (or **leaflets**) of many rainforest plants, *e.g.* the leaflets of *Ceratozamia hondurensis*.
- drooping.** Bent or hanging downward (**abaxially**), *e.g.* the **leaflets** of *Ceratozamia kuesteriana*, the **leaves** of *Cycas lane-poolei*, and the **lips** of the **terminal facets** of the **sporophylls** of *Encephalartos aplanatus*. *See also* **declinate**, **deflexed**. *Cf.* **inflexed**, **reflexed**.
- dry pollination.** Type of **hand pollination** whereby **pollen** is introduced to a **female cone** in powder form, often by means of pouring or blowing into the open spaces (**cracks**) between the **sporophylls** of a **receptive cone**.
- dwarf.** Small stature or **habit**, *e.g.* *Zamia pygmaea*. *See also* '**artificial dwarfing**' **hypothesis**.
- 'dynamic habitat' hypothesis.** Premise which suggests that cycad **species** are rapidly and dynamically **evolving** in response to climatic changes caused by glacial cycles, as opposed to the traditional view that species are slowly evolving and **relictual**; originally proposed in reference to species of *Dioon* in Mexico (*sensu* Gregory & Chemnick, 2004).
- e-.** Prefix meaning 'without' or 'lacking'.

- 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 interactions.
- edaphic.** Relating to the soil environment, *e.g.* soil structure, quality, pH, etc.
- edulis.** Latin, meaning ‘edible’, *e.g.* the root word of the **specific epithet** of *Dioon edule*, referring to the use of its **seeds** as a food source by native inhabitants of San Luis Potosí, Mexico.
- electrophoresis.** Analytical technique in which an electrical gradient is used to separate compounds, especially proteins, according to their charge and molecular mass.
- elegans.** Latin, meaning ‘elegant’, *e.g.* the **specific epithet** of *Macrozamia elegans* and the root word of the first part of the specific epithet of *Zamia elegantissima*, referring to the neat and pleasing **habit**.
- ellipsoid.** Of a 3-dimensional structure that is widest near the middle but narrowed towards each rounded end, *e.g.* the **seeds** of *Cycas wadei*.
- elliptic.** Of a 2-dimensional structure that is widest near the middle but narrowed towards each rounded end, *e.g.* the **leaflets** of *Zamia amplifolia*. *See also* **obovate**, **ovate**.
- elongate.** Lengthened or drawn out, *e.g.* the **apical spines** of *Cycas elongata* **megasporophylls**.
- elongation.** In cycads, rapid **growth** of **male cones** just prior to **dehiscence**, or rapid growth of **developing leaves** during **emergence**.
- emarginate.** Having a shallow notch at the **apex**, *e.g.* as in the **sarcotesta** of *Cycas revoluta*, and the **leaflets** of *Zamia pygmaea*.
- 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**.
- emend.** To improve by critical editing; to correct, revise, or enhance a faulty, inadequate, or incomplete **species description**, *e.g.* the emended description of *Dioon mejiae* (Haynes & Bonta, 2007).
- emergent.** Said of a **trunk** when it extends above ground level; of a **tree** that extends above the **canopy** of surrounding trees.
- emergent leaf color.** Color of the **leaflets** of newly **emerging leaves**; though this is sometimes **characteristic** for a given **taxon** (*e.g.* *Zamia imperialis*), other times different colors can occur in the same **species** or **population** (*e.g.* *Z. standleyi*).
- emerging.** In cycads, early **development** of a **cone** or **flush** of **leaves**; immature cone or flush.
- Endangered (EN).** IUCN **Red List** category in which a **taxon** is facing a very high risk of **extinction** in the wild. *See also* **Critically Endangered**, **Data Deficient**, **Extinct**, **Extinct in the Wild**, **Least Concern**, **Near Threatened**, **Vulnerable**.
- endemic.** Restricted in occurrence to a particular area, *e.g.* *Microcycas calocoma* is endemic to Cuba. *Cf.* **exotic**, **indigenous**.
- 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**.
- enigma.** One that is puzzling, ambiguous, or inexplicable, *e.g.* *Encephalartos inopinus* is an enigma in the **genus** because it is so different morphologically from the other **species**.
- ensiform.** Sword-shaped, as approximated by the **leaflets** of some cycads, *e.g.* *Cycas media* **subspecies** *ensata*.



- ensis.** Latin termination meaning ‘place of origin’; in cycads, the ending of a **specific epithet** that refers to the region of occurrence or **endemicity** of the so-named **species**, *e.g.* *Ceratozamia hondurensis* is endemic to Honduras.
- entire.** With a continuous **margin**; not **toothed** or **lobed**, *e.g.* the **leaflets** of the **mature leaves** of *Dioon edule* and all **species** of *Cycas*.
- entomophily.** Insect-mediated **pollen** transfer. *Cf.* **anemophily**, **hand pollination**.
- eophyll.** First **leaf** produced by a **seedling**. *See also* **euphyll**.
- epicotyl.** That part of a plant **embryo** above the insertion of the **cotyledon**. *Cf.* **hypocotyl**, **mesocotyl**.
- epidermis.** Outermost primary cellular layer of an organism. *Cf.* **hypodermis**.
- epigeous.** Occurring above soil level, as for the **stems** of **arborescent** cycads. *See also* **caulescent**. *Cf.* **acaulescent**, **hypogeous**.
- epiphyte**, adj. **epiphytic.** Plant growing on another plant non-parasitically, or on some other elevated support, *e.g.* *Zamia pseudoparasitica*.
- epithet.** *See* **specific epithet**.
- erect.** Upright; perpendicular; in cycads, used to describe the natural orientation of **stems** (*e.g.* the **trunk** of *Dioon merolae*) or of the most recent **crown** or **flush** of **leaves** (*e.g.* the **crown** of *Ceratozamia norstogii*). *Cf.* **decumbent**, **procumbent**, **prostrate** (pertaining to stems); **arching**, **ascending**, **spreading** (pertaining to leaves).
- erio-**. Greek, prefix meaning ‘woolly’, *e.g.* the first part of the **specific epithet** of *Stangeria eriopus*, referring to the woolly **leaf bases**. *See also* **-pus**.
- ethnobotany.** Study of the use of plants by the races of man.
- ethno-ecology.** Study of ways people conceptualize elements of the natural environment and the human activity within it; used here in a broader context than **ethnobotany** with regard to all interactions between humans and cycads.
- etiolated.** Abnormally **elongated leaf** resulting from a plant grown under low light intensity.
- 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**.
- eurys.** Greek, meaning ‘broad’, *e.g.* the root word for the first part of the **specific epithet** of *Ceratozamia euryphyllidia*, though technically referring to **leaves**, the epithet actually refers to the extraordinarily broad **leaflets**. *See also* **phyllon**.
- evolution.** Cumulative change in the **characteristics** of **populations** from **generation** to generation; change in **gene frequencies** over time as a result of **natural selection**.
- ex situ.** Latin, of plants or plant collections in **cultivation** outside their natural **habitat**. *Cf.* **in situ**.
- ex-situ conservation.** Conservation method that entails the removal of **seed**, **pollen**, or plants from their original **habitat**, keeping these resources of **biodiversity** alive outside of their natural environment.
- exclamation mark (!).** Used in **taxonomic** literature to signify that a particular **herbarium specimen** has been examined by the **author**. *Cf.* **non visus (n.v.)**.
- excurrent.** Extending beyond the **apex** of a **leaf**, *e.g.* the **rachis** of *Ceratozamia matudae*.
- exotic.** Not native; introduced. *Cf.* **endemic**, **indigenous**.
- explinate.** **Spreading** or extending outwardly in a **flat** form, *e.g.* the **lateral facets** of the **megasporophyll bullae** of *Encephalartos caffer*.
- exsiccatum**, plural **exsiccata.** Latin, pertaining to 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; among the very many extinct cycad genera are *Ceratozamites*, *Crossozamia*, *Dioonites*, *Eostangeria*, *Palaeocycas*, *Pseudoctenis*, *Ticoa*, and *Zamites*. *See also* **extirpated.** *Cf.* **extant.**

**Extinct (EX).** IUCN Red List category in which there is no reasonable doubt that the last individual of a **taxon** has died; a taxon is presumed Extinct when exhaustive surveys in known and/or expected **habitat**, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. *See also* **Critically Endangered, Data Deficient, Endangered, Extinct in the Wild, Least Concern, Near Threatened, Vulnerable.**

**Extinct in the Wild (EW).** IUCN Red List category in which a **taxon** is known only to survive in **cultivation**; a taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected **habitat**, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. *See also* **Critically Endangered, Data Deficient, Endangered, Extinct, Least Concern, Near Threatened, Vulnerable.**

**extirpated.** Locally **extinct**; in cycads, often caused by **poaching** or **habitat** degradation.

**extrinsic.** Existing or having its origin outside an individual, group, or system. *Cf.* **intrinsic.**

**exudate.** Substance that has oozed forth, *e.g.* **mucilage** exuding from a wound on a cycad **caudex**.

**F<sub>1</sub>, F<sub>2</sub>.** **Hybrid progeny** of the first or second **filial generation** of a plant cross, respectively, *e.g.* *Encephalartos natalensis* x *woodii*.

**face.** Colloquial for the **terminal facet** of a **sporophyll bulla**.

**facet.** Flattened **terminal, median, or lateral** section of a **sporophyll bulla** defined by ridges (Melville, 1957). *See also* **latero-sagittal ridge, medio-sagittal ridge, sagittal ridge.**

**falcate.** Curved in a sickle shape, *e.g.* the **leaflets** of *Cycas falcata*.

**family.** **Taxonomic rank** below **order** but above **genus**; cycad families comprise 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; **mealy**.

**fasciculate.** Arranged in a **whorl**, *e.g.* the **leaflets** of the common **form** of *Ceratozamia hildae*.

**feeder root.** One of the numerous small roots of a plant, through which moisture and nutrients are absorbed from the soil. *Cf.* **taproot.**

**female cone.** **Seed-bearing strobilus.** *See also* **megasporangiate strobilus, ovulate cone, seed cone.** *Cf.* **microsporangiate strobilus, pollen cone.**

**ferox.** Latin, meaning ‘fierce’, *e.g.* the **specific epithet** of *Encephalartos ferox*, referring to the stiff, sharply **spiny leaflets**.

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

**fertile.** In cycad biology, that portion of the **cone** (or in *Cycas*, the **megasporophyll**) that produces **gametes**. *Cf.* **sterile.**

**fertilization.** Union of male and female **gametes** resulting in a **zygote**; in **horticulture**, the application of organic or inorganic compounds to enhance plant **growth**.

**fide.** Latin, meaning ‘according to’ or ‘by the assurance of’. *See also* **sensu.**

**filial generation.** **Offspring generation.** *See also* **F<sub>1</sub>, F<sub>2</sub>.**

**filius (fil., f.).** Latin, meaning ‘son of’; used in reference to father-and-son **authors** of **taxa**.

**flabellate.** Fan-shaped, *e.g.* the **megasporophyll blade** of some *Cycas* **species**.

**flagellate.** Having flagella, used to describe the **motile sperm** of cycads.

- flat.** In cycads, a **leaflet margin** that is not curved or curled in any way; leaflets oriented straight out from the rachis in cross section. *Cf.* **involute**, **revolute**, **sinuate**, **undulate** (leaflet margins); **declinate**, **keeled**, **secund** (leaf cross section).
- flavonoid.** Large range of plant secondary metabolites comprising specific phenolic compounds, usually occurring as glycosides; often colored as in many plant pigments.
- flexuose, flexuous.** Of zig-zag shape, *e.g.* alluded to in the much twisted **rachis** of *Macrozamia flexuosa*.
- float test.** Commonly used method of inferring (as opposed to actual testing) the **viability** of cycad **seeds**, with the ‘**sinkers**’ being set aside to **germinate** and the ‘**floaters**’ often being discarded; it is important to note that this ‘viability’ test is often wrong, as not all seeds that sink will **germinate** and not all seeds that float are bad.
- flotation layer.** Tissue layer of the **sarcotesta** of some *Cycas* seeds that makes them naturally buoyant, *e.g.* as in *Cycas micronesica*.
- floater.** Colloquial for a cycad **seed** deemed (often mistakenly) nonviable when **float-tested** in water. *Cf.* **sinker**.
- floccose.** Bearing soft, uneven hairs, *e.g.* the **cataphylls** of *Cycas cairnsiana*.
- flora.** All plant **taxa** occurring in a specific geographical area.
- flush, flushing.** In cycads, a group of newly **emerging leaves**; also used in reference to a **cohort** of leaves. *See also* **phenology**. *Cf.* **coning**.
- foetid.** Having an offensive odor, *e.g.* the **pheromones** exuded by some cycad **cones** to attract their insect **pollinators**.
- foliola.** Latin, meaning ‘**leaflet**’, *e.g.* the root word of the second part of the **specific epithet** of *Encephalartos brevifoliolatus*, referring to its relatively short leaflets. *See also* **brevis**.
- folium, folius.** Latin, meaning ‘**leaf**’, *e.g.* the root word of the second part of the **specific epithet** of *Ceratozamia latifolia*, though technically referring to leaves, this epithet actually refers to the distinctively broad **leaflets**. *See also* **ceratos**.
- forked.** Divided into equal or nearly equal halves, *e.g.* the **leaflets** of *Cycas bifida*. *See also* **bifid**, **bifurcate**. *Cf.* **simple**.
- form, forma (f.).** In **taxonomy**, a **rank** below **species**; **morphological variant**.
- fossulate.** Having a grooved surface, as **pollen**. *Cf.* **foveolate**, **psilate**.
- Fourier transformation.** Mathematical process converting state space to frequency space, usually applied to time series data to find periodic signals.
- foveolate.** Having a pitted surface, as **pollen**. *Cf.* **fossulate**, **psilate**.
- frass.** Debris and fecal matter produced by insects, *e.g.* the characteristic accumulation of frass and **mucilage exudate** on the surface of cycad **stems** infested with **stem borers**.
- fringed.** In cycads, a **margin** of **tissue** protruding from the **terminal facet** of the **sporophylls**, *e.g.* *Encephalartos villosus*.
- frizzletop.** **Micronutrient deficiency** caused by a lack of available manganese in the soil, easily treated by applying manganese sulfate.
- frond.** Having the form of a fern **leaf**; commonly misapplied to other **pinnately**-compound leaves, as in palms and cycads.
- fulvous.** Dull brownish-yellow, *e.g.* the **male cones** of many *Zamia* **species**.
- fungal leaf spot.** Fungal disease, often of *Zamia*, caused by *Mycoleptodiscus* or other fungi that cause well-defined areas of tissue to die creating noticeable spots.
- funiculus, plural funiculi.** Attachment stalk of an **ovule**. *See also* **stipe**.

