

# Washington Flora Checklist

## A checklist of the Vascular Plants of Washington State

### Hosted by the University of Washington Herbarium

#### Family: Salicaceae

44 terminal taxa (species, subspecies, and varieties).

The Washington Flora Checklist aims to be a complete list of the native and naturalized vascular plants of Washington State, with current classifications, nomenclature and synonymy.

#### Taxa included in the checklist:

- Native taxa whether extant, extirpated, or extinct.
- Exotic taxa that are naturalized, escaped from cultivation, or persisting wild.
- Waifs (e.g., ballast plants, escaped crop plants) and other scarcely collected exotics.
- Interspecific hybrids that are frequent or self-maintaining.
- Some unnamed taxa in the process of being described.

Family classifications follow [APG IV](#) for angiosperms, PPG I (J. Syst. Evol. 54:563-603. 2016.) for pteridophytes, and Christenhusz et al. (Phytotaxa 19:55-70. 2011.) for gymnosperms, with a few exceptions. Nomenclature and synonymy at the rank of genus and below follows the [2nd Edition of the Flora of the Pacific Northwest](#) except where superceded by new information.

Accepted names are indicated with **blue type**, synonyms with **gray type**.

Native species and infraspecies are marked with **bold-face type**.

\*Non-native and introduced taxa are preceded by an asterisk.

**Please note:** This is a working checklist, continuously updated. Use it at your discretion.

Created from the Washington Flora Checklist database on August 28th, 2025 at 1:55pm PT.

Available online at <https://burkeherbarium.org/waflora/>

Comments and questions should be addressed to the checklist administrators:

David Giblin ([dgiblin@uw.edu](mailto:dgiblin@uw.edu))

Peter Zika ([zikap941@gmail.com](mailto:zikap941@gmail.com))

#### Suggested citation:

Weinmann, F., P.F. Zika, D.E. Giblin, B. Legler. 2002+. Checklist of the Vascular Plants of Washington State. University of Washington Herbarium. <https://www.burkeherbarium.org/waflora/>. Accessed Aug 28, 2025.

# Dicots:

## Salicaceae [FNA7, HC, HC2] Willow Family

Treatment of Salicaceae here follows Flora of North America, Volume 7.

### *Populus* [FNA7, HC, HC2]

Sp. Pl. 2: 1034. 1753; Gen. Pl. ed. 5, 456. 1754.  
aspen, cottonwood, poplar

#### \**Populus alba* L. [FNA7, HC, HC2]

Sp. Pl. 2: 1034. 1753.  
white poplar

*Populus alba* L. var. *bolleana* Lauche [HC]

*Populus alba* L. var. *pyramidalis* Bunge [HC]

Commonly spreading from cultivation, primarily by root sprouts, on both the east and west sides of the Cascades.

#### \**Populus xcanescens* (Aiton) Sm. [Stace 1997]

gray poplar

recently collected in Thurston Co.

#### \**Populus deltoides* W. Bartr. ex Marshall [FNA7, HC, HC2]

Arbust. Amer. 106. (as *deltoide*). 1785.  
eastern cottonwood

#### \*ssp. *monilifera* (Aiton) Eckenw. [FNA7, HC2]

J. Arnold Arbor. 58: 204. 1977.

*Populus deltoides* Bartr. ex Marshall var. *occidentalis* Rydb. [HC]

#### \**Populus nigra* L. [HC, HC2, Stace 1997]

Sp. Pl. 2: 1034. 1753.  
black cottonwood, lombardy poplar

*Populus dilatata* Aiton

*Populus italica* (Du Roi) Moench

*Populus nigra* L. var. *italica* Du Roi [HC]

#### *Populus tremuloides* Michx. [FNA7, HC, HC2]

Fl. Bor. Amer. 2: 243. 1803.  
quaking aspen

*Populus tremula* L. ssp. *tremuloides* (Michx.) Á. Löve & D. Löve

#### *Populus trichocarpa* Torr. & A. Gray [FNA7, HC, HC2]

Icon. Pl. 9: plate 878. 1852.  
black cottonwood

*Populus balsamifera* L. [FNA7, HC2], misapplied

*Populus balsamifera* L. ssp. *trichocarpa* (Torr. & A. Gray) Brayshaw [JPM, KZ99]

*Populus balsamifera* L. var. *californica* S. Watson

*Populus trichocarpa* Torr. & A. Gray ex Hook. var. *cupulata* S. Watson

*Populus trichocarpa* Torr. & A. Gray var. *ingrata* (Jeps.) Parish

FNA7: "In addition to hybridizing with other North American species of sect. *Tacamahaca*, *Populus trichocarpa* also hybridizes with both native species of sect. *Aigeiros*. *Populus xgenerosa* A. Henry (synonym *P. xinteramericana* van Broekhuizen), a hybrid between *P. trichocarpa* and *P. deltoides*, is rare in the far western area of the range for *P. deltoides* subsp. *monilifera*, where it overlaps with the more drought-tolerant inland *P. trichocarpa* (Idaho, Montana, Washington, and Wyoming) (J. E. Eckenwalder 1984). This hybrid has also been grown artificially, and such hybrids between coastal *P. trichocarpa* and *P.*

deltoides subsp. deltoides are becoming increasingly important plantation trees in the Pacific Northwest from northern Oregon to British Columbia, as well as in Europe. They are perhaps the fastest growing of all poplars in volume, with the rapid height growth of *P. trichocarpa* added to the steady diameter growth of *P. deltoides* (R. F. Stettler et al. 1988)."

