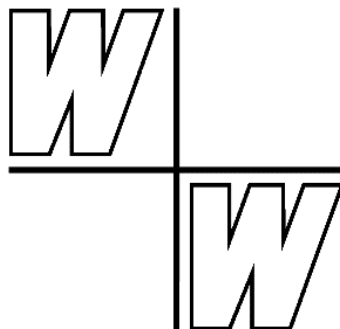


Data Collection on Intergeneric Hybrids and Basic Types: **GYMNOSPERMAE**

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version 2 01.10.2026



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

GYMNOSPERMAE

6 orders, 12 families, 84 genera, 1110 species

gymnosperms = Nacktsamer

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 7: 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

Summary:

5 intergeneric hybrids, in 2 families (Cupressaceae, Zamiaceae).

6 preliminary basic types, average species-number per basic type $404 / 6 = 68$ species):

Basic type level: family 6.

Araucariaceae 3: 38. **0 IG**

Cupressaceae 32: 143. **4 IG** (incl. **3 ISF**)

Cycadaceae 1: 120. – (**>2 IS**)

Ginkgoaceae* 1: 1. – (Ginkgoales)

Sciadopityaceae 1: 1. –

Welwitschiaceae 1: 1. –

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.)

* = only extant family of the order

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 hybridogeneous origin of a taxon.

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

Colors 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

araucarians = **Araukariengewächse**

(sometimes included in Cupressales)

Araucariaceae 3: 41.

Podocarpaceae 20: 174.

Araucariales: Araucariaceae 3: 38

araucarians = **Araukariengewächse**

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

Probably **basic type family Araucariaceae** (3: 38), 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/>).

IS: POWO (2025): 0 IS.

Araucariales: Podocarpaceae 20: 174

podocarp family = **Steineibengewächse**

IS: 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. 4 IG (incl. 3 ISF)

cypress family = Zypressengewächse

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.

Taiwanioideae 1 *Taiwania* 2.

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

Possibly **basic type family Cupressaceae** (32: 143). 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/>).

POWO 2025: *Cupressus*: 3 IS, *Juniperus* 8 IS, *Thuja* 3 IS.

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)

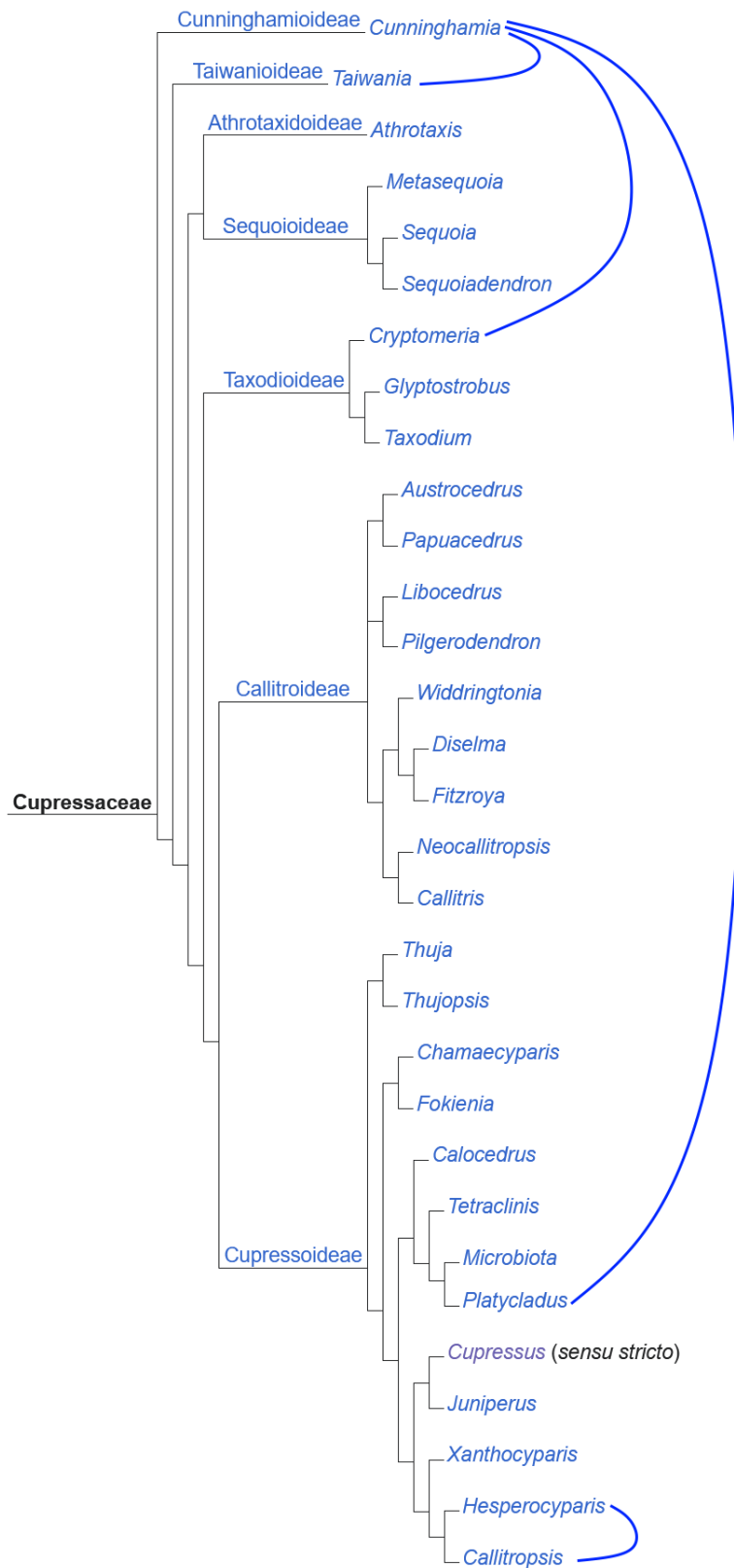
Cunninghamia lanceolata × *Taxodium ascendens*, *distichum* **ISF Cunninghamioideae × Taxodioideae ISF unconfirmed** Jiangsu Institute of Botany 1975 according to Chen et al. 2018.