- furfuraceous.** Covered with bran-like **scales** or powder, *e.g.* the **emergent foliage** of *Cycas furfuracea* and *Zamia furfuracea*.
- fuscous.** Dark grayish-brown, dusky, *e.g.* the color of the **abaxial** surface of the **leaflets** of *Ceratozamia fuscoviridis*.
- fusiform.** Spindle-shaped; narrowed at each end and swollen centrally, *e.g.* as in the **male cones** of *Cycas taitungensis* and many other *Cycas* **species**.
- 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 comprises the basic unit of inheritance, each prescribing a code for the synthesis of a specific protein.
- gene flow.** Exchange of **genetic** factors within and between **populations** by **interbreeding** or **migration**.
- gene frequency.** Proportion of one **allele** to the total of all alleles at the same **locus** in the **gene pool**.
- gene pool.** Total genetic material of a freely **interbreeding population** at a given time; all **genes** at a given **locus** in a **population** in a given **generation**.
- genealogy.** Line of descent from an ancestor through its derivatives; the ‘pedigree’ of an organism. *See also lineage*.
- generation.** All individuals produced within a single **life cycle**.
- genetic marker.** **Gene** or **DNA** sequence having a known location on a **chromosome** and associated with a particular gene or **trait**.
- genetic refuge.** Geographic region symbolizing a centralized source of hereditary information; used in reference to a central **population** or **taxon** surrounded by one or more **allopatric species** or taxa.
- 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, plural genera.** **Taxonomic rank** below **family** but above **species**; **extant** cycad genera comprise *Bowenia, Ceratozamia, Cycas, Dioon, Encephalartos, Lepidozamia, Macrozamia, Microcycas, Stangeria*, and *Zamia* (with *Chigua* now being of questionable **validity** [*sensu* Lindström, 2009]). *Cf. specific epithet*.
- genus novum (gen. nov.).** Latin, citation at the time a new **genus** is first described. *See also species nova*.
- geographical barrier.** Any geographical feature that prevents **gene flow** between **populations**.
- geographical range.** Limits of the **distribution** of a **species** or group.
- germinate, germination.** Process by which the **embryo** resumes **growth** and escapes from the confines of the **seed** and the young **seedling** is established.
- germinated seed.** Of a cycad seed that has begun to germinate, indicating that it is viable.
- germplasm.** Any living cells, tissues, **seeds**, or other **propagules** conserved for **genetic** purposes.
- girdling leaf trace.** A vascular strand in the **cortex**, the path of which describes a circuitous rather than a direct route to the **leaf base**; defining **character** of the **Order Cycadales**.
- glabrate.** **Glabrous**, but obviously having previously had an **indumentum**. *Cf. glabrescent*.
- glabrescent.** Still with hairs, but losing them and in the process of becoming **glabrous**. *Cf. glabrate, pubescent*.
- glabrous.** Of a smooth surface, without hair of any kind, *e.g.* the **mature leaves** of most cycad **species**. *See also nitidus. Cf. lanate, pilose, pubescent, sericeous, tomentose*.
- glaucous.** Becoming **glaucous**. *Cf. nitidus*.

- glaucous.** Of a surface covered by a bluish-gray waxy or powdery bloom, *e.g.* the **leaves** of *Macrozamia glaucophylla*. *See also* **pruinose**. *Cf.* **nitidus**.
- globose.** Nearly spherical; globular, *e.g.* the **seeds** of *Cycas siamensis* or the **pseudococone** of *Cycas panzhihuanensis*.
- gonas.** Latin, meaning ‘seed’, *e.g.* the root word of the second part of the **specific epithet** of *Encephalartos pterogonus*, though technically referring to seeds, the epithet actually refers to the distinctive **wing-like** and **toothed** appendages below the **terminal facet** of the **microsporophylls**. *See also* **pteron**.
- GPS.** Global Positioning System, a worldwide electronic satellite-linked system for establishing latitude, longitude, and altitude.
- gratus.** Latin, meaning ‘pleasing’, *e.g.* the **specific epithet** of *Encephalartos gratus*, referring to its pleasing appearance.
- growth.** Increase in size, number, or complexity; progressive **development**.
- growth rate.** Rate of increase in the number of individuals in a **population**.
- guanine (G).** A pyrimidine base, C<sub>4</sub>H<sub>5</sub>N<sub>3</sub>O, that is the **nucleotide** constituent of **DNA** and **RNA** involved in **base pairing** with **cytosine (C)**. *See also* **adenine (A)**, **thymine (T)**, **uracil (U)**.
- guard cells.** Pair of cells surrounding a **stoma** of a **leaf** and regulating stomatal opening and closing.
- gymnosperm.** 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.
- hand pollination.** **Anthropogenic pollen** transfer for the purpose of producing **viable** cycad **seeds** via **artificial propagation**. *Cf.* **anemophily**, **entomophily**, **open pollinated**.
- haploid.** Having only one set of **chromosomes**. *Cf.* **diploid**.
- hardened, hardened off.** Of **leaves** that have completed **development** and are no longer soft. *See also* **indurate**.
- hardiness zones.** *See* **USDA hardiness zones**.
- hardy.** *See* **cold-hardy**.
- haustorium.** Absorptive branch or organ of a parasite that penetrates a host tissue. *See also* **mycorrhiza**.
- head.** Colloquial, in reference to the individual **apices** of a **multi-headed** plant.
- herbarium.** Collection of preserved (usually dried) plant **specimens**; the building in which such a collection is kept.
- herbarium specimen.** A representative sample (usually dried) of a plant, usually from a specific **population** or locality. *See also* **exsiccatum**, **holotype**, **isotype**, **lectotype**, **neotype**, **paratype**, **plantae exsiccatae**, **type**.
- herbivore.** Organism that feeds on plants, *e.g.* pest insects such as **cycad aulacaspis scale** (*Aulacaspis yasumatsui*) and cycad blue butterfly (*Chilades pandava*).
- heteros.** Greek, meaning ‘different’, *e.g.* the root word of the first part of the **specific epithet** of *Macrozamia heteromera*, referring to its **divided** and undivided **leaflets**. *See also* **–merus**.
- heterosis.** Increased vigor resulting from **hybridization** when measured against either parental stock; **hybrid vigor**.
- heterozygous.** Having two different **alleles** at a given **locus** of a **chromosome** pair. *Cf.* **homozygous**.
- hexagonal.** Having six sides, *e.g.* the 2-dimensional profile of most cycad **megasporophylls** (except *Cycas*).

- hierarchy.** Representation of relationships where mutually exclusive lower groups are successively included in more inclusive groups. *See also* **systematics**.
- hirsute.** Covered with short coarse hairs, *e.g.* the **leaves** of *Encephalartos hirsutus*. *See also* **lanate, pilose, pubescent, sericeous, tomentose**. *Cf.* **glabrous, nitidus**.
- histology.** Study of biological tissues.
- hoary.** Covered with grayish hair or **pubescence**, *e.g.* the **emerging leaves** of *Cycas basaltica*.
- holotype, holo.** Single **herbarium specimen** or illustration of the **type** collection used or designated by the **author** of the name. *See also* **isolectotype, isotype, lectotype, neotype, paratype**.
- homologous, 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**; **monomorphic**. *See also* **dimorphic, polymorphic**.
- homoplasy.** Mistaken **homology**; superficial similarity between **characters** or **character states** due to **convergence**, parallel **evolution**, or reversal, *e.g.* the occurrence of **bipinnately compound leaves** in *Bowenia* and *Cycas*.
- homozygous.** Having identical **alleles** at a given **locus** of a **chromosome** pair. *Cf.* **heterozygous**.
- horns.** In cycads, sharp protrusions on the **sporophylls**, *e.g.* the **genus** *Ceratozamia* is characterized by two horns per sporophyll (= **bicornate**).
- horridus.** Latin, meaning ‘horrible’, *e.g.* the **specific epithet** of *Encephalartos horridus*, referring to its stiff, **spiny leaflets**.
- horticulture.** Science or art of **cultivating** fruits, vegetables, flowers, or ornamental plants; from the Latin *hortus* (‘garden’).
- humilis.** Latin, meaning ‘humble’ or ‘lowly’, *e.g.* the **specific epithet** of *Encephalartos humilis* and *Macrozamia humilis*, referring to the small stature.
- humus.** Dark, loamy, organic portion of the soil remaining after prolonged microbial decomposition.
- hybrid.** Natural or artificially produced plant resulting from a cross of genetically-dissimilar parents, commonly between two different **species**.
- hybrid swarm.** Series of highly variable **forms** produced by repeated **genetic** exchanges between related **taxa**. *See also* **hybrid zone**.
- hybrid vigor.** *See* **heterosis**.
- hybrid zone.** Zone of overlap between adjacent **populations, subspecies, or species** in which **interbreeding** occurs; **zone of hybridization**. *See also* **hybrid swarm**.
- hydrophyte, adj. hydrophytic.** Plant **adapted** to grow in water, *e.g.* *Zamia nesophila* is adapted to growing in standing seawater for extended periods when its beach strand **habitat** becomes inundated during regularly occurring storms. *Cf.* **mesophyte, xerophyte**.
- hymen.** Greek, meaning ‘thin’ or ‘membranous’, *e.g.* the first part of the **specific epithet** of *Zamia hymenophyllidia*, though technically referring to **leaves**, this epithet actually refers to the extremely thin, almost **transparent leaflets**. *See also* **phyllon**.
- hypocotyl.** That part of a plant **embryo** below the **cotyledon** but above the **root**. *See also* **radicle**. *Cf.* **epicotyl, mesocotyl**.
- hypodermis.** Cellular layer immediately internal to an **epidermis**.
- hypogeous.** Occurring below soil level; subterranean, *e.g.* the **stems** of *Stangeria eriopus*, many *Zamia* **species**, and most *Macrozamia* Section *Parazamia* species. *See also* **acaulescent**. *Cf.* **arborescent, caulescent, epigeous**.

- hypostomatic.** Of leaves and leaflets with **stomata** on the **abaxial** surfaces only. *Cf.* **amphistomatic.**
- IBA.** Indole butyric acid, an **auxin** (synthetic plant hormone).
- ibidem (ib., ibid.).** Latin, in the same place; used in footnotes and bibliographies to refer to the book, chapter, article, or page cited just before.
- ICBN.** *See* **International Code of Botanical Nomenclature.**
- idem (id.).** Latin, something that has been mentioned previously.
- idioblast.** Specialized cell with inclusions, in cycads storing **toxins** possibly as a **herbivore** deterrent; a cell without known function.
- imbricate.** Overlapping, *e.g.* the **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**, *e.g.* **seedling leaves** of *Cycas cairnsiana*. *Cf.* **paripinnate.**
- in-.** Prefix meaning ‘not’. *See also* **a-.**
- in situ.** Latin, of plants growing naturally in their native **habitat**. *Cf.* **ex situ.**
- incertae sedis.** Latin, of uncertain placement in a **classification** system.
- incipient species.** **Populations** that are in the process of diverging to the point of **speciation** but which still have the potential to **interbreed** even though they are prevented from doing so by a specific barrier. *See also* **allopatric speciation, isolating mechanism.** *Cf.* **hybrid swarm, hybrid zone.**
- incised.** Deeply and sharply cut, *e.g.* the **leaflets** of *Cycas micholitzii*. *Cf.* **pinnate, simple.**
- incubous.** Arrangement in which a **leaflet** partially **shields** the next **distal** leaflet when viewed from above (**adaxially**), *e.g.* as in *Dioon califanoi* and *Encephalartos hirsutus*. *Cf.* **succubous.**
- incurved.** With **apex** bent or curving upward (**adaxially**), *e.g.* the tips of the median **microsporophylls** of *Macrozamia platyrachis*. *Cf.* **recurved.**
- indehiscent.** Not opening on maturity. *Cf.* **dehiscent.**
- indeterminate.** With **growth** of the **axis** continuing indefinitely. *Cf.* **determinate.**
- indigenous.** Native to a particular area but not necessarily restricted there. *Cf.* **endemic, exotic.**
- indumentum.** Covering of (often pigmented) **trichomes** or **scales**. *See also* **tomentum.**
- indurate.** **Hardened**, often with the hardening developed only at **maturity**, *e.g.* the **leaves** of all cycads.
- ineditus (ined.).** Latin, unpublished, often in reference to an anticipated new **species description**.
- inerm.** Without **spines** or **prickles**; **unarmed**, *e.g.* the **petioles** of *Zamia inermis*. *Cf.* **armed.**
- inflexed.** Bent longitudinally inwards (**adaxially**), *e.g.* **emerging leaves** of many *Zamia* species. *See also* **circinate, conduplicate, ptyxis, vernation.** *Cf.* **declinate, deflexed, reflexed.**
- inserted.** Attached to or growing out of, *e.g.* **leaflets** inserted on the **rachis**. *See also* **leaflet angle(s) of insertion.**
- insertion angle(s).** *See* **leaflet angle(s) of insertion.**
- insular.** Pertaining to islands, *e.g.* the **habitat** of *Zamia nesophila*.
- integer.** Latin, meaning ‘entire’, *e.g.* the root word of the first part of the **specific epithet** of *Zamia integrifolia*, a misnomer that refers to the **leaflet margins** which are not actually entire. *See also* **folium.**
- integument.** Outer covering of an **ovule**, forming the layers of the **seed coat** at maturity. *See also* **sarcotesta, sclerotesta.**
- interbreeding.** Mating or **hybridization** between different individuals, **populations, varieties, or species.**
- interfertile.** Capable of **interbreeding**, often in reference to inter-species **hybridization.**
- intergrade.** To merge into each other in a series of stages, **forms, or types**, *e.g.* in a **hybrid zone.**