**Salix** [FNA7, HC, HC2]

Sp. Pl. 2: 1015. 1753; Gen. Pl. ed. 5, 447. 1754.

[name conserved]

willow

**Salix amygdaloides** Andersson [FNA7, HC, HC2]

Öfvers. Kongl. Vetensk.-Akad. Förh. 15: 114. 1858.

peach-leaf willow

**Salix arctica** Pall. [FNA7, HC, HC2]

Fl. Ross. 1(2): 86. 1788.

arctic willow

*Salix arctica* R. Br. ex Richardson, homonym (illegitimate)

*Salix arctica* Pall. ssp. *tortulosa* (Trautv.) Hultén

*Salix arctica* Pall. var. *araioclada* (C.K. Schneid.) Raup

*Salix arctica* Pall. var. *kophophylla* (C.K. Schneid.) Polunin

*Salix arctica* Pall. var. *tortulosa* (Trautv.) Raup

FNA7: "*Salix arctica* is polymorphic and nomenclaturally confusing. E. Hultén (1967, 1971) recognized three subspecies: 1) subsp. *arctica* (circumpolar from Iceland and the Faeroe Islands across northern Russia, Alaska and Canada to Greenland, south to the Hudson Bay shores of Ontario and the Gaspé Peninsula); 2) subsp. *crassijulis* (a North Pacific race ranging from Kamchatka and the Russian Far East to the Aleutian Islands, south central and southeastern Alaska along the coast to northern Washington); and 3) subsp. *torulosa* (ranging from the mountains of central Asia to Kamchatka and the Bering Straits, the Brooks Range and the Rocky Mountains in Alaska, south in the cordillera to southern British Columbia and Alberta). While formal recognition of the three races is appealing, they are actually very difficult or impossible to separate morphologically and have strongly overlapping ranges. Some of the variability may be due to environmental modification (D. B. O. Savile 1964; G. W. Argus 1973; J. H. Soper and J. M. Powell 1985). On Attu Island, Alaska, there are plants to 2 m along with dwarf plants (C. Parker, pers. comm.). Their tall stature cannot be accounted for by habitat alone. The possibility that the complex morphological variability within *S. arctica* may be ecophenic or ecotypic deserves study."

**Salix barclayi** Andersson [FNA7, HC, HC2]

Öfvers. Kongl. Vetensk.-Akad. Förh. 15: 125. 1858.

barclay's willow

*Salix barclayi* Andersson var. *angustifolia* (Andersson) Andersson ex C.K. Schneid.

*Salix barclayi* Andersson var. *conjuncta* (Bebb) C.R. Ball ex C.K. Schneid.

*Salix pyrolifolia* Anderss. var. *hoyeriana* (Dieck) Dippel

**Salix bebbiana** Sarg. [FNA7, HC, HC2]

Gard. & Forest. 8: 463. 1895.

Bebb's willow, gray willow, long-beak willow

*Salix bebbiana* Sarg. var. *bebbiana* [HC]

*Salix bebbiana* Sarg. var. *capreifolia* (Fernald) Fernald

*Salix bebbiana* Sarg. var. *depilis* Raup

*Salix bebbiana* Sarg. var. *luxurians* (Fernald) Fernald

*Salix bebbiana* Sarg. var. *perrostrata* (Rydb.) C.K. Schneid. [HC]

*Salix bebbiana* Sarg. var. *projecta* (Fernald) C.K. Schneid.

**Salix boothii** Dorn [FNA7, HC2]

Canad. J. Bot. 53: 1505. 1975.

Booth's willow

*Salix myrtillofolia* Andersson [FNA7, HC, HC2], misapplied

*Salix pseudocordata* (Andersson) Rydb., misapplied

*Salix pseudomyrsinites* Andersson [FNA7], misapplied

FNA7: "Salix boothii forms natural hybrids with *S. brachycarpa* var. *brachycarpa*, *S. eastwoodiae*, *S. glauca* var. *villosa*, and *S. wolfii*. There are numerous intermediate specimens of *S. boothii* that suggest hybridization with *S. arizonica*, *S. brachycarpa*, *S. eastwoodiae*, *S. lutea*, or *S. wolfii*, but further study is needed. A DNA study of *S. arizonica* showed that a specimen from southwestern Utah previously identified as *S. arizonica* × *S. wolfii* probably was *S. boothii* × *S. wolfii* (J. T. Thompson et al. 2003). In Mountain Park, Alberta, and the Steens Mountains, Oregon, the putative hybrid *Salix boothii* × *S. glauca* var. *villosa* grew in thickets with both parents. Ovaries were sparsely hairy on the distal half or on the beak, leaves were glaucous abaxially, and floral bracts were mostly glabrous abaxially, but some with hairs proximally. One plant in fruit produced copious seed hairs but no seed."