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]



Cupressaceae: hybrids in the phylogeny of 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, CC BY 4.0).

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Cupressales: Sciadopityaceae 1: 1 + extinct taxa

umbrella pine family = Schirmtannengewächse

Sciadopitys 1 verticillata.

Probably **basic type family Sciadopityaceae** (1: 1), at least as for the extant species: well-defined, isolated family with a unique type of “needles”.

Cupressales: Taxaceae (incl. Cephalotaxaceae) 6: 38 + 9 extinct genera

yew family = Eibengewächse

Some authors place Taxaceae in the order Pinales.

Amenotaxus 8, Austrotaxus 1, Cephalotaxus 8, Pseudotaxus 1, Taxus 13, Torreya.

IS: POWO (2026): *Amenotaxus 1 IS, Taxus 2 IS*.

Cycadales 2 families

Cycadales: Cycadaceae 1: 120

Cycas 120.

Probably **basic type family Cycadaceae** (1: 120): monogeneric, distinct. The family is a living fossil and occurred in the Permian in North America and Asia (see <https://paleobiodb.org/navigator/>).

IS: POWO (2026): *Cycas 2 IS*.

Cycadales: Zamiaceae 9: 248 + fossil genera. 1 IG

sago-palm family = Zapfenpalmfarne

AP website 2026: no subdivision.

The former family Stangeriaceae (*Bowenia, Stangeria*) nests within Zamiaceae.

2 subfamilies:

Diooideae 1: 14 *Dioon 14*.

Zamioideae 8: 234

Encephalarteae *Encephalartos 66, Lepidozamia 2, Macrozamia 42*.

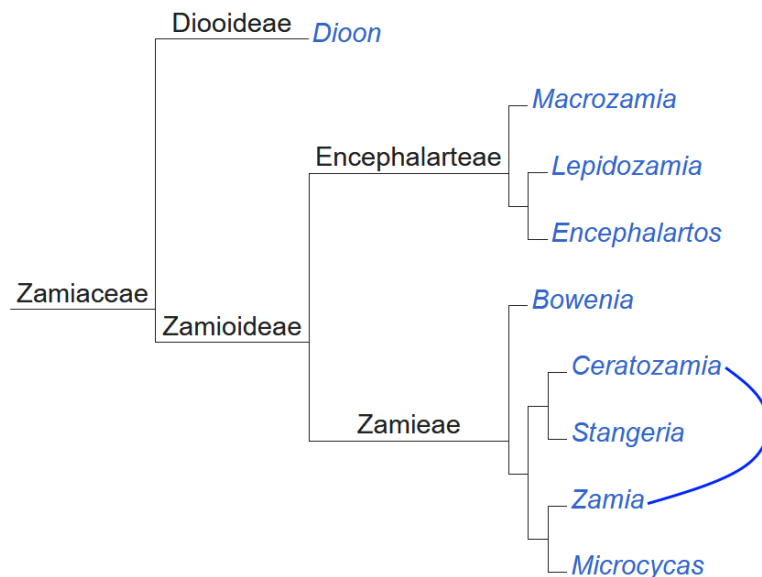
Zamieae *Bowenia 2, Ceratozamia 27, Microcycas 1, Stangeria 1, Zamia 86 (incl. Chigua)*.

IS: POWO (2025): 1 IS *Zamia* (“*Ceratozamia*”) (*loddigesii* × *verschaffeltii* → *katzeriana* nat. hyb. Mexiko)

Ceratozamia mexicana × *Zamia monticola* Zamioideae Zamieae Chamberlain 1926
(p.411: art. hyb.), Papadopoulos 1928, Knobloch 1972

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

Encephalartos villosus × *Zamia pumila* IT Zamioideae Encephalarteae × Zamioideae
intertribal = **unconfirmed** Chamberlain 1926, p.417: “The seeds have not yet
germinated, so that it is doubtful whether any F₁ generation will be obtained”,
Knobloch 1972, Encyclopedia Britannica 2011



Zamiaceae: hybrids in the phylogeny of Coiro et al. 2024, doi.org/10.1038/s42003-024-06024-9), CC BY 4.0, from en.wikipedia 2025.

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<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 or maidenhair family = Ginkogewächse

Ginkgo biloba 1.

Probably **basic type family Ginkgoaceae** (1: 1), as for the extant species: The whole order is very distinct and consists of only one extant species,. 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

joint-fir family = Meerträubelgewächse

Ephedra 71.

POWO 2025: 1 IS.

Gnetales: Gnetaceae 1: 40

gnetum family = Gnetumgewächse

Gnetum 40.

POWO 2025: 0 IS.

Gnetales: Welwitschiaceae 1: 1 + few extinct genera

welwitschia family = Welwitschiagewächse

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

pine family = Kieferngewächse

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.

IS: POWO (2025): *Abies* 7 IS, *Larix* 7 IS, *Picea* 7 IS, *Pinus* 22IS, *Tsuga* 1–2 IS.

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 beevn 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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