- International Code of Botanical Nomenclature (ICBN).** Internationally accepted rules for naming plant **species** adopted during various meetings of the International Botanical Congress, *e.g.* the Vienna Code of 2005 (McNeill *et al.*, 2007).
- internode.** Part of an **axis** between two successive **nodes**, joints, or points of attachment of **leaves** or **leaflets**. *Cf.* **node**.
- interstitial region.** Intervening zone between areas of defined structure.
- intrinsic.** Originating or occurring within an individual, group, or system. *Cf.* **extrinsic**.
- invalid.** Refers to **scientific names** published with incomplete information or in an invalid publication. *See also nomen illegitimum. Cf. valid.*
- involute.** With **margins** rolled inwards (**adaxially**), *e.g.* as in *Cycas revoluta* **var. involuta**. *Cf. revolute*.
- isoenzymes, isozymes.** Differing molecular forms of an enzyme that serve the same function.
- isolating mechanism.** Any **intrinsic** or **extrinsic** mechanism or barrier to the free exchange of **genes** between **populations**.
- isolectotype, isolecto.** Duplicate of (having the same collection details as) a **herbarium specimen** chosen from the original material to replace a missing **holotype** or **isotype**. *See also holotype, isolectotype, isotype, lectotype, neotype, paratype.*
- isotype, iso.** **Herbarium specimen** that is a duplicate of (having the same collection details as) the **holotype**. *See also holotype, isolectotype, lectotype, neotype, paratype.*
- iteroparous.** Of an organism that has multiple reproductive seasons over its lifetime, *e.g.* all cycads.
- 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 the Conservation of Nature and Natural Resources, a United Nations organization.
- jugate.** Of a **pinnate leaf**; having **leaflets** in pairs, *e.g.* as in most cycad **species**.
- juvenile.** Non-reproductive **life cycle** stage with no visible **stem** (or barely visible) and **leaves** arranged in one or more well-developed **cohorts** or **crowns** (*sensu* Yáñez-Espinosa, 2009). *Cf. adult, mature, seedling.*
- juvenile leaf.** **Leaf** of a young plant (and of **offsets** and **suckers**) that is different in **form** from those of an **adult**. *Cf. adult leaf.*
- karpos.** Greek, meaning ‘fruit’, *e.g.* the root word of the second part of the **specific epithet** of *Cycas macrocarpa*, though cycads do not technically have fruit, this epithet actually refers to the large **seeds**. *See also macro, mega.*
- karyology.** Study of the **characteristics** of **chromosomes**, commonly in terms of their **haploid** number and **morphology**.
- keeled.** V-shaped; resembling a boat keel; **secund**, *e.g.* the **leaves** of *Dioon califanoi* and *Encephalartos lehmannii*. *See also pinna-pinna (pp) angle. Cf. declinate, deflexed, reduplicate.*
- key.** *See dichotomous key.*
- kinetin.** Plant **growth** hormone,  $\beta$ -furfuryl-aminopurine.
- koikas.** Greek, meaning a kind of palm, *e.g.* the root word for the **generic** name *Cycas*.
- lacinate.** Cut into narrow segments, *e.g.* the **megasporophyll blades** of many *Cycas* **species**.
- laevis.** Latin, meaning ‘smooth’, *e.g.* the root word of the first part of the **specific epithet** of *Encephalartos laevifolius*, referring to the lack of **tomentum** on the **leaves**. *See also folius.*
- lamina, plural laminae.** Flattened and expanded portion of a **leaf**, **leaflet**, or **sporophyll**; **blade**.
- lanate.** Woolly with long, intertwined, curly hairs, *e.g.* the **stem apex**, **emergent leaves**, and **cones** of *Encephalartos lanatus*. *See also hirsute, pilose, pubescent, sericeous, tomentose. Cf. glabrous, nitidus.*



- lanceolate.** Lance-shaped, much longer than broad, with a wide base, tapered **apex**, and widest below the center, *e.g.* the **median leaflets** of *Cycas petraea*. *See also* **oblanceolate**.
- lateral.** At or on the side of an organ. *See also* **lateral facet**. *Cf.* **terminal**.
- lateral facet, lateral angle.** Side surfaces of **sporophyll bullae** (Melville, 1957). *Cf.* **median facet, terminal facet**.
- lateral lobe.** Side projection of a **megasporophyll**. *Cf.* **median lobe, sagittal crest**.
- latero-sagittal ridge.** Line, sometimes more distinct than others, separating the **median facet** from the **lateral facets** of *Encephalartos sporophyll bullae* (Melville, 1957). *Cf.* **medio-lateral ridge, sagittal ridge**.
- latus.** Latin, meaning ‘wide’, *e.g.* the root word of the first part of the **specific epithet** of *Ceratozamia latifolia*, though technically referring to **leaves**, the epithet actually refers to the broad **leaflets**. *See also* **folium**.
- leaf.** Usually green, flattened, **lateral** structure attached to a **stem** and functioning as a principal organ of **photosynthesis** and **transpiration** in most plants.
- leaf base.** Often swollen point of attachment of the **leaf** to the **caudex**. *See also* **collar**.
- leaf flush.** *See* **flush**.
- leaf miner.** Tiny grub that tunnels in young cycad **leaves** leaving whitish blotches or trails.
- leaf scar.** Colloquial for **persistent leaf base**, with or without an **abscission**, often forming rings on **arborescent caudices** corresponding to **successive flushes**.
- leaf spot.** *See* **fungal leaf spot**.
- leaf stalk.** Stalk of a leaf; **petiole**.
- leaflet.** Primary **division** of a **compound leaf**; **pinna**.
- leaflet angle(s) of insertion.** Manner in which the **leaflets** are arranged or oriented on the **rachis**. *See* **imbricate, incubous, pinna-pinna (pp) angle, pinna-rachis (pr) angle, shielding (s) angle, succubous**.
- leaflet length-to-width (L:W) ratio.** Index that describes the **morphometrics** of a cycad **leaflet** (*sensu* Taylor *et al.*, 2008).
- Least Concern (LC).** IUCN Red List category by which a **taxon** does not qualify for **Critically Endangered, Endangered, Vulnerable** or **Near Threatened**; widespread and abundant taxa are included in this category. *See also* **Critically Endangered, Data Deficient, Endangered, Extinct, Extinct in the Wild, Near Threatened, Vulnerable**.
- lectotype (lecto.).** **Herbarium specimen** chosen from the original material to replace a missing **holotype** or **isotype**. *See also* **holotype, isolectotype, isotype, neotype, paratype**.
- leggy.** Colloquial for a plant growing tall and spindly, usually from inadequate sunlight; **etiolated**.
- lenticel.** Gas-exchange tissue in cycad **coralloid roots**.
- lenticular.** Shaped like a biconvex lens, *e.g.* the **nodules** of **coralloid roots**.
- Lepidoptera.** **Order** of insects that includes moths and butterflies; most common **herbivores** on cycad **leaves**.
- lepidos, lepis.** Greek, meaning ‘scale’, *e.g.* the root word of the first part of the **generic name** *Lepidozamia* and the second part of the **specific epithet** of *Cycas xipholepis*.
- life cycle.** Sequence of events from the origin as a **zygote** to the death of an individual.
- life history.** Significant features of a **life cycle** through which an organism passes, with particular reference to strategies influencing survival and reproduction.
- lignified.** Of cell walls impregnated with **lignin**.

- lignin.** Complex insoluble polysaccharide mixture serving to strengthen and protect cell walls. *See also xylem.*
- ligulate.** Strap- or tongue-shaped, *e.g.* the **leaf** outline of many cycad species.
- lineage.** Line of descent of an organism; ancestry. *See also genealogy.*
- linear.** Long and narrow, the sides parallel or nearly so, *e.g.* the **leaflets** of *Zamia angustifolia*.
- lip.** Colloquial, in cycads, a **margin** of **tissue** protruding from the **terminal facet** of the **sporophylls**, *e.g.* as in *Encephalartos villosus*.
- literature.** In science, the accumulation of scientific papers and materials published on a given subject.
- lit(t)oral.** Of the coast or shore, *e.g.* the **habitat** of *Cycas littoralis*.
- lobate, lobed.** Having **lobes**; lobed, *e.g.* the **leaflets** of *Encephalartos arenarius*. *Cf.* **entire**.
- locus, plural loci.** The position of a given **gene** on a **chromosome**.
- long-lived.** Describes a plant where the individuals subsist for a number of years, *i.e.* cycads, in general, *e.g.* individual plants of *Dioon mejiae* in Honduras may be as much as 1,200 years old.
- long-stalked.** Colloquial, pertaining to a long **peduncle**. *Cf.* **sessile, short-stalked**.
- longis, longi-.** Latin, meaning ‘long’, *e.g.* the first part of the **specific epithet** of *Encephalartos longifolius*, referring to the relatively long **leaves**. *See also folius.*
- lucid.** Shining or glowing, *e.g.* the **leaflets** of *Macrozamia lucida* or *Zamia splendens*. *Cf.* **glaucous**.
- lumper. Taxonomist** who groups by similar **traits**, assuming that differences are not as important as similarities, and then places organisms which share several major **characteristics** in the same group. *Cf.* **splitter**.
- machete botany.** Colloquial, crude method of study and collection by early botanists and naturalists.
- macronutrient.** Chemical compound required for plant **growth** in relatively large quantities, *e.g.* nitrogen, phosphorus, potassium. *Cf.* **micronutrient**.
- macrozamin.** Toxic **MAM** glycoside found only in cycad tissue; methylazoxymethanol- $\beta$ -primeveroside. *See also cycasin.*
- macros.** Greek, meaning ‘large’, *e.g.* the root word of the first part of the **generic name** *Macrozamia*.
- male cone. Pollen-bearing strobilus.** *See also microsporangiate strobilus, pollen cone. Cf. female cone, megasporangiate strobilus, ovulate cone, seed cone.*
- MAM.** Methylazoxymethanol, the toxic compound found as its glycoside in **cycasin, macrozamin**, and structurally-related compounds in cycad tissues.
- manicatus.** Latin, meaning ‘long-sleeved’, *e.g.* the root word of the **specific epithet** of *Zamia manicata*, referring to the presence of a **petiolule**.
- manoxylic.** Having a small amount of secondary **xylem** tissue with relatively abundant **parenchyma**, as in cycad **stems**.
- margin.** The edge of a **leaflet blade**.
- marginate.** Having a well-defined border or **margin** of distinctive appearance, color, pattern, or structure. *Cf.* **emarginate**.
- marker.** *See genetic marker.*
- 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; **adult**. *Cf.* **juvenile, seedling**.
- maximum parsimony.** Non-parametric statistical method commonly used in computational **phylogenetics** for estimating **phylogenies**.
- mealy.** Covered with fine, flour-like powder; **farinaceous**.

- mealybug.** Any of the **scale** insects belonging to the **Family** Pseudococcidae that have a white powdery covering and are destructive plant pests, *e.g.* especially of **species** like *Zamia furfuracea* that have dense **crowns** of **leaves**.
- mean.** Average; equal to the sum of the observations divided by the number of observations.
- median.** Arising from or positioned at the midpoint; used in reference to the **leaflets** occurring in the mid-portion of a cycad **leaf**; also used in statistics for that value of a **variable** in an ordered array that has an equal number of observations or items above it or below it. *Cf.* **apical**, **basal**.
- median facet.** **Flat**, angled surface above the **terminal facet** of a **sporophyll bulla** (Melville, 1957). *Cf.* **lateral facet**.
- median lobe.** Central projection of the **adaxial** face of a **megasporophyll**. *Cf.* **lateral lobe**, **sagittal crest**.
- medio-lateral ridge.** Line, sometimes more distinct than others, forming the lower edge of the **terminal facet** of *Encephalartos sporophyll bullae* (Melville, 1957). *Cf.* **latero-sagittal ridge**, **medio-lateral ridge**, **sagittal ridge**.
- medullary ray.** Sheet of primary stem **parenchyma** tissue extending from the **pith** to the **cortex**.
- mega.** Greek, meaning ‘large’, *e.g.* the root word of the first part of the **specific epithet** of *Cycas megacarpa*, referring to the distinctive large **seeds**. *See also* **karpos**.
- 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**. Seed-bearing cone, **seed cone**, or **ovulate cone**; less correctly **female cone**. *Cf.* **microsporangiate strobilus**.
- megaspore.** Spore that gives rise to a female **gametophyte**. *Cf.* **microspore**.
- megaspore mother cell.** That cell in a **megasporangium** that produces a **megaspore** by **meiosis**.
- megasporophyll.** **Sporophyll** bearing one or more **ovules** or later **seeds**, or potentially so. *Cf.* **microsporangiate strobilus**.
- meiosis.** Process of cell division by which the **chromosome** number becomes **haploid**; cell division that produces the **gametes**. *Cf.* **mitosis**.
- melano-.** Greek, meaning ‘black’ or ‘very dark’, *e.g.* the first part of the **specific epithet** of *Zamia melanorachis*, referring to the dark brown to almost dark purple **rachis**.
- membranous**, less commonly **membranaceous**. Thinly textured, as in a membrane, *e.g.* the **leaflets** of *Ceratozamia euryphyllidia*. *See also* **chartaceous**, **papyraceous**. *Cf.* **coriaceous**.
- merus.** Greek, meaning ‘part’ or ‘member’, *e.g.* the root word of the second part of the **specific epithet** of *Macrozamia diplomera*, referring to the **dichotomously** divided **leaflets**. *See also* **diplo-**.
- meristem.** Localized region of dividing cells that gives rise to the permanent tissues of a plant.
- mesic.** Moist conditions, or **adapted** to such conditions.
- mesocotyl.** That part of the **axis** of an **embryo** that bears the **cotyledon**. *Cf.* **epicotyl**, **hypocotyl**.
- mesophyte**, adj. **mesophytic**. Land plant that grows in an environment having a moderate amount of moisture, *e.g.* most cycad **species**. *Cf.* **hydrophyte**, **xerophyte**.
- metacentric.** Of a **chromosome**, having its **centromere** equidistant from the two ends. *Cf.* **acrocentric**, **telocentric**.
- micro.** Greek, meaning ‘small’, *e.g.* the first part of the **generic** name *Microcycas*, referring to its (supposedly) smaller overall stature compared to the genus *Cycas*.
- microhabitat.** Small, specialized **habitat**.
- micronutrient.** Chemical compound required for plant **growth** in small quantities, the shortage of which can be a common cause of deficiency symptoms in plants, *e.g.* manganese, boron. *Cf.* **macronutrient**.

- micronutrient deficiency.** Symptom(s) expressed in plants not receiving sufficient quantities of a particular **micronutrient**. *See also* **frizzletop**.
- micropyle.** Orifice in the **integuments** and later **seed coats**, at the **distal** end of a cycad **ovule**, through which the **pollen** or **pollen tube** enters. *See also* **coronula**. *Cf.* **chalaza**.
- microsatellites.** Regions of repetitive **DNA** that are highly variable and useful for **genetic** analyses of **populations** or **species**.
- microsporangiate strobilus**, less correctly **microstrobilus**. Pollen-bearing cone, **pollen cone**; less correctly **male cone**. *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**.
- microspore mother cell.** That cell in a **microsporangium** that produces **microspores** by **meiosis**.
- microsporophyll.** **Sporophyll** bearing **microsporangia**. *Cf.* **megasporophyll**.
- microtubule.** Submicroscopic proteinaceous tube that is a major structural element in plant cells.
- midrib, midvein.** Main, central vascular supply of a **leaflet**, *e.g.* the raised central **vein** of *Cycas* leaflets.
- migration.** **Gene flow**; exchange of **genetic** information between **populations**.
- mitochondrial DNA (mtDNA).** **Haploid DNA** molecule present in the **mitochondrion**; commonly used in **genetic** studies. *Cf.* **cpDNA, nDNA**.
- mitochondrion**, plural **mitochondria**. Spherical or elongated **organelle** in the **cytoplasm** of nearly all **eukaryotic** cells, containing **genetic** material and many **enzymes** important for cell metabolism, including those responsible for the conversion of food to usable energy.
- mitosis.** Process of **chromosome** division and separation that takes place in a dividing cell, producing daughter cells of equivalent chromosomal composition to the parent cells; ‘normal’ cell division. *Cf.* **meiosis**.
- molecular systematics.** Study of organisms and their interrelationships using biochemical **characters** and techniques; study of **evolutionary** relationships using comparative molecular data.
- monomer.** One-parted unit, or individual subunit, of a **polymer**.
- monomorphic.** Having only one **form**. *See also* **homomorphic**. *Cf.* **dimorphic, polymorphic**.
- monophyletic.** Derived from a single ancestor. *See also* **paraphyletic, polyphyletic**.
- monopodial.** Used to describe a **growth habit** with unlimited **apical** growth, *e.g.* most, if not all, cycads.
- monospecific.** Of a **genus** with only one **species**, *e.g.* *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**, *e.g.* Cycadaceae is a monotypic family, while *Microcycas* and *Stangeria* are monotypic (and **monospecific**) genera.
- montane.** Of mountains or high places, *e.g.* the **habitats** of *Macrozamia montana* and *Zamia montana*.
- morphogeographic.** Combining aspects of shape and **distribution**, *i.e.* **morphology** and geography; recommended **species** concept for cycads (*sensu* Walters & Osborne, 2004).
- morphology.** Study of the external architecture of an entity; sum of the **phenotypic traits** of an organism.
- morphometric.** Of the measurement of **morphological characters**.
- ‘**mother**’ **plant.** Colloquial, referring to a plant that has produced **suckers** or **offsets** that have been removed by **division** for the purpose of **vegetative propagation**.
- motile sperm.** **Characteristic** unique to **Cycadales** and **Ginkgoales** among the seed plants.
- mucilage.** Gelatinous substance; in cycads comprising complex water-soluble carbohydrates and produced in response to stress or wounding.