***Salix brachycarpa* Nutt. [FNA7, HC, HC2, IFBC]**

N. Amer. Sylv. 1: 69. 1842.  
short-fruited willow

**var. *brachycarpa* [FNA7, HC2]**

N. Amer. Sylv. 1: 69. 1842.  
short-fruited willow

*Salix brachycarpa* Nutt. var. *alticola* E.H. Kelso

*Salix brachycarpa* Nutt. var. *antimima* (C.K. Schneid.) Raup

*Salix brachycarpa* Nutt. var. *glabellcarpa* C.K. Schneid.

*Salix brachycarpa* Nutt. var. *sansevierii* C.R. Ball

*Salix chlorolepis* Fernald var. *antimima* C.K. Schneid.

*Salix desertorum* Richardson var. *fruticulosa* Andersson

*Salix desertorum* Richardson var. *stricta* Andersson

FNA7: "Variety *brachycarpa* forms natural hybrids with *Salix arizonica*, *S. barclayi*, *S. boothii*, *S. candida*, *S. chlorolepis*, *S. glauca* var. *villosa*, and *S. planifolia*. Placement of specimens from Anticosti Island, Quebec, and North Point, James Bay, Ontario, with densely villous branchlets and relatively short petioles, thought to be hybrids with *Salix glauca* var. *cordifolia*, is dubious. Variety *brachycarpa* × *Salix candida* (*S. xargusii* B. Boivin) is infrequent in Manitoba, Quebec, and Saskatchewan. Variety *brachycarpa* × *Salix chlorolepis* (*S. xgaspeensis* C. K. Schneider) resembles var. *brachycarpa* but has leaves only slightly pilose and ovaries with hairs only on the beaks (G. W. Argus 1965). Variety *brachycarpa* × *Salix glauca* var. *villosa* (*S. xwyomingensis* Rydberg) is a frequent hybrid in southern Rocky Mountains. It is characterized by stipes 0.3 mm or longer, long-cylindrical catkins, ovaries with relatively long beaks, petioles more than three times the length of buds, and leaves sparsely hairy. The extent and nature of this hybridization needs to be studied (G. W. Argus 1965). Variety *brachycarpa* × *Salix planifolia* "var. *monica*" occurs in Steens Mountains, Oregon."

***Salix candida* Flügge ex Willd. [FNA7, HC, HC2]**

Sp. Pl. 4: 708. 1806.  
sage willow, sage-leaf willow

*Salix candida* Flügge ex Willd. var. *denudata* Andersson

*Salix candida* Flügge ex Willd. var. *tomentosa* Andersson

*Salix candidula* Nieuwl.

FNA7: "Salix candida is geographically wide-ranging but limited to calcareous habitats and, for that reason, it is quite local or even rare in some parts of its range."

***Salix cascadiensis* Cockerell [FNA7, HC, HC2]**

Muhlenbergia. 3: 9. 1907.  
Cascade willow

*Salix brownii* (Anderss.) Bebb var. *tenera* (Andersson) M.E. Jones

*Salix cascadiensis* Cockerell var. *thompsonii* Brayshaw

*Salix tenera* Andersson

FNA7: "The morphological variability of *Salix cascadiensis* is not well understood. Typically, it has leaves that are narrow, sharply pointed, and glaucous abaxially, catkins 15-43-flowered, dark brown floral bracts, and ovaries very densely hairy. Specimens with leaves not glaucous abaxially, catkins relatively few-flowered, and ovaries either sparsely hairy throughout, hairy only on beaks, or hairy in streaks, may be hybrids but the glabrous ovaried *S. cascadiensis* var. *thompsonii* shows no obvious signs of hybridization. Hybrids: *Salix cascadiensis* is suspected to hybridize with *S. barclayi*. *Salix cascadiensis* × *S. rotundifolia*

var. *dodgeana* resembles the former in its narrow, acute to acuminate leaves and the latter in leaves not glaucous abaxially, tawny floral bracts, relatively short catkins, and glabrous ovaries. The catkins are intermediate in being 6-7-flowered."

***Salix commutata* Bebb [FNA7, HC, HC2]**

Bot. Gaz. 13: 110. 1888.

variable willow

*Salix barclayi* Andersson var. *commutata* (Bebb) Kelso

*Salix commutata* Bebb var. *denudata* Bebb

*Salix commutata* Bebb var. *puberula* Bebb

FNA7: "Salix *commutata* forms natural hybrids with *S. barclayi*, *S. barrattiana*, and *S. eastwoodiae*."

***Salix drummondiana* Barratt ex Hook. [FNA7, HC, HC2]**

Fl. Bor.-Amer. 2: 144. 1838.

Drummond's willow

*Salix drummondiana* Barratt ex Hook. ssp. *subcaerulea* (Piper) A.E. Murray, orthographic variant

*Salix drummondiana* Barratt ex Hook. var. *bella* (Piper) C.R. Ball

*Salix drummondiana* Barratt ex Hook. var. *subcaerulea* (Piper) C.R. Ball, orthographic variant

*Salix subcaerulea* Piper, orthographic variant

FNA7: "Salix *drummondiana* is distinguished from the similar, but unrelated, *S. sitchensis* by having branches often strongly glaucous, branchlets sparsely hairy, largest medial blades lorate, narrowly elliptic, elliptic, or oblanceolate, usually narrower, 3-6.2 times as long as wide, margins slightly revolute, and surfaces with white hairs, sometimes also ferruginous; *S. sitchensis* has branches not glaucous or weakly so, branchlets usually moderately to very densely hairy, largest medial blades elliptic, narrowly oblanceolate, oblanceolate, or obovate, usually slightly broader, 2.1-3.1-4 times as long as wide, margins strongly revolute, and surfaces with white hairs. Vegetative specimens of *Salix drummondiana* are distinguished from *S. geieriana* by having largest medial blade margins revolute, surfaces usually densely short-silky adaxially, and midribs glabrous; *S. geieriana* has largest medial blade margins flat, surfaces usually moderately densely long-silky adaxially, and midribs silky or glabrous. *Salix drummondiana* and *S. lemmonii* can be separated on the basis of variable characters including: branch glaucousness, leaf size, blade hair density and color, catkin size and shape, anther length, petiole length, and chromosome number. Hybridization is rare but may occur in Lassen and Sierra counties, California."

***Salix eastwoodiae* Cockerell ex A. Heller [FNA7, HC2]**

Cat. N. Amer. Pl. ed. 3. 89. 1910. (as *fastwoodiae*). 1910.

Sierran willow

*Salix californica* Bebb

Not in H&C; apparently a portion of the *S. commutata* plants from WA should be *C. eastwoodiae*. FNA7: "Salix *eastwoodiae* and *S. commutata* are distinct species with different ploidal levels, the former tetraploid and the latter diploid; where they come into contact in the Pacific Northwest, hybrids occur and vegetative plants are often difficult to separate. See comparison below. The most important difference is that ovaries of *S. eastwoodiae* usually are silky turning glabrescent in age and those of *S. commutata* are glabrous. Populations occur in Oregon with both glabrous and hairy ovaries without any other evident differences. There are also unusual specimens, which are often tentatively identified as *S. eastwoodiae*, that have glabrous ovaries and patches of hairs at the base and on the sutures. The possibility that they are hybrids between *S. eastwoodiae* and *S. boothii*, *S. commutata*, or *S. lemmonii* needs study. *Salix commutata* is distinguished from *S. eastwoodiae* by having leaf blades sometimes amphistomatous, 1.5-3.4 times as long as wide, teeth 0-19 per cm, adaxial surfaces glabrous or pilose to villous, floral bracts tawny to brown, staminate and pistillate adaxial nectaries oblong to square, and ovaries glabrous; *S. eastwoodiae* has leaf blades hypostomatous, 1.8-5 times as long as wide, teeth 0-10 per cm, adaxial surfaces tomentose or long-silky, floral bracts brown to black, staminate and pistillate adaxial nectaries narrowly oblong to oblong, and ovaries silky to glabrescent. Hybrids: *Salix eastwoodiae* forms natural hybrids with *S. arizonica*, *S. boothii*, and *S. commutata*. *Salix eastwoodiae* x *S. lasiandra* was found in Sierra County, California, growing with both parents in a wetland along a disturbed roadside. It had leaf indumentum and hair color of *S. eastwoodiae* and leaf shape and margins of *S. lasiandra*. Catkins of this intersubgeneric hybrid were teratological and presumably infertile."

***Salix exigua* Nutt. [FNA7, HC, HC2]**

N. Amer. Sylv. 1: 75. 1842.  
coyote willow, narrow-leaf willow  
(see also *Salix melanopsis*)

**var. *columbiana* Dorn [HC2]**

Brittonia 50: 204. 1998.  
Columbia River willow

*Salix columbiana* (Dorn) Argus [FNA7]  
*Salix fluviatilis* Nutt. [HC], rejected name

FNA7: "Salix fluviatilis Nuttall, long used for a Columbia River endemic (*S. columbiana*), is a rejected name. *Salix columbiana* forms natural hybrids with *S. exigua* var. *exigua* and *S. sessilifolia*. Both hybrids are reported from Oregon and Washington (R. D. Dorn 1998)."

**var. *exigua* [FNA7, HC, HC2]**

N. Amer. Sylv. 1: 75. 1842.  
coyote willow, narrow-leaf willow

*Salix argophylla* Nutt.  
*Salix exigua* Nutt. ssp. *exigua* [HC]  
*Salix exigua* Nutt. var. *luteosericea* (Rydb.) C.K. Schneid.  
*Salix exigua* Nutt. var. *nevadensis* (S. Watson) C.K. Schneid.  
*Salix exigua* Nutt. var. *stenophylla* (Rydb.) C.K. Schneid. [HC]  
*Salix exigua* Nutt. var. *virens* Rowlee  
*Salix fluviatilis* Nutt. var. *argophylla* (Nutt.) Sarg.  
*Salix interior* Rowlee var. *luteosericea* (Rydb.) C.K. Schneid.  
*Salix longifolia* Muhl. var. *argophylla* (Nutt.) Andersson  
*Salix longifolia* Lam. var. *exigua* (Nutt.) Bebb  
*Salix longifolia* Muhl. var. *opaca* Andersson  
*Salix luteosericea* Rydb.  
*Salix malacophylla* Nutt. ex C.R. Ball  
*Salix nevadensis* S. Watson  
*Salix stenophylla* Rydb.

FNA7: "Variety *exigua* forms natural hybrids with var. *hindsiana*, *Salix columbiana*, *S. interior*, and *S. melanopsis*. Variety *exigua* × var. *hindsiana* was reported by R. D. Dorn (1998). Inasmuch as the two varieties are subtly distinct, hybrids are difficult to recognize. Variety *exigua* × *Salix interior* probably occurs throughout their area of overlap; it is known to me from Alberta and Nebraska, where there are plants with leaves indistinctly toothed and more silky than in *S. interior*. R. D. Dorn (1998) reported it from Alberta, British Columbia, Colorado, Montana, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. Variety *exigua* × *Salix melanopsis* is intermediate, with juvenile leaves densely hairy proximally, truncate floral bracts, and prominent stipules (R. D. Dorn 1998)."

***Salix farriarum* C.R. Ball [FNA7, HC, HC2]**

Contr. U.S. Natl. Herb. 22: 321 (as *farrae*). 1921.  
Farr's willow

*Salix farriarum* C.R. Ball var. *microserrulata* C.R. Ball  
*Salix hastata* L. var. *farriarum* (C.R. Ball) Hultén

Not reported for WA by FNA. However, one specimen from Okanogan County annotated as *S. farriarum* by George Argus in 2005. FNA7: "*Salix farriarum* is a cordilleran species ranging from Wyoming to central British Columbia with disjunct occurrences in northwestern British Columbia, western Northwest Territories, and southern Yukon. It is related to *S. hastata*, an amphiberian species ranging from Scandinavia to southwestern Yukon and northwestern Northwest Territories. There may be reasons for treating these slightly different plants as *S. hastata* var. *farriarum*, but R. D. Dorn (1975) maintained them as a species based on flavonoid differences. In a phenetic study (G. W. Argus 2007), the two taxa had dissimilarity values at the same level as other closely related species. They are treated here as species, primarily because their ranges are disjunct. They can be separated as follows: *Salix farriarum* is distinguished from *S. hastata* by having largest medial blades narrowly elliptic to elliptic, pistillate nectaries oblong or ovate, stipules on early leaves absent or rudimentary (sometimes foliaceous), branches strongly to weakly glaucous or not, floral bract apices rounded, and plants of the cordillera in Alberta and British Columbia, in



Idaho, Montana, Oregon, and Wyoming; *S. hastata* has largest medial blades narrowly elliptic to broadly elliptic or broadly obovate, pistillate nectaries square, stipules on early leaves foliaceous (sometimes rudimentary), branches not glaucous, floral bract apices acute or rounded, and plants of Alaska, Northwest Territories, and Yukon. *Salix farriarum* and *S. barclayi* are sympatric in western Canada and the Pacific Northwest, where they are difficult to separate. *Salix farriarum* can often be recognized by its largest medial leaves with at least some minute, ferruginous hairs on the adaxial midrib or blade surfaces; ferruginous hairs do not occur in *S. barclayi*. Its leaf margins also tend to be more nearly entire, but relatively short teeth are not infrequent. Such plants are sometimes interpreted as intergrades between *S. farriarum* and *S. barclayi* (R. D. Dorn 1975). The variable leaf toothiness also occurs in *S. hastata* and may not be a reliable indicator of intergradation. *Salix farriarum* also differs from *S. barclayi* in usually having shorter anthers, 0.3-0.6 mm versus 0.6-1 mm in *S. barclayi*. See 61. *S. barclayi*."

\**Salix fragilis* L. [FNA7, HC2]

Sp. Pl. 2: 1017. 1753.

crack willow

FNA7: "*Salix xfragilis* Linnaeus: The hybrid white willow, *S. alba* Linnaeus x *S. euxina* L. Belyaeva, a European introduction, is the most commonly cultivated and naturalized tree-willow in the flora area. It is characterized by: trees, 3-20 m, stems erect or drooping; branches highly brittle at base; petioles with spherical or foliaceous glands distally, pilose or villous adaxially; largest medial leaf blade amphistomatous, very narrowly elliptic or narrowly elliptic, margins uniformly serrate or serrulate, abaxial surface glaucous, both surfaces sparsely long-silky to glabrescent, adaxial surface slightly glossy or dull; juvenile leaves at first densely long-silky soon glabrous; pistillate bract deciduous after flowering; stamens 2; anthers yellow; pistillate adaxial nectary shorter than or equal to stipe; stipe 0.3-0.5 mm; ovary pyriform, glabrous; ovules 6-12 per ovary; styles 0.4-1 mm; capsules 4.5-6 mm;  $2n = 57, 76$ . Flowering is in late May-early June. Individual trees can persist for years by trunk suckering and spread vegetatively by shoot fragmentation along stream margins, shingle and sand beaches, sedge meadows, hardwood forests, and sand pits. It occurs from 0 to 2500 m."

*Salix geyeriana* Andersson [FNA7, HC, HC2]

Öfvers. Kongl. Vetensk.-Akad. Förh. 15: 122. 1858.

Geyer's willow

*Salix geyeriana* Andersson ssp. *argentea* (Bebb) A.E. Murray

*Salix geyeriana* Andersson var. *argentea* (Bebb) C.K. Schneid.

*Salix geyeriana* Andersson var. *geyeriana* [HC]

*Salix geyeriana* Andersson var. *meleiana* J.K. Henry [HC], orthographic variant

*Salix geyeriana* Andersson var. *meleina* J.K. Henry

*Salix meleina* (J.K. Henry) G.N. Jones

FNA7: "*Salix geyeriana* is characterized by its dark gray appearance, slender, dark branches, narrow leaves long-silky on both surfaces, general absence of stipules, and small, subglobose catkins. Plants in the Pacific Northwest with foliaceous stipules may be hybrids or introgressants, but the other parent is unknown. Hybrids: *Salix geyeriana* forms natural hybrids with *S. bebbiana*, *S. irrorata*, *S. lemmonii*, *S. ligulifolia*, and *S. pedicellaris*. Alleged hybrids with *S. sitchensis*, based on plants from British Columbia with broader, more hairy leaves, and catkins longer than in *S. geyeriana*, but with the short stipes of *S. sitchensis* (J. K. Henry 1915), are unconvincing. *Salix geyeriana* x *S. lemmonii* is uncommon but in mixed stands of the parental species some plants resemble *S. geyeriana* in having relatively short, subspherical catkins, small anthers, and petioles sometimes with petiolar glands; and *S. lemmonii* in having leaf blades amphistomatous, margins serrulate, and foliaceous stipules on early leaves. Because the species have different chromosome numbers, hybrids may be infertile, but occasional seeds have been seen. This hybrid is known from California (Lassen and Sierra counties), Oregon (Jefferson and Lane counties), and near Victoria, British Columbia. *Salix geyeriana* x *S. pedicellaris* occurs in Washington. It has the white and ferruginous hairs on leaves and ovaries of *S. geyeriana*, and leaves glaucous adaxially with prominent 2 and 3 veins of *S. pedicellaris*."

*Salix glauca* L. [FNA7, HC, HC2]

Sp. Pl. 2: 1019. 1753.

gray willow

var. *villosa* Andersson [FNA7, HC2]

Proc. Amer. Acad. Arts. 4: 68. 1858.

glaucous willow, gray willow

*Salix glauca* L. ssp. *glabrescens* (Andersson) Hultén

*Salix glauca* L. var. *glabrescens* (Andersson) C.K. Schneid.

*Salix pseudolapponum* Seemen

*Salix villosa* D. Don ex Hook.

*Salix wolfii* Bebb var. *pseudolapponum* (Seemen) M.E. Jones

FNA7 by George Argus includes WA in the distribution of this taxon, however no specimens from WA are held in any PNW herbaria. The more conservative approach to this issue is including this on the checklist of WA vascular plants with the assumption that George Argus did see a specimen as part of preparing the FNA *Salix* treatment.

***Salix hookeriana* Barratt ex Hook. [FNA7, HC, HC2]**

Fl. Bor.-Amer. 2: 145, plate 180. 1838.

coastal willow

*Salix amplifolia* Coville

*Salix hookeriana* Barratt ex Hook. var. *laurifolia* J.K. Henry

*Salix hookeriana* Barratt ex Hook. var. *tomentosa* J.K. Henry ex C.K. Schneid.

*Salix piperi* Bebb [HC]

*S. piperi* Bebb is treated as separate species in H&C.GA recognizes the glabrous-capsuled form common in the Puget Sound region which is called *S. piperi*; however, he chooses to treat it as synonymous with *S. hookeriana*. FNA7: "*Salix hookeriana* is primarily a coastal species occurring from northern California northward to Oregon, Washington, and southern Vancouver Island, with disjunct populations on Queen Charlotte Islands, British Columbia, and northward to Yakutat Bay, Turnagain Arm, and Kodiak, Alaska. It was treated by G. W. Argus (1973) and R. D. Dorn (2000) in a broad sense because of an absence of strong distinguishing characters and intergradation in characters that could be used to divide it. It is highly variable and three very similar taxa have been named: *S. amplifolia*, *S. hookeriana* (including vars. *tomentosa* and *laurifolia*), and *S. piperi*. Although extremes of these taxa sometimes are recognizable, the intergradation displayed is so great that even attempts to recognize them as varieties are thwarted. The *amplifolia* variant in Alaska is characterized by having only white leaf hairs, hairy ovaries, no stipules, and catkins often borne on distinct flowering branchlets, but variation can occur within the same population, and typical *S. hookeriana* on Vancouver Island sometimes displays the same characteristics. The *piperi* variant, an inland population in western Oregon and Washington, is usually recognized by local botanists as different from coastal populations. It is characterized by leaves and branchlets soon becoming glabrate and stipules prominent. These characteristics, however, sometimes appear in northern California coastal populations, and some inland populations in Oregon include very hairy individuals that are indistinguishable from coastal variants of *S. hookeriana*. In general, very hairy populations of *S. hookeriana* are probably an adaptation to marine coastal environments, but some variation may be due to hybridization and introgression with *S. scouleriana*. Inland populations suggest the influence of *S. lasiolepis*. Two hexaploid chromosome numbers reported for *S. hookeriana* from Vancouver Island (R. L. Taylor and S. Taylor 1977) and Queen Charlotte Islands (R. L. Taylor and G. A. Mulligan 1968), British Columbia, indicate that hybridization has played a role in the evolution of this complex. It is possible that each variant of *S. hookeriana* has had a different, possibly even recurrent, polyploid origin. Further cytological and genetic study is indicated. The following comparisons may help to distinguish *Salix hookeriana*, *S. lasiolepis*, and *S. scouleriana*. Vegetative specimens of *Salix hookeriana* can be distinguished from *S. lasiolepis* by having floral buds ellipsoid, beaks distinctly long-tapered, densely long-hairy (villous), red-brown, blades usually pilose, villous, or woolly on abaxial surfaces, usually 18-63 mm wide, and 1.5-4.2 times as long as wide; *S. lasiolepis* has floral buds ovoid, beaks inconspicuous and blunt, sparsely to moderately densely short-hairy (velvety), yellowish to red-brown, blades usually tomentose on abaxial surfaces, usually 6-32 mm wide, and 3.2-9.6 times as long as wide. *Salix hookeriana* is distinguished from *S. scouleriana* by having branchlets with spreading hairs (woolly or tomentose to glabrate), petioles usually pilose to tomentose, blades typically narrowly elliptic but variable, stigmas 0.3-0.74, short in relation to styles (0.6-2.3 mm), and pistillate nectaries 0.5-1.4 mm, shorter or longer than stipes; *S. scouleriana* has branchlets usually with short, erect hairs (velutinous), sometimes spreading (villous or tomentose), petioles velvety or villous adaxially, blades typically oblanceolate but variable, stigmas 0.4-1.04 mm, long in relation to styles (0.2-0.6 mm), and pistillate nectaries 0.2-0.8 mm, shorter than stipes. Hybrids: *Salix hookeriana* forms natural hybrids with *S. barclayi* and *S. scouleriana*. Variation in some *S. hookeriana* populations suggests hybridization with *S. lasiolepis* but no positive identifications have been made. R. D. Dorn (2000)



doubted that hybridization in California between these species with different chromosome numbers was possible, but species with different chromosome numbers do hybridize [for example, *S. athabascensis* (4x) × *S. pedicellaris* (2x)]; synthetic hybridization studies are indicated. *Salix hookeriana* × *S. scouleriana*: Plants from southern British Columbia with leaves similar to *S. hookeriana* but with prominent stipules, catkins both erect and recurving, and relatively long stigmas were thought by J. K. Henry (1915) to be this hybrid."

***Salix lasiandra* Benth. [FNA7, HC, HC2]**

Pl. Hartw. 335. 1857.

Pacific willow

**var. *caudata* (Nutt.) Sudw. [FNA7, HC, HC2]**

Bull. Torrey Bot. Club. 20: 43. 1893.

gland willow, Pacific willow, shining willow

*Salix lasiandra* Benth. ssp. *caudata* (Nutt.) A.E. Murray

*Salix lasiandra* Benth. var. *fendleriana* (Andersson) Bebb

*Salix lucida* Muhl. ssp. *caudata* (Nutt.) A.E. Murray

**var. *lasiandra* [FNA7, HC, HC2]**

Pl. Hartw. 335. 1857.

Pacific willow

*Salix lasiandra* Benth. var. *abramsii* C.R. Ball

*Salix lasiandra* Benth. var. *lancifolia* (Andersson) Bebb

*Salix lasiandra* Benth. var. *lyallii* Sarg.

*Salix lasiandra* Benth. var. *macrophylla* (Andersson) Little

*Salix lasiandra* Benth. var. *recomponens* Raup

*Salix lucida* Muhl. ssp. *lasiandra* (Benth.) A.E. Murray

***Salix lasiolepis* Benth. [FNA7, HC, HC2]**

Pl. Hartw. 335. 1857.

arroyo willow

*Salix lasiolepis* Benth. var. *bracelinae* C.R. Ball

*Salix lasiolepis* Benth. var. *falax* Bebb

*Salix lasiolepis* Benth. var. *lasiolepis*

*Salix lasiolepis* Benth. var. *sandbergii* (Rydb.) C.R. Ball

*Salix lutea* Nutt. var. *nivaria* Jeps.

FNA7: "*Salix lasiolepis* is polymorphic. Variety *bigelovii* has been recognized in coastal California and Oregon (G. W. Argus 1993). It differs mainly in density of leaf indumentum and in having leaves tending to be slightly broader; it may be a coastal ecotype and is not formally recognized here."

***Salix maccalliana* Rowlee [FNA7, HC2]**

Bull. Torrey Bot. Club. 34: 158. 1907.

Maccalla's willow

FNA7: "The decaploid to dodecaploid chromosome number for *Salix maccalliana*, highest in the genus, suggests a complex origin. Relationships with subg. *Chamaetia* and subg. *Salix* were suggested by Rowlee and by H. M. Raup (1959). Staminate flowers with abaxial nectaries, tawny and persistent bracts, and villous ovaries suggest a link with *S. glauca*; leaves with coarse, ferruginous hairs and serrate margins suggest *S. lucida* (Rowlee). Although *S. maccalliana* is phenetically closer to sect. *Salicaster* than to (subg. *Chamaetia*) sect. *Glaucæ* (G. W. Argus 1997), it is probable that because it incorporates genomes from more than one subgenus, its subgeneric placement is arbitrary."

**\**Salix matsudana* Koidz. [HC2]**

Bot. Mag. (Tokyo) 29: 312. 1915.

corkscrew willow

***Salix melanopsis* Nutt. [FNA7, HC2]**

N. Amer. Sylv. 1: 78, plate 21. 1842.

dusky willow

*Salix bolanderiana* Rowlee

*Salix exigua* Nutt. ssp. *melanopsis* (Nutt.) Cronquist [HC]

*Salix exigua* Nutt. var. *gracilipes* (C.R. Ball) Cronquist  
*Salix exigua* Nutt. var. *tenerrima* (L.F. Hend.) C.K. Schneid.  
*Salix parksiana* C.R. Ball  
*Salix sessilifolia* Nutt. var. *vancouverensis* Brayshaw  
*Salix tenerrima* (L.F. Hend.) A. Heller

FNA7: "Salix melanopsis forms natural hybrids with *S. exigua* var. *exigua*, *S. sessilifolia*, and *S. sitchensis* (R. D. Dorn 1998)."

***Salix monochroma* C.R. Ball [FNA7, HC2]**

Bot. Gaz. 71: 431, fig. 1. 1921.  
one-color willow

*Salix eriocephala* Michx. var. *monochroma* (C.R. Ball) Dorn

***Salix nivalis* Hook. [FNA7, HC, HC2]**

Fl. Bor.-Amer. 2: 152. 1838.  
dwarf snow willow

*Salix nivalis* Hook. var. *nivalis* [HC]  
*Salix nivalis* Hook. var. *saximontana* (Rydb.) C.K. Schneid. [HC]  
*Salix reticulata* L. ssp. *nivalis* (Hook.) Å. Löve, D. Löve & B.M. Kapoor  
*Salix reticulata* L. var. *nana* Andersson  
*Salix reticulata* L. var. *nivalis* (Hook.) Andersson  
*Salix reticulata* L. var. *saximontana* (Rydb.) Kelso

FNA7: "Because geographic overlap is small and evidence of intergradation is tenuous, *Salix nivalis* is best treated as a species separate from *S. reticulata*; *S. nivalis* was previously treated as a subspecies of *S. reticulata* (G. W. Argus 1986b, 1991)."

***Salix pedicellaris* Pursh [FNA7, HC, HC2]**

Fl. Amer. Sept. 2: 611. 1813.  
bog willow

*Salix myrtilloides* L. var. *hypoglauca* (Fernald) C.R. Ball  
*Salix myrtilloides* L. var. *pedicellaris* (Pursh) Andersson  
*Salix pedicellaris* Pursh var. *hypoglauca* Fernald  
*Salix pedicellaris* Pursh var. *tenuescens* Fernald

FNA7: "*Salix pedicellaris* is very distinct with decumbent habit, leathery, glabrous leaves that are glaucous on both surfaces, loosely flowered catkins, ovaries reddish, glabrous and often glaucous, and stipes 2.1-3.2 mm. In the flora area, it hybridizes with six other species (see below). This compares with the closely related European *S. myrtilloides* Linnaeus, which is reported (B. Jonsell and T. Karlsson 2000+, vol. 1) to hybridize with seven species. The distinctive appearance may make hybrids easily recognizable but it is complex cytologically."

***Salix petrophila* Rydb. [FNA7, HC2]**

Bull. New York Bot. Gard. 1: 268. 1899.  
alpine willow

*Salix arctica* Pall. ssp. *petraea* (Andersson) Å. Löve, D. Löve & B.M. Kapoor  
*Salix arctica* Pall. var. *caespitosa* (P.B. Kenn.) Kelso  
*Salix arctica* Pall. var. *graminifolia* (E.H. Kelso) Kelso  
*Salix arctica* Pall. var. *petraea* Andersson [HC]  
*Salix arctica* Pall. var. *petrophila* (Rydb.) Kelso  
*Salix brownei* (Andersson) Bebb var. *petraea* (Andersson) