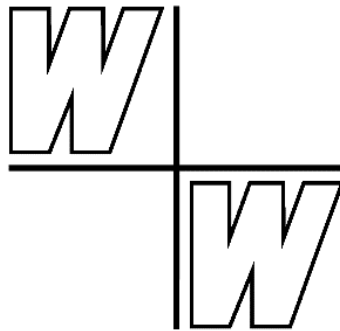


Data Collection on Intergeneric Hybrids and Basic Types: GYMNOSPERMAE

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<https://www.wort-und-wissen.org/artikel/data-collection-basic-types/>**

GYMNOSPERMAE

6 orders, 12 families, 84 genera, 1110 species

Orders and families according to The Gymnosperm Database 2025.

<https://www.conifers.org/>

Araucariales 2 families Araucariaceae 3: 41, Podocarpaceae 20: 174

Cupressales: 3 families Cupressaceae 28: 154, Sciadopityaceae 1: 1, Taxaceae (incl. Cephalotaxaceae) 6: 28

Cycadales: 2 families Cycadaceae 1: 120, Zamiaceae 10: 246

Ginkgoales: 1 family Ginkgoaceae 1: 1

Gnetales: 3 families (or sometimes separate orders) Ephedraceae 1: 71, Gnetaceae 1: 40, Welwitschiaceae 1: 1

Pinales: 1 family Pinaceae 11: 234

Hybridization is not frequent in Gymnosperms.

General references on Gymnospermae:

The Gymnosperm Database (2025). Earle CJ (ed.). <http://www.conifers.org/>

International plant names index (= **IPNI**), formerly Index Kewensis (= **IK**) = www.ipni.org

Knobloch IW (1972) Intergeneric hybridization in flowering plants. Taxon 21, 97–103.

POWO = Plants of the World Online <https://powo.science.kew.org/> Actual but incomplete list of nothospecies and nothogenera of Pteridophyta and Spermatophyta

Stevens PF (2001 onwards) Angiosperm Phylogeny Website. update 2025 <http://www.mobot.org/MOBOT/research/APweb/> (= **AP website**).

Abbreviations:

° = taxa actually not accepted in the rank of a genus, e. g. *Cerasus*° (= *Prunus* p. p.)

10: 50 etc. The numbers behind the names of families etc. refer to extant genera and species

IS = interspecific hybrid. **IG** = intergeneric hybrid. **IST** = intersubtribal hybrid.

IT = intertribal hybrid. **ISF** = intersubfamilial hybrid. **IF** = interfamilial hybrid.

EC = embryo culture or ovule culture

SO = somatic hybrid by cell fusion; normally these hybrids are asymmetric

AS = asymmetric hybrids, they do not equally express maternal and paternal features

HY = assumed intergeneric hybridogenuous origin of a taxon.

nat. hyb. = natural hybrid **art. hyb.** = artificial hybrid

Colours within the crosses:

Red letters: intergeneric hybrids (incl. former IG).

Gray letters: hybridity unconfirmed or erroneous.

Green letters: notes on tribes, subfamilies etc. involved in the hybridization.

Yellow shaded: Notes concerning basic types.

Araucariales 2 families

(sometimes included in Cupressales)

Araucariaceae 3: 41

Podocarpaceae 20: 174

Araucariales: Araucariaceae 3: 38

Agathis 17, *Araucaria* 20, *Wollemia* 1

IPNI 2018: 0 IS – POWO 2025: 0 IG, 0 IS

Probably basic type *family Araucariaceae*, very distinct. The family is a living fossil and has been found worldwide since the Upper Palaeozoic (at least from the Carboniferous/Permian, see <https://paleobiodb.org/navigator/>).

Araucariales: Podocarpaceae 20: 174

POWO 2025; *Dacrydium* 1 IS, *Podocarpus* 1 IS

Cupressales 3 families

Cupressaceae 28: 154, Sciadopityaceae 1: 1, Taxaceae (incl. Cephalotaxaceae) 6: 38

Cupressales: Cupressaceae (incl. Taxodiaceae) 32: 143 + extinct taxa

IPNI 2018: 1 IG: × *Taxodiomeria*; *Juniperus* 8 IS, *Thuja* 1 IS –

POWO 2025: 4 IG (but be aware that only one of these is correct, because

× *Hesperotropis*, × *Cupressocyparis*, × *Cuprocyparis*, × *Neocupropsis* are synonyms, and × *Taxodiomeria* is now interspecific; *Cupressus*: 3 IS, *Juniperus* 8 IS, *Thuja* 3 IS

7 subfamilies (AP website 2025):

Arthrotaxidoideae 1 *Arthrotaxis* 2

Callitroideae (= Actinostroboideae) 10: 32 *Actinostrobus*, *Austrocedrus*, *Callitris* 15, *Diselma*, *Fitzroya*, *Libocedrus*, *Neocallitropsis*, *Papuacedrus*, *Pilgerodendron*, *Widdringtonia*

Cunninghamioideae 1 *Cunninghamia* 2 + extinct genera

Cupressoideae 13: 131 There have been large changes in the last years and many authors retain *Cupressus* in a wide sense. *Callitropsis nootkatenis* (= *Cupressus n.*, *Chamaecyparis n.*, *Xanthocyparis n.*), *Calocedrus*, *Chamaecyparis*, *Cupressus* 12, *Fokienia*, *Hesperocyparis macrocarpa* = *Cupressus m.*, *Neocyparis*° *m.*), *Juniperus* 67, *Microbiota*, *Platycladus*, *Tetraclinis*, *Thuja*, *Thujopsis*, *Xanthocyparis*

Sequoioideae 3: 3 *Metasequoia* 1, *Sequoia* 1, *Sequoiadendron* 1

Taiwanoideae 1 *Taiwania* 2

Taxodioideae 3: 5 *Cryptomeria* 1, *Glyptostrobus* 1, *Taxodium* 3

Possibly basic type **family Cupressaceae**: Only few confirmed intergeneric hybrids are known, but 3 of them connect distant subfamilies. The family is a living fossil and has existed throughout the whole Northern Hemisphere since the Mesozoic era (Triassic/Jurassic, see <https://paleobiodb.org/navigator/>).

Callitropsis × *Hesperocyparis* **Taxodioideae** (→ × *Hesperotropsis* Garland & Moore 2012):
3 nothospecies:

1. *Ca. nootkatensis* × *He. macrocarpa* → (× *Hesperotropsis leylandii* = “× *Cuprocyparis leylandii*”, × *Cupressocyparis leylandii*). This hybrid (the Leyland Cypress) is frequently cultivated in gardens and parks. It was for a long time considered to be a hybrid *Chamaecyparis* × *Cupressus* which is not in conformance with new taxonomic insights, or interspecific within a paraphyletic *Cupressus* s. l.
2. *Ca. nootkatensis* × *He.* (= „*Cupressus*“) *arizonica* (→ *Hesperotropsis notabilis* = “× *Cuprocyparis*” *notabilis*);
3. *Ca. nootkatensis* × *He.* (= *Neocyparis*°) *lusitanica* (→ *Hesperotropsis ovensii* = “× *Neocupropsis*” *ovensii*)

There is a large number of synonyms for these 3 nothospecies, because the names of the parents have changed in the last years. – For details see Garland & Moore 2012, see also POWO 2025

Cedrus deodara × *Taxodium distichum* **IF Pinaceae × Cupressaceae unconfirmed** Jiangsu Institute of Botany according to Chen et al. 2018

Chamaecyparis × *Cupressus* see *Callitropsis* × *Hesperocyparis*

Cunninghamia × *Platycladus* **ISF Cunninghamioideae × Cupressoideae** Ming 2008 (*Cun. lanceolata* × *Pl. orientalis*, hybridity confirmed ISSR markers)

This is a wide hybrid, connecting extreme parts of family Cupressaceae!

Cunninghamia × *Taiwania* **ISF Cunninghamioideae × Taiwanioidae** Yang & Chung 1999 (art. hyb., *Cun. lanceolata*, *konishii* × *T. cryptomerioides*: Seeds developed but were unable to germinate)

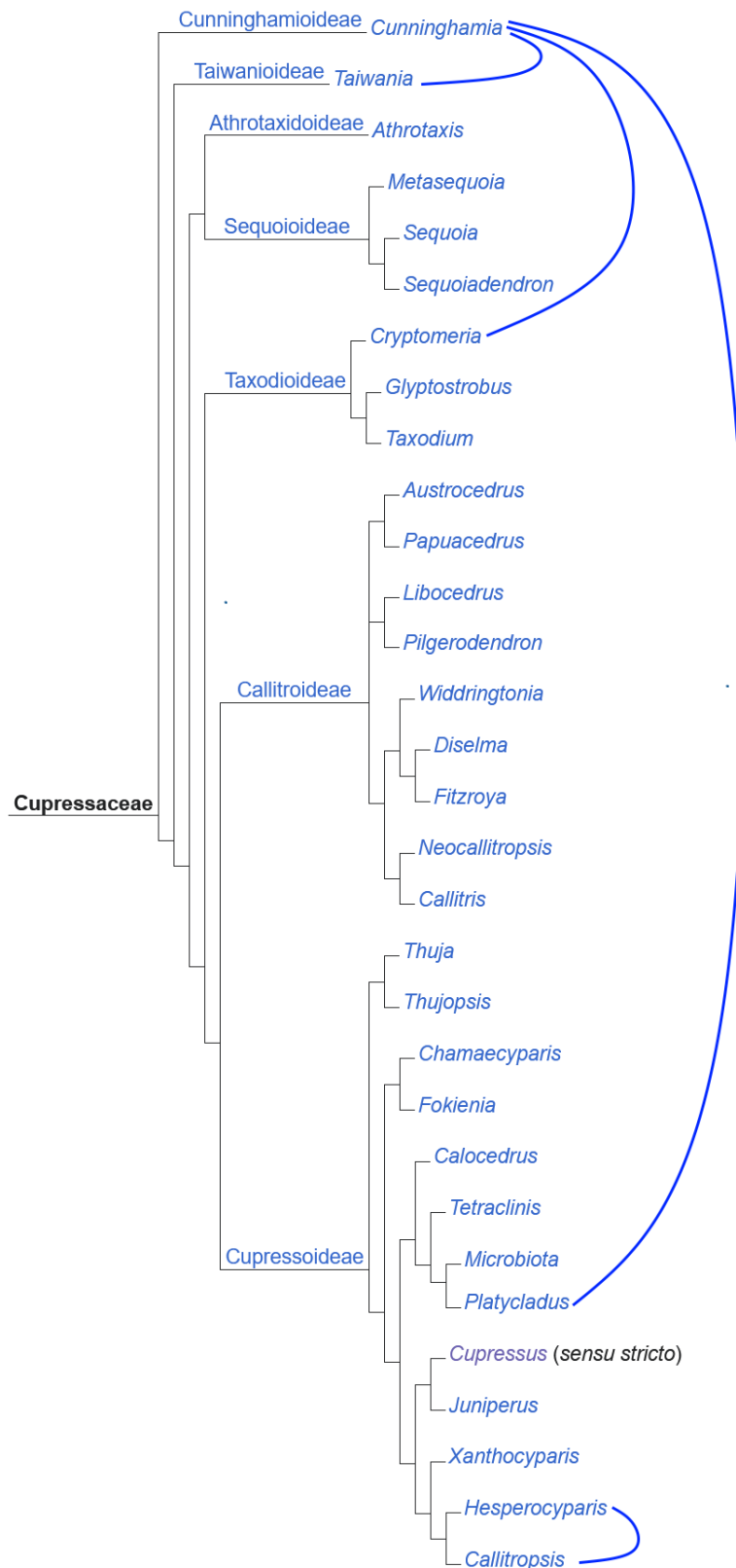
Cunninghamia lanceolata × *Taxodium ascendens, distichum* **ISF Cunninghamioideae × Taxodioideae ISF unconfirmed** Jiangsu Institute of Botany 1975 according to Chen et al. 2018.

Cryptomeria × *Cunninghamia* **ISF Taxodioideae × Cunninghamioideae** Li et al. 1999, Qi et al. 1999 (art. hyb., *Cr. fortunei* = *japonica* × *Cu. lanceolata*), Yang & Chung 1999 (*Cr. japonica* × *Cu. lanceolata*, *konishii* art. hyb.: Seeds were unable to germinate).

This is a wide hybrid, connecting extreme parts of family Cupressaceae!

Cryptomeria × *Taxodium* **Taxodioideae** (→ × *Taxodiomeria* Z. J. Ye, J. J. Zhang & S. H. Pan 2003 Sida 20 (3): 1001) (*C. fortunei* = *japonica* × *T. mucronatum* → × *Taxodiomeria peizhongii*) Zhang et al. 2003 (“the hybrid species strongly resemble *Taxodium mucronatum*”), IPNI 2011, Hatch 2012 (“some seedlings turned out to be true”), Ling et al. 2006 (“erroneous, not an intergeneric hybrid”), POWO 2025 (“accepted”)

A 2021 molecular study supported a very similar phylogeny but with some slight differences, along with the splitting of *Cupressus* (found to be paraphyletic):^[6]



Family Cupressaceae: Cladogram based on Stull et al. 2021, [doi:10.1038/s41477-021-00964-4](https://doi.org/10.1038/s41477-021-00964-4), CC BY 4.0, from en.wikipedia 2025 and intergeneric hybridization.

References on Cupressaceae:

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- Li WD, Qi WQ, Cheng XF & Hu SY (1999) Soft X-ray diagnosis on seed development and observation on seed germination and seedling growth in artificial hybridization in *Cunninghamia* and *Cryptomeria*. *Acta Bot. Sinica* 41, 690f.
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Zhang J-J et al. (2003) *Taxodiomeria* (Taxodiaceae), an intergeneric hybrid between *Taxodium* and *Cryptomeria* from Shanghai, People's Republic of China. Sida, Contributions to Botany 20, 999–1006. <https://www.jstor.org/stable/41968139>

Cupressales: Sciadopityaceae 1: 1

Sciadopitys verticillata

Probably basic type **family Sciadopityaceae**: Monotypic family with only 1 species and a unique type of needles.

Cupressales: Taxaceae (incl. Cephalotaxaceae) 6: 38

Amenotaxus, *Austrotaxus*, *Cephalotaxius*, *Pseudotaxus*, *Torreya*

Cycadales 2 families

Cycadales: Cycadaceae 1: 120

Cycas 120

IPNI 2018: 0 IG, 0 IS. – POWO 2025: 0 IS

Probably basic type **family Cycadaceae** (monogeneric, distinct). The family is a living fossil and occurred in the Permian in North America and Asia (see <https://paleobiodb.org/navigator/>).

Cycadales: Zamiaceae 10: 248 + fossil genera

AP website 2025: no subdivision. The former monotypic family Stangeriaceae nests within Zamiaceae. – 2 subfamilies:

Encephalartoideae 4 tribes: Diooeae 1 *Dioon* 14, Encephalarteae *Encephalartos* 66, *Lepidozamia* 2, *Macrozamia* 42

Zamioideae 3 tribes: Ceratozamiaceae *Ceratozamia* 27, Zamieae *Microcycas* 1, *Zamia* 78 (incl. *Chigua*)

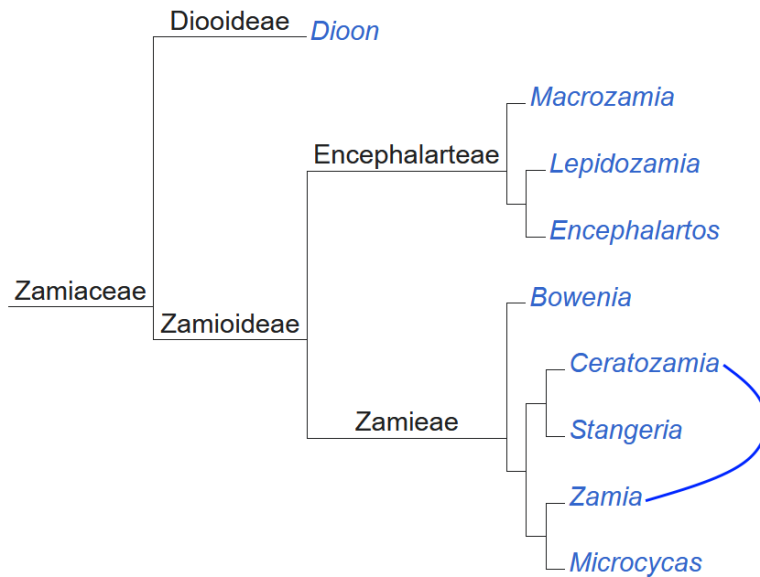
IPNI 2018: 0 IG, *Ceratozamia* 1 IS – POWO 2025 0 IG, 1 IS *Zamia* × *katzeriana* = *Z. loddigesii* × *Z. verschaffeltii*

Ceratozamia mexicana × *Zamia monticola* **IT** Zamioideae Ceratozamiaceae × Zamieae

Chamberlain 1926, Papadopoulos 1928, Knobloch 1972

Encephalartos × *Macrozamia* **ISF** Encephalartoideae × Zamioideae **unconfirmed**
Encyclopedia Britannica 2011

Encephalartos villosus × *Zamia pumila* **ISF** Encephalartoideae × Zamioideae
intersubfamilial = **unconfirmed** Chamberlain 1926: “The seeds have not yet germinated, so that it is doubtful whether any F₁ generation will be obtained”, Knobloch 1972, Encyclopedia Britannica 2011



Family Zamiaceae: Cladogram based on e. g. Coiro et al. 2024, doi.org/10.1038/s42003-024-06024-9), CC BY 4.0, from en.wikipedia 2025, and intergeneric hybridization.

References:

Chamberlain CJ (1926) Hybrids in Cycads. Bot. Gaz. 81 (4), 401–406.

<http://www.cycad.org/documents/Chamberlain-1926-Hybrids-in-Cycads.pdf>

Encyclopedia Britannica <http://gluedideas.com/Encyclopedia-Britannica-Volume-11-Part-1-Gunnery-Hydroxylamine/Cycadales.html> (“Recently some very interesting hybrids have been obtained by crossing various species of *Zamia* with others of the same genus and with species of *Encephalartos* and *Macrozamia*“.)

Papadopoulos S (1928) A morphological comparison of leaflets of a hybrid cycad and the two parents. Bot. Gaz. 85 (1), 30–45. <http://www.jstor.org/pss/2470452>

Ginkgoales 1 family

Ginkgoales: Ginkgoaceae 1: 1 and extinct taxa!

Ginkgo biloba

Probably basic type **family Ginkgoaceae:** Whole order with only one extant species, very distinct. The family is a living fossil and appeared almost worldwide in the Carboniferous and Permian (North America, Europe, Africa, Asia, see <https://paleobiodb.org/navigator/>).

Gnetales 3 families

Gnetales: Ephedraceae 1: 71

Ephedra 71
POWO 2025: 1 IS

Gnetales: Gnetaceae 1: 40

Gnetum 40
POWO 2025: 0 IS

Gnetales: Welwitschiaceae 1: 1 + few extinct genera

Welwitschia mirabilis

Probably basic type **family Welwitschiaceae**: Very distinct family with only one extant species. The family is a living fossil and is known as a fossil since the Permian on the Indian subcontinent (see <https://paleobiodb.org/navigator/>), today they only exist in Namibia and Angola in Africa.

Pinales 1 family

Pinales: Pinaceae 11: 234

4 subfamilies:

Abietoideae 6 *Abies* 51, *Cedrus* 3, *Keteleeria* 3, *Nothotsuga* 1, *Pseudolarix* 1, *Tsuga* 8

Laricoideae 3 *Cathaya* 1, *Larix* 10, *Pseudotsuga* 4

Piceoideae 1 *Picea* 35

Pinoideae 1 *Pinus* 111

IPNI 10/2018: 2 IG × *Hesperotsuga*, × *Tsugo-keteleeria*, × *Tsugo-picea*; *Abies* 4 IS, *Larix* 2 IS, *Picea* 3 IS, *Pinus* 26 IS. – POWO 2025: 44 IS (*Abies* 7, *Larix* 7, *Piceae* 7, *Pinus* 22, *Tsuga* 1–2)

Hesperopeuce^o (= *Tsuga* p. p.) × *Picea* (→ *Picea* sect. *Omorika*) **unconfirmed** → according to Bobrov 1983 all 5 species of sect. *Omorika* of *Picea* represent intergeneric hybrids of this type.

Hesperopeuce^o (= *Tsuga* p. p.) *mertensiana* × *Tsuga heterophylla* **IS Abietoideae** (→ × *Hesperotsuga* C. N. Page 1988 publ. 1989 in Notes Roy. Bot. Gard. Edinburgh 45: 389) IS (nat. hyb.) Page 1988, IK 1991, POWO 2025 (*Tsuga mertensiana* × *Tsuga heterophylla* → *T. × jeffreyi* nat. hyb.). This hybrid is interesting because the 2 species involved belong to different subgenera or even genera.

Keteleeria × *Tsuga* (→ × *Tsugo-Keteleeria* van Campo-Duplan & Gaussen 1948 in Trav. Lab. For. Toulouse, Tome I, 4, Art. 24, 6) IK 1950, Gaussen 1966, Knobloch 1972 → **erroneous**, see Duffield 1951, Farjon 1990, Wang et al. 2000

Larix × *Pseudotsuga* (→ *Larix* sect. *Multiseriales*) **unconfirmed** → according to Bobrov 1983 all 5 species of sect. *Multiseriales* of *Larix* represent intergeneric hybrids of this type; the possibility of hybridization was proved experimentally

Nothotsuga: The hybrid origin hypothesis was not confirmed by Ran et al. 2018 Mol. Phyl. Evol. 129, 106–116.

Picea × *Tsuga* (→ × *Tsugo-Picea* van Campo-Duplan & Gaussen 1948 in Trav. Lab. For. Toulouse, Tome I, 4, Art. 24, 8) IK 1950, Gaussen H 1966, Knobloch 1972 [→ **erroneous**, see Duffield 1951, Farjon 1990, Wang et al. 2000]

References on Pinaceae:

Bobrov EG (1983) Intergeneric hybridization in the family Pinaceae. [Russian] Bot. Zhurnal (Leningrad) 68, 857–865. *Picea* × *Tsuga* hybridogeneous, *Larix* × *Pseudotsuga* hybridogeneous

Duffield JW (1951) Review of „Sur quatre hybrides des genres chez les Abiétinées” [Van Campo-Duplan & Gaussen 1948]. J. Forest. (Washington) 48, 440.

Farjon A (1990) Pinaceae. Drawings and descriptions of the genera *Abies*, *Cedrus*, *Pseudolarix*, *Keteleeria*, *Nothotsuga*, *Tsuga*, *Cathaya*, *Pseudotsuga*, *Larix* and *Picea*. (Regnum Vegetabile) Königstein: Koeltz Scientific Books.

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