- mucilage canal.** Passage within an organ which allows for the transport of **mucilage**.
- mucronate.** Ending abruptly in a sharp point or spur known as a mucro, *e.g.* the pointed **apex** of some *Zamia macrostrobili*, and the **leaflets** of *Cycas basaltica*.
- mulch.** Protective covering, usually of organic matter such as **leaves**, straw, or peat, placed around plants to prevent the evaporation of moisture, the freezing of **roots**, and the **growth** of weeds.
- multi-headed.** In cycads, a plant (often **acaulescent**) bearing numerous individual **apices**, often forming a **clump**. *Cf.* **solitary**.
- multipinnate.** Of a **compound leaf**, having more than two orders of **division**, *e.g.* the **leaflets** of *Cycas multipinnata*. *See also* **bipinnate**.
- multiseriate.** Organized in several rows, as structures of a plant, *e.g.* the **sporophylls** of cycad **cones**.
- multispermy.** Production of higher multiples of **sperm** by the male **gametophyte** of a plant.
- multivariate analysis.** Simultaneous statistical analysis of two or more **variables**.
- muricate.** With numerous short, hard outgrowths, *e.g.* the small, sharp **teeth** of the **leaflet margins** of *Zamia muricata*.
- mutant.** Any organism, **gene**, or **character** that has undergone a mutational change, *e.g.* the **crested** or ‘**cristate**’ **mutation** causes **leaves** and **cones** to be produced in **linear** rather than **radial symmetry**.
- mutation.** Sudden heritable change in **genetic** material, often resulting from an alteration of a single **gene** by the duplication, replacement, or deletion of a number of **DNA base pairs**.
- mutualism.** Symbiotic relationship in which both partners benefit, *e.g.* as in the association of **cyanobacteria** in the **coralloid roots** of cycads. *See also* **symbiont**.
- 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.
- N<sub>2</sub> fixation.** Reduction of atmospheric nitrogen by any of several agents, *e.g.* by **cyanobacteria** in **coralloid roots** of cycads.
- napiform.** Turnip-shaped; large and round in the upper part, and very slender below, *e.g.* the **tuberous**, subterranean (**hypogeous**) **caudex** of many cycad **species**.
- narrowly.** Having a length:breadth ratio between 3:1 and 6:1; if the ratio is more than 6:1 then the shape is described as very narrowly, except in the case of very narrowly **oblong** which is termed **linear**.
- natural selection.** Non-random differential **reproduction** of different **genotypes** in a **population**.
- Near Threatened (NT).** IUCN **Red List** category in which a **taxon** is does not qualify for **Critically Endangered**, **Endangered** or **Vulnerable** now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. *See also* **Critically Endangered**, **Data Deficient**, **Endangered**, **Extinct**, **Extinct in the Wild**, **Least Concern**, **Vulnerable**.
- neck canal cells.** Column of cells within an **archegonial neck** that are lysed during **fertilization**.
- neocycasins.** Group of cycad **toxins** differing from **cycasin** or **macrozamin** only in the kind of sugar present in the molecule.
- neoteny.** Expression of **mature** sex **characteristics** in a **seedling** or **juvenile**. *See also* ‘**artificial dwarfing**’ **hypothesis**, **precocious**.
- neotype (neo.).** New material designated to replace a missing **holotype** when no original material remains in a **herbarium** collection. *See also* **isolectotype**, **isotype**, **lectotype**, **paratype**.
- nerved.** *See* **corrugated**, **pleated**, **plicate**.
- nerves.** Fine **veins** which traverse the **leaf blade**.
- neso.** Greek, meaning ‘island’, *e.g.* the first part of the **specific epithet** of *Zamia nesophila*, referring to its propensity for an **insular** existence. *See also* **philo**.

- neuro.** Greek, meaning ‘nerve’, *e.g.* the first part of the **specific epithet** of *Zamia neurophyllidia*, though technically referring to **leaves**, this epithet actually refers to the strongly nerved appearance of the **leaflets**. *See also phyllon.*
- neurotoxin.** Any substance capable of affecting or damaging nerves and nerve tissue.
- niche.** Function or position of a **species** within an **ecological community**, including the physical environment to which it has become **adapted**.
- nitidus.** Smooth and shiny, *e.g.* the **adaxial leaflet** surface of *Zamia splendens*. *See also glabrous. Cf. glaucous, hirsute, lanate, pubescent, sericeous, tomentose.*
- nitrogenase.** Enzyme capable of reducing atmospheric nitrogen. *See also mycorrhiza, N<sub>2</sub> fixation.*
- node.** A point on a **stem** or **leaf** where leaves or **leaflets** originate. *Cf. internode.*
- nodule.** Raised bump (*e.g.* on the **adaxial** surface of the **leaflets** of *Encephalartos heenanii*) or swelling (*e.g.* the termini of **coralloid roots** where the **cyanobacteria** occur).
- nomen ambigua, nomen ambiguum (nom. ambig.).** Latin, pertaining to a name that has long referred to different **taxa** and should be abandoned.
- nomen dubium (nom. dub.).** Latin, pertaining to a 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.).** Latin, pertaining to a 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.).** Latin, pertaining to a 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.).** Latin, pertaining to an avowed new name unaccompanied by a **description** or **diagnosis**, *e.g.* Linden’s name *Cycas neocaledonica*.
- nomenclature.** Assignment of names to **taxa**, in accordance with the **International Code of Botanical Nomenclature**. *See also binomial nomenclature. Cf. taxonomy.*
- non visus (n.v.).** Latin, in reference to an item not seen, *e.g.* a **herbarium specimen** that could not be examined. *Cf. exclamation mark (!).*
- nucellus. Megasporangium** of a **seed**.
- nucleotide.** Any of various compounds consisting of a nucleoside combined with a phosphate group and forming the basic constituent of **DNA** and **RNA**. *See also adenine (A), cytosine (C), guanine (G), thymine (T), uracil (U).*
- nucleus.** Core part of any **eukaryotic** cell, a membrane-encased **organelle** containing the **genetic** material.
- ob-.** Prefix meaning ‘inversely’ or ‘opposite to’.
- oblanceolate.** Lance-shaped, much longer than broad, with a wide **apex**, tapered base, and widest above the center, *e.g.* the **leaflets** of *Ceratozamia hondurensis*. *See also lanceolate.*
- obligate.** Restricted to only one **taxon** or activity, *e.g.* an obligate **pollinator**.
- oblique.** Having a slanting or sloping direction, course, or position; inclined, *e.g.* the orientation of the **leaflets** of *Zamia obliqua* on the **rachis**.
- obovate.** Of a 2-dimensional structure that is egg-shaped in outline but broadest above the middle, *e.g.* the **leaflets** of *Ceratozamia euryphyllidia*. *See also elliptic, ovate.*
- obovoid.** Of a 3-dimensional structure that is **obovate** in longitudinal section, *e.g.* the **seeds** of *Cycas multipinnata*. *See also ovoid.*

- obtrullate.** Of a 2-dimensional structure resembling a trowel blade with the broadest **axis** above the middle and a length:breadth ratio between 3:2 and 2:1, *e.g.* the **microsporophylls** of *Dioon mejiae*. *See also leaflet length-to-width ratio. Cf. trullate.*
- obtuse.** Blunt or rounded at the **apex**, *e.g.* the **leaflets** of *Stangeria eriopus*. *Cf. acute.*
- Occam’s razor.** Axiom which states that, when faced with two or more equally plausible explanations for a given situation or phenomenon, the most viable will usually be the one that makes the fewest assumptions. *See also parsimony.*
- occidua.** Latin, meaning ‘of the west’, *e.g.* the **specific epithet** of *Macrozamia occidua*, referring to its occurrence in Sundown National Park, Queensland, Australia (alluding to the setting of the sun in the west).
- odont.** Greek, meaning ‘tooth’, *e.g.* the root word of the second part of the **specific epithet** of *Zamia oligodonta*, referring to the few teeth on the **leaflet margins**. *See also olig.*
- odor-mediated push-pull pollination.** Hypothesis pertaining to the **coevolution** of cycads and their **pollinators** involving highly specific cycles of heat and odor production in cycad **cones** that first attract and then repel pollinators (*sensu* Terry *et al.*, 2007). *See also thermoperiod.*
- offset.** Vegetative **axis** arising from an **adventitious bud laterally** on a cycad **trunk**; colloquial, **pup**. *Cf. sucker.*
- oid.** Suffix denoting a 3-dimensional shape.
- olig.** Greek, meaning ‘few’, *e.g.* the first part of the **specific epithet** of *Zamia oligodonta*, referring to the few **teeth** on the **leaflet margins**. *See also odont.*
- omnel.** Kernel of an **omnule**; a ‘cleaned cycad seed’.
- omnule.** Collective term for **mature** cycad **seeds** and fully-expanded unfertilized **ovules** that are externally indistinguishable; ‘cycad seed’.
- once-pinnate.** Simply **pinnate**; first order of compounding a **leaf**, such that the **pinnae** are not themselves further divided, *e.g.* the **leaflets** of *Cycas bifida*. *Cf. twice-pinnate.*
- ontogeny.** **Developmental** cycle or **life-history** of an individual from its inception until its sexual **maturity**.
- oon.** Greek, meaning ‘eggs’, *e.g.* the root word for the second part of the **generic** name *Dioon*, referring to the paired **seeds** on each **megasporophyll**. *See also dis.*
- opaque.** Of **veins** that do not transmit light when held up to a light source, *e.g.* of the **leaflets** of *Ceratozamia miqueliana*. *Cf. transparent.*
- open pollinated.** Natural (or unintended) transfer of **pollen** from **male** to **female cones** of *ex situ* or garden plants by native (or introduced) **pollinators** (or wind?) resulting in **fertilized seed** without the cone having been **hand pollinated**; sometimes resulting in the unintentional production of **hybrid seed** as a result of **cross-pollination**. *See also anemophily, entomophily. Cf. hand pollinated.*
- opere citado (op. cit.).** Latin, referring to a publication already cited; no longer used in modern scientific writing.
- ophiolitic.** Containing ophiolite; composed of serpentine, dolomite, magnetite, or calcite, and of a cloudy green or pale green color, *e.g.* the soil where *Cycas ophiolitica* grows.
- opinus.** Latin, meaning ‘expected’, *e.g.* the second part of the **specific epithet** of *Encephalartos inopinus*, with the modifying prefix *in-* (‘not’), referring to its unexpectedly dry **habitat**.
- opposite.** Pertaining to **leaflets** borne directly across from one another on the **rachis**; **paired**. *Cf. alternate.*
- orbicular.** Nearly circular, *e.g.* the **megasporophyll lamina** of *Cycas petraea*.
- order.** **Taxonomic rank** below **division** or **class** but above **family**.

- organelle.** Cell component with a specific function. *See also* **chloroplast, flagellum, mitochondrion.**
- orientis.** Latin, meaning ‘of the east’, *e.g.* the **specific epithet** of *Cycas orientis*, referring to its occurrence in the east of Arnhem Land, Australia.
- ornamental.** Used to describe plants, which are planted for their architectural, specimen, or landscape qualities, as opposed to being planted for food or commercial purposes.
- orographic.** Pertaining to geographic relief factors, *e.g.* hills, mountains, plateaus, valleys, and slopes.
- orthographic variants.** In **taxonomy**, two or more different spellings of the same name, *e.g.* although *Dion* was the original spelling of the cycad **genus** *Dioon*, it was incorrect, and as such, *Dion* is now an (incorrect) orthographic variant of *Dioon*.
- orthostichy.** Row created by intersection of contact **parastichies**, *e.g.* **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**.
- outcrossing.** Breeding between extra-**populational** individuals. *See also* **hybrid zone.**
- 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 2-dimensional structure that is egg-shaped in outline but broadest below the middle, *e.g.* the **leaflets** of *Zamia vazquezii*, or the **megasporophyll lamina** of *Cycas lindstromii*. *See also* **elliptic, obovate.**
- over-collecting, over-collection.** Over-exploitation of wild rare plants coveted by collectors, thereby posing a serious threat to **species, populations, and habitats.**
- ovoid.** Of a 3-dimensional structure that is **ovate** in longitudinal section, *e.g.* the **male cone** of *Cycas pectinata*. *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**, *e.g.* the **stems** of **arborescent** cycads.
- pachys.** Greek, meaning ‘thick’, *e.g.* the root word of the first part of the **specific epithet** of *Cycas pachypoda*, referring to its distinctive broad **trunk** base. *See also* **podos.**
- paired.** Having **opposite leaflet** arrangement. *Cf.* **alternate.**
- paleoendemic, palaeoendemic.** Referring to a **taxon** that is a geographical remnant of one that was formerly much more widespread.
- paleontology, palaeontology.** Study of organisms from former geological periods, typically fossilized plants or animals or their parts.
- pallid.** Pale, *e.g.* the **basal blotch** (or **callus**) on some *Macrozamia* **leaflets** or the **emergent leaf** of some *Zamia* **species.**
- palynology.** Study of all aspects of **pollen** from **extant** and **extinct** plants.
- pantropical.** Spanning tropical regions around the world, *e.g.* the global **distribution** of cycads.
- papyraceous.** Papery in texture, *e.g.* the **leaflets** of *Zamia vazquezii*. *See also* **chartaceous, membranous. Cf. coriaceous.**
- parallel-veined.** Having its **veins** parallel to one another, without major intersecting vascular bundles, *e.g.* the **leaflets** of all *Cycas* **species. Cf. anastomosing.**
- parameter.** Any one of a number of possible **variables** relating to a process or phenomenon. *See also* **characteristic.**



- paraphyletic.** Of an artificial group comprising a single ancestor and some, but not all, of its descendants. *See also* **monophyletic**, **polyphyletic**.
- parasiticus.** Latin, meaning ‘parasitic’, *e.g.* the root word of the second part of the **specific epithet** of *Zamia pseudoparasitica*, with the modifier **pseudo** (meaning ‘false’), referring to its **epiphytic** (not parasitic) **habit** and **habitat**.
- parastichy.** Spiral arrangement of **leaves** on an **axis** (or **sporophylls** in a **cone**), *e.g.* *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**.
- parcus.** Latin, meaning ‘sparing’ or ‘frugal’, *e.g.* the root word of the first part of the **specific epithet** of *Macrozamia parcifolia*, though technically referring to **leaves**, this epithet actually refers to the fine, wispy **leaflets**. *See also* **folius**.
- parenchyma.** Thin-walled cells in storage tissues such as the **cortex** zone between the **epidermis** and **vascular tissue**, *e.g.* the starch-rich **stems** of *Stangeria eriopus* and similar cycads. *See also* **sclerenchyma**.
- paripinnate.** Even-pinnate; of a **leaf** or **leaflet** where the **rachis** or **rachilla** does not terminate in a solitary **pinna** or **pinnule**, *e.g.* most cycad **leaves**. *Cf.* **imparipinnate**.
- Parkinsonian dementia.** A neurological disease sometimes associated with cycad **toxicity** in humans, *e.g.* the Chamorro people of Guam who traditionally ate the **seeds** of *Cycas micronesica* have exhibited symptoms of this disease. *See also* **amyotrophic lateral sclerosis (ALS)**.
- parsimony**, adj. **parsimonious.** Economy or frugality in use or application.
- parsimony analysis.** *See* **maximum parsimony**.
- parthenocarpic.** Developing without **fertilization**, *e.g.* full-sized but **unfertilized seeds** of *Encephalartos*.
- pathogen.** Disease-causing agent, especially a bacterium, fungi, or other microorganism, *e.g.* common cause of **trunk** and **root rot** in cycads.
- pauci.** Latin, meaning ‘few’, *e.g.* the first part of the **specific epithet** of *Encephalartos paucidentatus*, referring to the relatively smooth **leaflet margins**. *See also* **dentate**.
- 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**.
- peat moss.** Partially decomposed sphagnum moss, often added to soil to increase moisture retention; medium of choice for the ‘**baggie method**’ of cycad **seed germination**.
- pectinate.** Comb-like; with closely-spaced, narrow segments, *e.g.* the **megasporophyll margins** 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**.
- pellucid.** **Transparent** or translucent, *e.g.* the **leaflets** of *Zamia disodon*.
- peltate.** With a stalk positioned centrally on the surface of a **lamina** or **sporophyll**, *e.g.* most cycad **bullae**.
- pendent, pendulous.** Hanging downwards (**abaxially**), *e.g.* the **female cones** of many *Dioon* species, or the **leaves** of *Zamia pseudoparasitica*.
- pericarp.** The wall of a fruit developed from the ovary wall; not present in cycads.

- periderm.** Composite layer of **cork** cells, cork **cambium**, and **parenchyma** that replaces the **epidermis** in older plants.
- persistent.** Remaining attached; not falling off, *e.g.* the **leaf bases** of *Ceratozamia*. *Cf.* **caducous**.
- petiolate.** Having or resembling a **petiole**. *Cf.* **sessile**.
- petiole.** Stalk of a **leaf**; in a **compound leaf**, that part of the **axis** below the lowermost **leaflets**, **pinnacanth**s, or **spines**. *See also* **rachis**. *Cf.* **petiolule**.
- petiole-to-rachis (P:R) ratio.** Index that describes the **morphometrics** (in this case, the relative lengths of the **petiole** and **rachis**) of a cycad **leaf** (*sensu* Taylor *et al.*, 2008).
- petiolule.** Stalk of a **leaflet**, that part of the **axis** below the leaflet **blade**, *e.g.* as in *Zamia manicata*. *See also* **rachilla**.
- petraeus.** Latin, meaning ‘of rocky places’, *e.g.* the root word of the **specific epithet** of *Cycas petraea*, referring to its **habitat** of bare limestone cliffs and boulders.
- phellogen.** Tissue composed of **meristematic** cells giving rise to **cork**; the cork **cambium**.
- phenetic.** Condition of overall similarity of chosen **characters** between **taxa** but without regard to whether the characters are **homologous** or due to **convergence**. *See also* **Adansonian**.
- phenogram.** Tree diagram showing **taxa** arranged **hierarchically** on the basis of **phenotypic** similarities without any regard for ancestry. *See also* **cladogram**, **dendrogram**, **phylogram**.
- phenology.** In plants, the study of recurrent phenomena, such as episodes of **reproduction**, in relation to seasonal patterns; in cycads, often refers to cycles of **coning** and **flushing**.
- phenotype.** Sum total of **morphological** or other **characters** defining an organism or group. *Cf.* **genotype**.
- phenotypic plasticity.** Capacity for marked **variation** in the **phenotype** as a result of environmental influences on the **genotype** during **development**.
- pheromone.** Volatile chemical substance emitted by an organ and acting as a signal to other organisms, *e.g.* cycad **cone** emissions that attract insect **pollinators**. *See also* **odor-mediated push-pull pollination**.
- philo.** Greek, meaning ‘loving’, *e.g.* the root word of the second part of the **specific epithet** of *Zamia nesophila*, referring to its propensity for an **insular** existence. *See also* **neso**.
- photoperiod.** Characteristic light interval that induces particular light-mediated responses in plants. *Cf.* **thermoperiod**.
- 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**.
- phyletic gradualism.** Model of **evolution** in which **species** change gradually through time, by slow directional transformation within a **lineage**, producing a long and graded **series** of differing **forms**. *Cf.* **punctuated evolution**.
- PhyloCode.** Controversial set of rules governing **phylogenetic nomenclature**, designed to name the parts of the tree of life by explicit reference to **phylogeny** (PhyloCode, 2009).
- phylogenetic, phylogeny.** Of or pertaining to the **evolutionary** history of an organism or group.
- phylogram, phylogenetic tree.** **Cladogram** where branch lengths are proportional to the number of changes that occur at each branch. *See also* **dendrogram**, **phenogram**.
- phyllon.** Greek, meaning ‘leaf’, *e.g.* the root word for the middle part of the **specific epithet** of *Ceratozamia euryphyllidia*, though technically referring to leaves, this epithet actually refers to the extraordinarily broad **leaflets**. *See also* **eurys**.
- 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.
- phytosanitary certificate.** Issued by agricultural inspectors to accompany a shipment of seeds or plants to declare their apparent freedom from harmful organisms such as insects, fungi, etc.
- pilose.** With soft hairs, *e.g.* the **immature leaves** of *Ceratozamia miqueliana*. *See also* **hirsute, lanate, pubescent, sericeous, tomentose**. *Cf.* **glabrous, nitidus**.
- pinna, plural pinnae.** Primary division of a **compound leaf**; **leaflet**.
- pinna-pinna (pp) angle.** Angle on the upper (**adaxial**) side of a **leaf** between the planes in which the hypothetical long **axes** of the **leaflets** occur (*sensu* Grobbelaar, 2002).
- pinna-rachis (pr) angle.** **Distal** angle between the hypothetical longitudinal **axis** of a **leaflet** and the axis of the **rachis** in the vicinity of the leaflet (*sensu* Grobbelaar, 2002).
- pinnacanth.** Sharply-pointed structure intermediate between a **leaflet** and a **spine**, usually green and hence photosynthetic, *e.g.* as on the **rachis** 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**, *e.g.* most cycad leaves. *See also* **bipinnate, multipinnate**.
- pinnatifid.** Composed of **pinnae**, or subdivided as if composed of pinnae.
- pinnule.** Secondary division of a **compound leaf**. *See also* **pinna**.
- pith.** Soft, sponge-like, central cylinder of the **stem**, composed mainly of **parenchyma**.
- planche.** French, used in some older botanical literature to denote an illustrative plate. *See also* **tabula**.
- plane.** **Flat**; level; pertaining to **leaflets** lacking distinctly raised **veins**. *Cf.* **corrugated, pleated, plicate**.
- plant press.** Structure typically made of two ventilated frames 12” x 18” (30 x 45 cm), within which plant **specimens** are arranged between sheets of driers and ventilators, tightly strapped together with press straps, in preparation of being added to a collection or **herbarium**.
- plantae exsiccatae.** Latin, in reference to **herbarium specimens**. *See also* **exsiccatum, holotype, isolectotype, isotype, lectotype, neotype, paratype, type**.
- platys, platy-**. Greek, meaning ‘broad’, *e.g.* the root word for the first part of the **specific epithet** of *Cycas platyphylla*, referring to the broad, **sterile** tip of the **megasporophylls**. *See also* **phyllon**.
- platyspermic.** Of **seeds**, flattened so as to be not **radially symmetrical**, *e.g.* *Cycas* **seeds**. *See also* **actinomorphic, zygomorphic**. *Cf.* **radiospermic**.
- pleated.** Of a **leaf** creased along its length, *e.g.* *Zamia neurophyllidia*. *See also* **corrugated, plicate**. *Cf.* **plane**.
- 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 like a fan; often used (perhaps incorrectly) to refer to the **corrugated** appearance of the **adaxial leaflet** surface in **species** such as *Zamia skinneri*. *Cf.* **plane**.
- plumose.** Feathery in a **whorled** appearance, *e.g.* the arrangement of **leaflets** on the **rachis** in *Ceratozamia norstogii*.
- pluri-**. Latin, meaning ‘several’ or ‘many’, *e.g.* the first part of the **specific epithet** of *Macrozamia plurinervia*, referring to its wider **leaflets** with more **veins** compared to related **taxa**. *See also* **nerve**.
- poaching.** Illegal removal of plants from their native **habitat**; common threat affecting the **threatened status** of cycads.
- podos.** Greek, meaning ‘foot’, *e.g.* the root word of the second part of the **specific epithet** of *Cycas pachypoda*, referring to its distinctive broad **trunk** base. *See also* **pachys**.

- pollen, pollen grain.** 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 chamber.** Chamber that receives the **pollen** inside a developing **seed**.
- pollen cone/strobilus. Male cone; microsporangiate strobilus.** *Cf.* **seed cone**.
- pollen tube.** Slender tube formed by the **pollen grain** that penetrates an **ovule** and releases the male **gametes**.
- pollination.** Transfer of **pollen** towards **ovules**. *See also* **anemophily, entomophily, hand pollination, open pollination**.
- pollinator.** Organism responsible for the transfer of **pollen** from the **pollen cone** to the **seed cone**; members of various insect groups have **coevolved** as cycad pollinators. *See also* **obligate**.
- polymer.** Large molecule composed of **monomer** subunits.
- polymorphic.** Persistently **variable in form**, *e.g.* **populations** of *Macrozamia polymorpha* and *Zamia polymorpha*. *Cf.* **dimorphic, homomorphic, monomorphic**.
- polyphyletic.** Artificial group comprising members that have originated independently from more than one ancestor. *Cf.* **monophyletic, paraphyletic**.
- polystelic.** Having more than one vascular cylinder.
- polythetic.** Referring to a group sharing many, but not all, features. *See also* **monothetic**.
- polyxylic.** Having concentric cylinders of **xylem** and **phloem**, as a **stem**.
- population.** Group of individuals of a **species** occupying a particular area, separate and distinct from other such groups.
- population density.** Number of **conspecific** individuals in a given area.
- population dynamics.** Study of changes within **populations** and the factors that cause or influence them.
- population genetics.** Study of **gene frequencies** and **selection** pressures in **populations**.
- post-mating isolation.** Condition in which **interbreeding** between two or more **populations** is prevented by **intrinsic** factors effective after mating; includes all **pre-zygotic** and **post-zygotic isolating mechanisms**. *Cf.* **pre-mating isolation**. *See also* **reproductive isolation**.
- post-zygotic isolating mechanism.** Mechanism preventing **interbreeding** between two or more **populations** that is effective after **zygote** formation. *Cf.* **pre-zygotic isolating mechanism**.
- poultice.** Moist, usually hot, mass of plant material applied to the skin for a medical purpose, *e.g.* the **tomentum** from *Dioon mejiae* **female cones** is used for this purpose by some villagers in Honduras. *See also* **ethnobotany**.
- prasinus.** Latin, meaning ‘leek green’, *e.g.* the root word of the **specific epithet** of *Zamia prasina*, referring to the bright grass-green **leaflets**.
- precocious.** Occurring particularly early in **development**. *See also* ‘**artificial dwarfing**’ hypothesis, **neoteny**.
- pre-mating isolation.** Condition in which **interbreeding** between two or more **populations** is prevented by **extrinsic** factors effective before mating or **fertilization**. *Cf.* **post-mating isolation**. *See also* **reproductive isolation**.
- prepollen.** **Microspore** with a **proximal** aperture but without a **distal** aperture; cycad **pollen** is considered an intermediate form between prepollen and ‘conventional’ pollen.
- preservation.** Maintenance of individual organisms, **populations**, or **species** by planned management and breeding programs. *Cf.* **conservation**.

- pre-zygotic isolating mechanism.** Mechanism preventing **interbreeding** between two or more **populations** that is effective before **fertilization** and **zygote** formation. *Cf.* **post-zygotic isolating mechanism.**
- prickle.** Small, sharp **protuberance** of **epidermal** origin, usually green, usually somewhat irregularly distributed, *e.g.* 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.**
- prima facie.** Latin, of evidence on hand before an investigation; literally ‘at first site’.
- primary thickening meristem.** Diffuse primary **meristem** which decreases in cross-sectional extent (*i.e.* becomes a thinner-walled cylinder) in a **basipetal** direction (DeMason, 1983).
- primer.** In genetics, a segment of **DNA** or **RNA** that is complementary to a given DNA sequence and that is needed to initiate replication by DNA polymerase.
- primitive.** Ancestral, mistakenly used in reference to cycads because of their antiquity.
- priority.** Rule of **nomenclature** whereby the first published of two validly published names for the same **taxon** is given approval as the accepted name. *See also* **International Code of Botanical Nomenclature.**
- procambium.** Primary **meristem** giving rise to **vascular tissue.** *See also* **cambium.**
- procumbent.** Trailing or lying along the ground but not rooting; typically referring to **stems**, *e.g.* the **trunks** of large, old plants of *Encephalartos equatorialis.* *See also* **decumbent, prostrate.** *Cf.* **erect.**
- pro-embryo.** Immature **embryo** inside some cycad **seeds** that **dehisce** prior to full embryo **maturation.** *See also* **after-ripening period.**
- progeny.** **Offspring** of a single mating or of an asexually reproducing individual.
- proliferous.** Bearing **offsets** and other **vegetative propagation** structures.
- propagule.** Any part of a plant capable of independently giving rise to a new plant, *e.g.* **seeds, offsets,** and **suckers** in cycads.
- prostrate.** Trailing or lying along the ground but not rooting; typically referring to **stems**, *e.g.* the stems of old plants of *Zamia poeppigiana.* *See also* **decumbent, procumbent.** *Cf.* **erect.**
- prothialial cell.** One of the cells of a **pollen grain** that does not appear to have a specific function.
- protuberant.** Swelling outward; bulging, *e.g.* **megasporophyll bullae.**
- proximal.** Nearest to the point of attachment of a structure; **basal.** *Cf.* **distal.**
- proximate factor.** Factor that defines the need for a physiological change in an organism.
- pruinose.** With surface covered by a waxy bloom, *e.g.* the **leaflets** of *Cycas pruinosa.* *See also* **glaucous.** *Cf.* **nitidus.**
- prune.** To partially or completely remove **leaves**; refers to both the aesthetic removal of dead or dying (**senescing**) leaves, and the reduction in leaf area as a means of reducing **transpiration** stress during **transplanting.**
- pseudo.** Greek, meaning ‘false’, *e.g.* the first part of the **specific epithet** of *Zamia pseudoparasitica,* referring to its **epiphytic** (not parasitic) **habit** and **habitat.** *See also* Latin **parasiticus.**
- pseudocone.** Term used by some **cycadologists** to refer to the cluster of **leaf-like megasporophylls** in *Cycas.*
- psilate.** Having a smooth surface, as pollen. *Cf.* **fossulate, foveolate.**
- pteron.** Latin, meaning ‘**wing**’, *e.g.* the root word of the first part of the **specific epithet** of *Encephalartos pterogonus,* referring to the distinctive wing-like and **toothed** appendages below the **terminal facet** of the **microsporophylls.** *See also* **gonas.**

- ptyxis.** Manner of folding of a **leaf** and **leaflets** at **emergence**. *See also* **circinate**, **conduplicate**, **inflexed**, **reflexed**, **vernation**.
- puberulent**, adj. **puberulous.** Covered with minute hairs or very fine down; finely **pubescent**, *e.g.* the exposed tip of the **microsporophylls** of *Cycas wadei*, and the **male cone peduncles** of *Zamia poeppigiana*. *See also* **hirsute**, **lanate**, **pilose**, **sericeous**, **tomentose**. *Cf.* **glabrous**, **nitidus**.
- pubescent.** Densely covered with fine short hairs, *e.g.* the **cataphylls** of *Ceratozamia euryphyllidia*. *See also* **hirsute**, **lanate**, **pilose**, **sericeous**, **tomentose**. *Cf.* **glabrous**, **nitidus**.
- pulp.** Colloquial for the soft, fleshy layer of the **sarcotesta**.
- punctuated evolution.** Model of evolution in which **species** are relatively stable and long-lived, and in which new species appear during concentrated outbursts of rapid **speciation** followed by differential success of some of those species. *Cf.* **phyletic gradualism**.
- pungent.** Terminating in a stiff, sharp point, *e.g.* *Dioon mejiae* **leaflets** and *Macrozamia* **sporophylls**.
- Punnett square.** Matrix used to derive the **genotypic** and **phenotypic** ratios of **zygotes** produced by the union of **gametes** of known parentage.
- pup.** Colloquial, referring to a cycad **sucker** or **offset**; occasionally applied to suckers or offsets separated from a ‘**mother**’ **plant** for the purpose of **vegetative propagation**.
- pupping.** Colloquial, referring to the vegetative production of cycad **suckers** or **offsets**; colloquial for the **habit** of such a plant, often forming a **clump**; **suckering**. *Cf.* **solitary**.
- purpureus.** Latin, meaning ‘purple’, *e.g.* the root word of the **specific epithet** of *Zamia purpurea*, referring to the deep reddish-purple **emerging leaves** and **immature female cones**.
- pus.** Greek, suffix meaning ‘footed’, *e.g.* the second part of the **specific epithet** of *Stangeria eriopus*, referring to the **woolly leaf bases**. *See also* **erio-**.
- pycnoxylic.** Composed of thick-walled tracheids, narrow rays, and little **parenchyma**.
- pygmaeus.** Latin, meaning ‘pygmy’ or ‘dwarf’, *e.g.* the root word of the **specific epithet** of *Zamia pygmaea*, referring to the small stature.
- quadrangular.** Of a 3-dimensional structure that is four-sided; **tetragonal**, *e.g.* the **petiole** of *Cycas beddomei*. *Cf.* **triangular**.
- r(h)achilla**, plural **r(h)achillae.** Diminutive of **rachis**; secondary **axis**; 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**.
- radial growth.** Primary process in **stem growth** in which the stem’s circumference increases.
- radial symmetry.** Symmetry along many longitudinal planes all passing through a central **axis**, *e.g.* the leaves of a **flush**.
- radicle.** Embryonic **root**; often misapplied to the **emergent hypocotyl** in **germinating cycad seeds**.
- radiospermic.** Of **seeds**, **radially symmetric**, *e.g.* the seeds of all cycad **genera** except *Cycas*. *See also* **actinomorphic**, **zygomorphic**. *Cf.* **platyspermic**.
- range.** *See* **geographical range**.
- rank.** *See* **taxonomic rank**.
- 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* **AFLP**, **RFLP**.
- RC.** Rescaled consistency index, the product of the **consistency index** (CI) and the **retention index** (RI) for a character in a **cladogram**.

- recalcitrant.** Of a **seed** needing to remain hydrated if **germination** is to occur; those cycad seeds that are ready to germinate upon **dehiscence**, *i.e.* those that do not have an **after-ripening period**, *e.g.* most species of *Zamia*.
- receptive.** Pertaining to a **female cone** whose **megasporophylls** have separated (**cracked**) to allow **pollinators** to enter during **pollination**. *Cf.* **dehiscent**.
- recessive.** In **genetics**, of, relating to, or designating an **allele** that does not produce a characteristic effect when present with a **dominant allele**; of or relating to a **trait** that is expressed only when alleles are present in the **homozygous** condition. *Cf.* **dominant, subdominant**.
- recruitment.** Increase in a **population** due to **migration**, vegetative proliferation, or **reproduction** from **seed**.
- recurved.** Bent or curving downward (**abaxially**), *e.g.* the **leaf tips** of *Encephalartos longifolius*. *See also* **reflexed**. *Cf.* **incurved**.
- Red List.** IUCN-published listing of plant and animal **taxa** in terms of perceived **threatened status**. *See also* **Critically Endangered, Data Deficient, Endangered, Extinct, Extinct in the Wild, Least Concern, Near Threatened, Vulnerable**.
- reductus.** Latin, meaning ‘reduced’, *e.g.* the root word of the **specific epithet** of *Macrozamia reducta*, referring to its smaller **habit** compared to the related *M. communis*.
- reduplicate.** Folded with the ‘V’ opened downward (**abaxially**), *e.g.* the **leaflets** of *Encephalartos inopinus*. *Cf.* **keeled, secund**.
- reflexed.** Of leaves, bent downward and outward more than 90 degrees, *e.g.* the **emerging leaves** of some *Dioon* species. *See also* **circinate, conduplicate, ptyxis, vernation**. *Cf.* **declinate, deflexed, inflexed**.
- relictual.** Remaining, relatively small portion of a previously larger **population** or **taxon**, *e.g.* *Encephalartos relictus*.
- re-pot.** To move or **transplant** a containerized plant from one container to another, usually using fresh soil; sometimes refers to the replacement of soil in the same container.
- reproduction.** The act or process of producing offspring.
- reproductive biology.** Study of factors pertaining to the production of offspring.
- reproductive isolation.** Often used specifically for the condition in which **interbreeding** between two or more **populations** is prevented by **intrinsic (pre-mating or post-mating isolating mechanism)** or **extrinsic (geographic barrier)** factors.
- revolute.** With **margins** rolled downwards (**abaxially**), *e.g.* the **leaflet margins** 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* **AFLP, RAPD**.
- rhomboid.** Of a 3-dimensional structure shaped like an **oblique-angled** parallelogram having four equal sides (= rhombus); of **sporophylls**, diamond-shaped with equal sides, *e.g.* the **bullae** of *Encephalartos concinnus*.
- 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**.
- rib meristem.** **Meristem** that gives rise to **pith**.
- ribbed, ridged.** Bearing ridges or raised markings, *e.g.* the **sclerotesta** of *Encephalartos transvenosus*, and the **trunks** of *Lepidozamia hopei*.
- ribosome.** Cellular **organelle** in which protein synthesis occurs.
- rigid.** Not flexible or pliant; stiff, *e.g.* the **leaflets** of *Zamia furfuracea*.

- RNA, ribonucleic acid.** Single-stranded **genetic** message between the **chromosome** and the **cytoplasm** that contains the **nucleotide uracil** instead of **thymine**; codes for proteins. *Cf.* **DNA**.
- robusta.** Latin, meaning ‘large’ or ‘robust’, *e.g.* the **specific epithet** of *Ceratozamia robusta*, referring to its large, robust **habit**.
- root.** Usually underground portion of a plant that lacks buds, **leaves**, or **nodes** and serves as support, draws minerals and water from the surrounding soil, and sometimes stores food.
- root ball.** **Cylindrical** or **conical** mass of **roots** and soil on a plant being prepared for **transplant**.
- root cap.** **Parenchymatous** layer of cells produced by the **root meristem** and covering it with a protective layer. *See also* **columella**.
- root prune.** To carefully cut the **roots** of a field- or garden-grown plant in preparation for **transplanting**.
- root rot.** Disease characterized by **root** decay, caused by various fungi; one of the primary causes of death in **cultivated** cycads.
- rooted, rooted out** (less commonly **rooted pup** or **rooted sucker**). Colloquial, referring to a **sucker** (or **offset**) previously removed from a ‘**mother**’ **plant** for the purpose of **vegetative propagation** and now fully re-established and ready for sale or re-planting.
- rooting hormone.** Chemical compound that promotes **root growth**.
- rostrate.** With a beak, *e.g.* the **microsporophylls** of *Encephalartos longifolius*.
- rosulate.** Having **leaves** (or other parts) arranged in a rosette, *e.g.* pertaining to all cycads.
- rufous.** Reddish to reddish-brown, *e.g.* the **tomentum** on the **cataphylls** of *Cycas ophiolitica* and the **female cones** of *Zamia furfuracea*.
- rugose.** Deeply wrinkled, *e.g.* the dried **sarcotesta** of many *Cycas* **seeds**. *Cf.* **nitidus**.
- rugulose.** Finely wrinkled; a diminutive of **rugose**, *e.g.* the **cataphylls** of *Zamia sandovalii* and the **sclerotesta** of *Dioon mejiae*. *Cf.* **nitidus**.
- sagittal crest.** Central projection of the **abaxial** face of a **megasporophyll**. *Cf.* **lateral lobe, median lobe**.
- sagittal ridge.** Line, sometimes more distinct than others, separating the **lateral facets** from each other in *Encephalartos* **sporophyll bullae** that lack a **median facet** (Melville, 1957). *Cf.* **latero-sagittal ridge, medio-lateral ridge**.
- sarcotesta.** Fleshy outer layer of the **integument** of a cycad **seed**, brightly-colored in many cycad **genera**. *Cf.* **sclerotesta**.
- sarcotesta index.** Little used mathematical formula describing the difference between the length of the **seed (omnule)** and its **kernel (omnel)** expressed as a percentage of the seed’s length (*sensu* Grobbelaar, 2002).
- satellite, satellite body.** Minute **chromosome** portion separated from the main body by the **centromere** or primary constriction.
- scabrous.** Rough to the touch, *e.g.* the **abaxial** surface of the **leaflets** of *Encephalartos latifrons*. *Cf.* **nitidus**.
- scale.** Dry, flattened, papery body; used colloquially in reference to **sporophylls**; any number of pest insects of cycads, *e.g.* **cycad aulacaspis scale**.
- scarification.** Any process of penetrating the protective **seed coat** of dormant **seeds** accomplished by chemical, mechanical, heat, or moisture treatment allowing water and oxygen into the seed, thereby helping to improve **germination**.
- scarious.** Thin, membranous, and dry, *e.g.* the **leaf bases** of *Macrozamia pauli-guilielmi* and the **cataphylls** of *Zamia sandovalii*.



- scientific name.** Unique combination of two words (**genus** and **specific epithet**), Latin in form and usually derived from Greek or Latin roots, that identifies a particular **species**; **botanical name.** *See also binomial nomenclature, nomenclature.*
- sclerenchyma.** Mechanical (supportive) tissue composed of empty, thick-walled cells. *See also parenchyma.*
- sclerophyllous.** **Foliage** toughened as an **adaptation** to a hostile environment, *e.g.* the **leaflets** of *Encephalartos ghellinckii*.
- sclerotesta.** Hard or stony inner layer of the **integument** of a cycad **seed.** *See also stony coat. Cf. sarcotesta.*
- scurfy.** Covered with small papery **scales**, *e.g.* the **female cone peduncles** of *Ceratozamia fuscoviridis.* *See also furfuraceous.*
- secondary constriction.** Localized, noncentromeric narrowing of a **chromosome** pair apparent during **mitosis** and **meiosis.**
- secondary wood.** **Xylem** in the **stem** or **root** produced by the **vascular cambium.**
- 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 which may be one or more series.
- secund.** Having **leaflets** at a markedly elevated angle above the **rachis**, yielding a V-shaped leaflet angle in cross section, *e.g.* the leaflets of *Macrozamia secunda* or *Encephalartos eugene-maraisii.* *See also keeled. Cf. reduplicate.*
- seed.** Fully mature **ovule** after **fertilization**, with an **embryo**, storage tissue, and all **integuments.** *See also omnule, corruptule.*
- seed coat.** **Integument** of the mature **seed.**
- seed colony.** *See breeding colony.*
- seed cone.** **Female cone**; **ovulate cone**; **megasporangiate strobilus.** *Cf. pollen cone.*
- seed leaf.** *See eophyll.*
- seedbank.** Traditionally, a facility designed for the **ex-situ conservation** of individual **species** and **varieties** through controlled **seed** storage; in cycads, a program that distributes cycad seeds, *e.g.* the Cycad Society Seedbank.
- seedling.** Non-reproductive **life cycle** stage with no visible **stem** and one to few **leaves** not arranged in a **crown** (*sensu* Yáñez-Espinosa, 2009). *Cf. adult, juvenile, mature.*
- segmented.** Of a **leaf** or other like organ that is divided into distinct segments, *e.g.* the finely **dichotomously** branching **marginal spines** of the **megasporophyll lamina** of *Cycas segmentifida.*
- selection.** *See natural selection.*
- SEM.** Scanning electron microscope (instrument) or micrograph (image produced by the instrument).
- seminal fringe.** Line of demarcation separating the **sporophyll** face from the point of attachment of the **ovule** on the **adaxial face.** *Cf. seminal ridge.*
- seminal ridge.** Line of demarcation separating the **sporophyll** face from the point of attachment of the **ovule** on the **abaxial face.** *Cf. seminal fringe.*
- seminifera.** Latin, meaning ‘seed bearing’, *e.g.* the second part of the **specific epithet** of *Cycas sexseminifera*, in the misplaced belief that the six seeds observed on the **megasporophyll** of the **type specimen** were diagnostic. *See also sex.*
- semiterete.** Half-round in cross section, *e.g.* the **petiole** of *Encephalartos arenarius.* *Cf. terete.*

**semotus.** Latin, meaning ‘remote’ or ‘distant’, *e.g.* the root word of the **specific epithet** of *Cycas semota*, referring to its occurrence in the farthest extremity of Cape York Peninsula, Australia.

**senescence, senescing.** Natural aging processes leading to the death of an organ or organism. *Cf.* **persistent.**

**sensu.** Latin, meaning ‘according to’ or ‘in the sense of’. *See also fide.*

**sensu lato.** Latin, meaning ‘in a broad or all-encompassing sense’.

**sensu stricto.** Latin, meaning ‘in the narrow or restricted sense’.

**senticosus.** Latin, meaning ‘full of thorns’, *e.g.* the **specific epithet** of *Encephalartos senticosus*, incorrectly referring to its **spiny leaflet margins**, which are actually **serrations**.

**septentrionalis.** Latin, meaning ‘north’ or ‘northern’, *e.g.* the **specific epithet** of *Encephalartos septentrionalis*, referring to this **species** being one of the northernmost of all central African cycads.

**sericeous.** With fine hairs giving a silky texture, *e.g.* the **cataphylls** of *Cycas diannanensis* or the **emerging leaves** of *Zamia hamannii*. *See also* **hirsute, lanate, pilose, pubescent, tomentose.** *Cf.* **glabrous, nitidus.**

**series.** *See section.*

**serpentine.** Of shape, sinuous or snake-like, *e.g.* the **trunks** of large, old plants of *Dioon merolae*; of a substrate, containing magnesium silicate and usually dull green, *e.g.* the soil where *Macrozamia serpentina* grows.

**serrate.** With a **margin** of saw-toothed, sharply-tipped protrusions pointing **apically**, *e.g.* the **leaflet margins** of *Zamia skinneri*. *See also* **dentate, tooth.**

**serrulate.** Minutely **serrate**, *e.g.* the **leaflet margins** of *Bowenia serrulata*. *See also* **denticulate.**

**sessile.** Without any apparent stalk, *e.g.* the **male cones** of *Dioon mejiae* and *Encephalartos lebomboensis*; in reference to cycad **leaves** without **petioles**, *e.g.* as in *Dioon spinulosum* and *Encephalartos villosus*.

**sex.** Latin, meaning ‘six’, *e.g.* the first part of the **specific epithet** of *Cycas sexseminifera*, in the misplaced belief that the six **seeds** observed on the **megasporophyll** of the **type specimen** were diagnostic. *See also* **seminifera.**

**sex change, sex reversal.** Incompletely understood (and not well documented) phenomenon in which a male plant becomes a female plant, or vice versa.

**sex ratio.** Proportion of males vs. females in a **population**.

**sexual dimorphism.** Marked **phenotypic** differences between males and females of the same **species**, *e.g.* the differences in shape and structure of the male and female **cones** of most cycad species. *See also* **dimorphic.**

**shield.** In cycads, the broadly flattened **terminal facet** of a cycad **megasporophyll**. *See also* **bullae.**

**shielding (s) angle.** Angle by which a **leaflet** is transversely inserted on the **rachis**, often, but not always, resulting in leaflet overlap (*sensu* Grobbelaar, 2002), *e.g.* if leaflets overlap **incubously** the s-angle is nominally positive, if leaflets overlap **succubously** the s-angle is nominally negative.

**shoot.** Young **growth** arising from a **germinating seed**; a bud, young **leaf**, or other new growth on a plant. *Cf.* **root.**

**short-stalked.** Colloquial, pertaining to a short **peduncle**; **sessile.** *Cf.* **long-stalked.**

**sieve cell.** Functional, living transport-cell type composing the **phloem** of **gymnosperms**.

**sigmoid.** S-shaped, *e.g.* the **peduncle** of some cycad **cones**.

**silvestris.** Latin, meaning ‘of the forests’, *e.g.* the **specific epithet** of *Cycas silvestris*, referring to its closed forest **habitat**.

**simple.** Of **leaves** not divided into **leaflets**; not applicable to cycads. *Cf.* **compound.**

- simplici-**. Latin, compound prefix meaning ‘**simple**’, *e.g.* the first part of the **specific epithet** of *Cycas simplicipinna*, in reference to its relatively simple **leaflets** compared to those of *C. micholitzii*.
- sine numero (s.n.)**. Latin, of a **herbarium** or other **specimen** accession that is without any collector’s accession number.
- sinker**. Colloquial for a cycad **seed** deemed (sometimes mistakenly) **viable** when **float-tested** in water. *Cf.* **floaters**.
- sinuate**, adj. **sinuous**. Having a strongly waved **margin**, *e.g.* the **leaflets** of *Cycas diannanensis*. *Cf.* **flat**.
- siphonogamy**. Process of effecting **fertilization** in **seed** plants by means of **pollen tubes**.
- siphonostele**. Vascular cylinder of plants, the central region of which is **pith**. *See also* **stele**.
- sister group**. In **cladistics**, the group most closely-related to a specific individual or group. *Cf.* **outgroup**.
- solitary**. Of a plant with a single **stem** producing no **suckers** or **offsets**, or a plant producing a single **cone**. *Cf.* **clumping, suckering**.
- sorus**, plural **sori**. Cluster of fern **sporangia**; misapplied to groups of **microsporangia** sharing a common vascular supply in some cycads.
- spatulate**. Shaped like a spatula, *e.g.* the **megasporophylls** of *Cycas micronesica*.
- speciation**. **Evolutionary** process in which **taxa** accumulate sufficient **genetic** changes so as to be recognized as distinct **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” (Osborne & Walters, 2004). *See also* **morphogeographic**.
- species complex**. **Variable** group of closely-related members known or suspected to represent different **species** but often difficult to **circumscribe**; usually resolved as a discrete **clade** in **taxonomic** analysis, *e.g.* the *Ceratozamia norstogii* complex comprises *C. norstogii*, *C. alvarezii*, and *C. mirandae*.
- species nova (sp. nov.)**. Latin, citation at the time a new **species** is first **described**, *e.g.* *Zamia macrochiera* D.W. STEV. *sp. nov.* (*Species novum*, while often seen in the literature, is grammatically incorrect). *Cf.* **genus novum**.
- specific epithet**. Second word of a **botanical** or **scientific name**. *Cf.* **genus**.
- specimen**. Specific plant strategically placed so people can gain the greatest enjoyment for the color, texture, or other pleasures it provides. *See also* **herbarium specimen**.
- spectabilis**. Latin, meaning ‘visually striking’ or ‘remarkable’, *e.g.* the **specific epithet** of *Bowenia spectabilis*, in reference to its unusual, striking **leaves**.
- spermatid**. Cell that differentiates and becomes a mature sperm.
- spermatogenesis**. Process of sperm initiation and **development**.
- spermatophyte**. Any seed-bearing plant, including all **gymnosperms** and **angiosperms**.
- spermatozoid**, sometimes **antherozoid**. Motile male **gamete** of lower plants, cycads, *Ginkgo*, etc.
- sphaerica**. Latin, meaning ‘spherical’, *e.g.* the root word of the **specific epithet** of *Cycas spherica*, referring to the rounded **seeds**.
- spheroid**. Shaped like a sphere but not perfectly round; **ellipsoid**, *e.g.* some *Cycas* **seeds** and the **microsporangia** of many cycad **species**.
- spine**. Hard, sharp, non-photosynthetic **protuberance** with vascular connections and not of **epidermal** origin; the spines on many cycad **rachises** and **sporophylls** are actually reduced **leaflets**. *See also* **pinnacanth, prickle, tooth**.

- spinescent, spinose.** Terminating in a sharp point; bearing sharp points, *e.g.* the **leaflets** and **petioles** of many cycad **species**. *See also* **pungent**. *Cf.* **entire, inerm, unarmed**.
- spinulose.** With many small **spines**, *e.g.* incorrectly alluded to the pointed projections on the **leaflet margins** of *Dioon spinulosum*, which are, in fact, **teeth**.
- spiralis.** Latin, meaning ‘spiraled’, *e.g.* the **specific epithet** of *Macrozamia spiralis*, referring to the (sometimes) twisted **rachis**.
- splendens.** Latin, meaning ‘shining’ or ‘brilliant’, *e.g.* the **specific epithet** of *Zamia splendens*, referring to the striking (and shiny) appearance of the **leaflets**.
- splitter. Taxonomist** who creates new categories or **species** to classify organisms on the basis of small differences. *Cf.* **lumper**.
- sporangium, plural sporangia.** *See* **microsporangium**.
- sporoderm.** Outer covering layers of a **pollen grain** or **megaspore**.
- sporophyll.** Modified **leaf** bearing reproductive structures. *See also* **megasporophyll, microsporophyll**.
- sporophyte. Spore-producing generation** in those plants that have **alternating generations**. *Cf.* **gametophyte**.
- spreading.** Extending out over a wide area; expansive, not upright; in cycads, used to describe the natural orientation (or **habit**) of the most recent **crown** or **flush** of **leaves**, *e.g.* the crown of *Ceratozamia latifolia* or *Dioon tomasellii*. *Cf.* **arching, ascending, erect**.
- sprout.** Colloquial for a **germinated seed**.
- SSC. Species Survival Commission**, an agency of the **IUCN**.
- stage.** Any distinguishable phase of **growth** or **development** of an organism. *See also* **life cycle**.
- staggers.** Disabling neurological disease of cattle caused by ingesting cycad **toxin**. *See also* **crampy, wobbles**.
- staminate cone/strobilus.** Incorrectly-derived term for **male cone; pollen cone; microsporangiate strobilus**.
- standard deviation.** In statistics, a measure of variation within a set of data, calculated as the square root of the **variance**.
- status novus (stat. nov.).** Latin, 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.
- stem.** The main **axis**, or a branch of the main axial system, of a plant; **caudex** in cycads.
- stem borer.** Insect larva that tunnels into **stems** and **trunks**, *e.g.* the native beetle *Dihammus marianarum* (Coleoptera: Cerambycidae) that infests *Cycas micronesica* in Guam.
- stenos.** Greek, meaning ‘narrow’, *e.g.* the root word of the first part of the **specific epithet** of *Macrozamia stenomera*, referring to the finely divided **leaflets**. *See also* **–merus**.
- stele.** Vascular column of a plant **stem** or **root**. *See also* **siphonostele**.
- sterile.** In cycads, that part of a **cone** or **megasporophyll** lacking functional sexual parts; infertile. *Cf.* **fertile**.
- sterile cell.** Cell in a **gymnosperm pollen tube** that gives rise, by cell division, to two **spermatids** and, eventually, two **spermatozoids**.
- sterile tip. Apex** of many cycad **cones** lacking **fertile sporophylls**.
- stipe.** Small stalk, *e.g.* thin tissue that connects the **ovules** to the **sporophylls** in *Dioon* **female cones**. *See also* **funiculus**.
- stipulate.** Having an appendage (stipule) at the base of a **petiole** or **cataphyll**, *e.g.* 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**.
- stony coat**. Colloquial for **sclerotesta**.
- stratification**. Technique of burying **seeds** in moist, coarse sand to expose them to periods of low temperature or to soften the **seed coat**.
- striate**. With longitudinal lines, grooves, or ridges, *e.g.* the **abaxial** surface of the **leaflets** of *Encephalartos paucidentatus*.
- strobilus**, plural **strobili**. Reproductive structure of **gymnosperms** and some cryptogams such as *Selaginella*; organized collection of **sporophylls** on a central **axis**. *See also* **cone**, **megasporangiate strobilus**, **microsporangiate strobilus**.
- sub-**. Prefix meaning ‘nearly’ or ‘almost’.
- subdominant**. Less than **dominant gene**. *Cf.* **recessive**.
- suberin**. Substance found in **corky** tissue.
- submetacentric**. Of a **chromosome**, having a shorter and a longer arm on either side of the **centromere**. *See also* **metacentric**. *Cf.* **apocentric**, **telocentric**
- subsidiary cell**. One of several **epidermal** cells bordering the **guard cells** of a **stoma**.
- subspecies (subsp.)**. **Taxonomic rank** immediately below **species**; group of individuals which differ **morphologically** from another group but not sufficiently to justify separate specific status, *e.g.* *Cycas media* subsp. *banksii*; subspecies are reproductively compatible but isolated from each other. *See also* **varietas**.
- substrate**. Supporting or nourishing medium for the **growth** of an organism, *e.g.* soil.
- subulate**. Narrow and drawn out to a fine point; awl-shaped, *e.g.* the **megasporophyll lobes** of *Cycas multipinnata*.
- succession**. The act or process of following in order or sequence; in cycads, pertaining to the manner of production of **cones** as a diagnostic **trait** in certain **species** groups within *Encephalartos* (*sensu* Vorster, 2004).
- succubous**. Arrangement in which a **leaflet** partially shields the one below (the next **proximal** leaflet) when viewed from above (**adaxially**), *e.g.* as in *Encephalartos turneri*. *Cf.* **incubous**.
- sucker**. Vegetative **axis** arising from an **adventitious bud** at the base of a cycad **trunk**; colloquial, **pup**. *Cf.* **offset**.
- suckering**. Vegetative production of **suckers**; **habit** of such a plant, often forming a **clump**; colloquial, **pupping**. *Cf.* **solitary**.
- sulcate**. Having a longitudinal groove or furrow, *e.g.* the **abaxial midvein** of *Cycas multipinnata* **leaflets**; cycad **pollen** grains are characteristically monosulcate.
- sulcus**. Groove of a **pollen grain** of a cycad through which the **pollen tube** emerges.
- surculose**. Producing **suckers**; **suckering**.
- suspensor**. That part of the plant **embryo** that attaches the embryo to the supporting tissues of the developing **seed**.
- suture**. Line of opening or **dehiscence** of a closed structure, *e.g.* as in cycad **microsporangia**.
- 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**.
- sympatric speciation**. Differentiation and attainment of **reproductive isolation** of **populations** that are not geographically separated and which overlap in their **distributions**. *Cf.* **allopatric speciation**.

- 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**.
- synapsis.** Pairing of **homologous chromosomes** during **meiosis**.
- syngamy.** Union of male and female **gametes**.
- syngonium.** Fertile body formed by the fusion of two or more **sporangia**.
- synonym.** **Scientific name** of a **species** or other **taxonomic group** that has been superseded by another name at the same rank, *e.g.* *Cycas chamberlainii* is a synonym of *C. riuminiana*.
- systematics.** **Classification** of living organisms into **hierarchical series** of groups emphasizing their **phylogenetic** relationships. *See also* **taxonomy**.
- systemic.** An insecticide or fungicide whose mode of action is via uptake into a plant, entering (and killing) the pest when the plant is consumed.
- tabula.** Latin, used in some of the older French botanical literature to denote a black and white plate. *See also* **planche**.
- taproot.** Enlarged or deeply **descending** storage **root** derived from the primary root of an **embryo**; main root of a plant, having a single, **dominant axis** and often serving the functions of structural support and food storage, *e.g.* the extensive taproot of some plants of *Zamia pseudoparasitica* that grow from the plant perched on high tree branches all the way to the forest floor. *Cf.* **feeder root**.
- taxon**, plural **taxa**. Any group of individuals, in any rank, having **characteristics** in common and of the same **evolutionary** origin.
- taxonomic group.** Any **taxon**, including all subordinate taxa.
- taxonomic key.** *See* **dichotomous key**.
- taxonomic rank.** Position of a **taxon** in a **hierarchy** of **classification**.
- taxonomist.** One who studies or performs **taxonomy**.
- taxonomy.** **Circumscription**, **classification**, and naming of organisms; in plants, systematic botany. *Cf.* **nomenclature**.
- tectum.** Outer covering of a **pollen grain**, composed of sporopollenin and forming a ‘roof’.
- tegula.** Latin, meaning ‘tile’, *e.g.* the root word of the first part of the **specific epithet** of *Encephalartos tegulaneus*, referring to its overlapping **microsporophylls** that resemble roof tiles.
- telocentric.** Of a **chromosome**, having but one arm, the **centromere** being **terminal**. *Cf.* **acrocentric**, **metacentric**.
- terete.** Solid structure which is circular in cross section; **cylindrical** or nearly so, *e.g.* the **petioles** of most cycad **species**. *Cf.* **semiterete**.
- terminal.** Arising from or positioned at the tip, *e.g.* used in reference to the most **distal leaflets** on a cycad **leaf**; **apical**. *See also* **terminal facet**. *Cf.* **basal**, **median**.
- terminal facet.** **Flat** surface on the **apex** of **sporophylls** that have raised **bullae** (Melville, 1957). *Cf.* **lateral facet**, **median facet**.
- testa.** *See* **integument**, **sarcotesta**, **sclerotesta**, **seed coat**.
- tetrad.** Last, **haploid**, four-cell stage in **meiosis**.
- tetrangular.** *See* **quadrangular**.

- thermogenesis.** Self-heating through respiratory activity, as in the **cones**, especially **male cones**, of many cycads. *See also* **odor-mediated push-pull pollination**.
- thermoperiod.** Recurring (*e.g.* daily, annually) temperature cycle that may have an inductive effect on plant **growth** and **development**. *See also* **odor-mediated push-pull pollination**. *Cf.* **photoperiod**.
- 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**. *See also* **conservation status**, **Red List**.
- thymine (T).** A purine base, C<sub>5</sub>H<sub>5</sub>N<sub>5</sub>, that is the **nucleotide** constituent of **DNA** involved in **base pairing** with **adenine (A)**. *See also* **cytosine (C)**, **guanine (G)**. *Cf.* **uracil (U)**.
- tiusinte.** Vernacular name of *Dioon mejiae* by the **indigenous** people in Olancho, Honduras, who use the **seeds** to make a variety of foodstuffs (Bonta *et al.*, 2006). *See also* **ethnobotany**.
- tomentose.** Densely **woolly** in a finely matted fashion, *e.g.* the **female cones** of *Dioon*. *See also* **hirsute**, **lanate**, **pilose**, **pubescent**, **sericeous**. *Cf.* **glabrous**, **nitidus**.
- tomentum.** Covering of fine hairs. *See also* **indumentum**, **tomentose**.
- tooth.** Sharply-tipped protrusion along a **leaf** or **leaflet** (or analogous structure) **margin** pointing away at an angle of 90°. *See also* **serrate**, **dentate**, **spinose**.
- topographic.** Relating to physical features, usually of the landscape; also used in reference to the surfaces of structures such as **pollen grains**, **leaves**, etc.
- topotype.** A **specimen** collected later from the original **type locality**, or from the area from which the **type** was described. *Cf.* **holotype**, **isolectotype**, **isotype**, **lectotype**, **neotype**, **paratype**, **type**.
- toxin.** *See* **neurotoxin**.
- trace elements.** *See* **micronutrients**.
- tracheid.** **Xylem** cell with thickened pitted or annular walls and tapered ends.
- trait.** Any **character** or property of an organism. *Cf.* **characteristic**.
- transfusion tissue.** Rather amorphous conducting tissue found in the **leaflets** of *Cycas*.
- transparent.** Of **veins** that readily transmit light when held up to a light source, *e.g.* of the **leaflets** of *Ceratozamia zoquorum*. *Cf.* **opaque**.
- transpiration.** Act or process of transpiring, especially through the **stomata** of plant tissue; water loss through the stomata.
- transplant.** To relocate a plant from one location (or one container) to another; a plant that has been so relocated. *See also* **re-pot**.
- transverse.** Broader than long; applied to 2- or 3-dimensional shapes, *e.g.* **elliptic** and **oblong** or **ellipsoid** and **obovoid** which have a length:breadth ratio of less than 5:6.
- tree.** Perennial **woody (angiosperm)** plant having a main **trunk** and usually a distinct **crown**; colloquially (though mistakenly) used in reference to large, **arborescent** cycads.
- ‘tree dioon’.** Any of the large, arborescent species of *Dioon*, *e.g.* *Dioon mejiae*.
- triangular.** Of a 3-dimensional structure that is three-sided, *e.g.* the **petiole** of *Cycas rumphii*. *Cf.* **quadrangular**.
- tribe.** **Taxonomic group** of related **genera** within a **family** or subfamily.
- trichome.** Small hair or **scale** of **epidermal** origin.
- trifurcate.** With three **terminal**, long **lobes**, *e.g.* the **apices** of some *Encephalartos hildebrandtii* **leaflets**. *Cf.* **bifurcate**.
- tripinnate.** Thrice **pinnately** compound. *Cf.* **bipinnate**, **once-pinnate**, **simple**, **twice-pinnate**.

- triploid.** A **polyploid** having three sets of **homologous chromosomes**, *e.g.* the **endosperm** of **angiosperm seeds**; misapplied to the **megagametophyte** of cycad seeds.
- trnL-F.** Spacer region of the maternally-inherited **chloroplast genome**.
- tropos.** Greek, meaning ‘boat keel’, *e.g.* the root word of the first part of the **specific epithet** of *Cycas tropophylla*, referring to its distinctively **keeled leaves**. *See also phyllon.*
- trullate.** Of a 2-dimensional structure resembling a trowel blade, *i.e.* with four straight sides with the **axis** broadest below the middle and a length:width ratio between 3:2 and 2:1, *e.g.* the **leaflets** of *Zamia vazquezii*. *See also leaflet length-to-width ratio. Cf. obtrullate.*
- truncate.** With an abrupt ending, as though cut off **terminally**, *e.g.* the **leaves** of *Encephalartos inopinus* and *Microcycas calocoma*, or the **megasporophylls** of *Zamia*.
- trunk.** Main **woody axis** of a **tree**; colloquially, in reference to the **caudex** or **stem** of **arborescent** cycads.
- trunkless.** Without a **trunk**; **acaulescent**. *Cf. arborescent.*
- t-test** or **Student’s t-test.** Statistical tool to assess whether the **mean** values from two sets of data are the same.
- tube nucleus.** **Nucleus** of the **pollen-tube cytoplasm**.
- tuber, tuberous.** Thickened underground **stem**.
- tuberculate.** Covered with small raised **protuberances**, *e.g.* the **bullae** surface of some cycad **megasporophylls**. *See also verrucose.*
- turgid.** Swollen or bloated, *e.g.* the **trunk** bases of many cycad **species**.
- twice-pinnate.** Doubly compound; having second-order **pinnae** or pinnae in turn made up of **pinnules**; **bipinnate**. *Cf. once-pinnate, simple, tripinnate.*
- 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, isolectotype, isotype, lectotype, neotype, paratype.*
- type locality.** Geographical place of collection where a **holotype** or **type** specimen of a **species** or **subspecies** was first found and **described**.
- ultimate factor.** Ecological factor having a permissive rather than determinative role in an organism’s **development**, *e.g.* rainfall, temperature, light intensity.
- umbinate.** Having or resembling a knob or knob-like **protuberance** (umbo), *e.g.* the **microsporophyll faces** of *Cycas micronesica*.
- unarmed.** Lacking **spines** or **prickles**; **inerm**, *e.g.* the **petioles** of *Zamia inermis*. *Cf. armed.*
- unbranched.** Possessing no **lateral** branches; **solitary**, *e.g.* the **caudex** of most **arborescent** cycads. *Cf. branched.*
- uncinate.** Hooked at the **apex**, *e.g.* the **microsporophylls** of *Encephalartos bubalinus*.
- undescribed.** Formerly discovered and known biological **taxon** lacking a **valid** published scientific **description**.
- undulate.** With wavy **margins**, usually of **leaflets**, *e.g.* the leaflets of *Cycas apoa*. *Cf. flat.*
- unfertilized.** Not having been **fertilized**; an ‘unfertilized egg’. *Cf. fertile*
- unweighted.** Calculated with equal weighting for each component.
- uracil (U).** A pyrimidine base, C<sub>4</sub>H<sub>4</sub>N<sub>2</sub>O<sub>2</sub>, that is an essential constituent of **RNA**. *See also nucleotide. Cf. thymine (T).*
- USDA hardiness zones.** Planting zones established by the United States Department of Agriculture, defined by minimum winter temperatures.



- valid.** Refers to a name published according to the rules of the **International Code of Botanical Nomenclature**. Cf. **invalid**.
- variable.** Factor of an experiment that can affect the outcome; of different **forms** or **variants**.
- variance.** In statistics, the square of the **standard deviation**, providing a measure of dispersion of values about a **mean**. See also **ANOVA**.
- variant.** **Morphological form** that differs from the typical form of a **species**. See also **polymorphic**.
- variegated.** Having two or more colors in a blotched or mottled pattern, e.g. the **leaflets** of *Zamia variegata*.
- varietas, variety (var.).** **Taxonomic rank** below **species**; group of individuals which differ **morphologically** from another group but not sufficiently to justify separate specific status, e.g. *Dioon edule* var. *angustifolia*; note that varieties are reproductively compatible, not **reproductively isolated**, from each other and may occur together in mixed stands within a **population**. 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**).
- vascular tissue.** Supportive and conductive tissue in plants, consisting of **xylem** and **phloem**.
- vegetative propagation.** Production of new plants by removal or **division** of **offsets** or **suckers**.
- vein.** Strand of **vascular tissue**.
- veld.** Open grassland of South Africa, often in reference to cycad **habitat**.
- venation.** Pattern of **veins** in a **leaf** or **leaflet**.
- ventral-canal cell.** Cell, sometimes only a vestigial **nucleus**, immediately above the **egg** in an **archegonium**.
- vernacular name.** The **common name** of a **species** or group other than the formal Latin or Latinized **scientific name**.
- vernation.** Manner of folding (or arrangement) of a **leaf** prior to **emergence**. See also **circinate**, **conduplicate**, **inflexed**, **ptyxis**, **reflexed**.
- verrucose.** **Warty** in appearance, e.g. the **bullae** surface of many cycad **sporophylls**, or the **seeds** of *Cycas diannanensis*. See also **tuberculate**.
- verticillate.** Arranged in **whorls**; **fasciculate**, e.g. the **leaflets** of the common form of *Ceratozamia hildae*.
- viable.** Alive and able to **germinate**.
- vicariant.** Of **species** that occupy similar ecological **niches** but in geographic isolation from each other; implies a **phylogenetic** relationship existing between the two species.
- villous.** With long, soft hairs, e.g. the **petioles** of *Encephalartos villosus*.
- viridis.** Latin, meaning ‘green’, e.g. the **specific epithet** of *Macrozamia viridis*, in reference to its bright green **leaflets**.
- vivipary.** Phenomenon by which **seeds** begin to **germinate** prior to **dehiscence** of the **female cone**, e.g. as often happens in *Zamia pseudoparasitica* and sometimes happens in *Cycas micronesica*.
- Vulnerable (VU).** IUCN **Red List** category by which a **taxon** is facing a high risk of **extinction** in the wild. See also **Critically Endangered**, **Data Deficient**, **Endangered**, **Extinct**, **Extinct in the Wild**, **Least Concern**, **Near Threatened**.
- warty.** Covered in bumps; **verrucose**, e.g. the **female cones** of *Encephalartos msinganus*.
- weevil.** Any of the numerous beetles of the **Family Curculionidae**; many are **pollinators** of cycads.
- wet pollination.** Type of **hand pollination** whereby the **pollen** is introduced to the **female cone** in liquid form, often by means of pouring or squirting into the open spaces (**cracks**) between **sporophylls**.

- whorl.** Ring-like arrangement of similar parts arising from a common point or **node**. *See also cohort, flush.*
- Wilks-Lambda test.** Statistical test comparing the centroids of a distribution of **means**; a **multivariate analysis of variance**. *See also ANOVA.*
- wing, adj. winged.** In cycads, a thin appendage of tissue below the **terminal facet** of **microsporophylls** (e.g. as in *Encephalartos pterogonus*) or **megasporophylls** (e.g. as in *Macrozamia douglasii*). *See also alate.*
- wobbles.** Disabling neurological disease of cattle caused by ingesting cycad **toxin**. *See also crampy, staggers.*
- wood.** Secondary **xylem** of **trees** and shrubs, lying beneath the bark and consisting largely of cellulose and **lignin**; mistakenly used with regard to cycad **stems** or **trunks**.
- wool.** Colloquial for heavy **tomentum** on some cycad **caudices**, e.g. *Encephalartos friderici-guilielmi*.
- xeric.** Dry conditions, or **adapted** to such conditions.
- xerophyte, adj. xerophytic.** Drought-tolerant plant, e.g. many species of *Dioon* and *Encephalartos*. *Cf. hydrophyte, mesophyte.*
- xylem.** Water-conducting tissue in vascular plants, comprising vessels and **tracheids**, dead at maturity and having a secondary layer of **lignin**.
- xiphos.** Greek, meaning ‘sword’, e.g. the root word of the first part of the **specific epithet** of *Cycas xipholepis*, referring to the long, hard, **pungent cataphylls**. *See also lepis.*
- zamia borer.** Insect that bores into **hypogeous Zamia stems**. *See also stem borer.*
- zone.** **Circumscribed** geographic area or region, distinguished significantly from adjacent areas, that has a broadly homogeneous climate characterized by similar and distinctive soil, flora or fauna; a belt or area to which certain **species** are limited.
- zone of hybridization.** Area of overlap between adjacent **populations, subspecies, or species** in which **interbreeding** occurs; **hybrid zone**.
- zooidogamy.** **Fertilization by motile sperm.**
- 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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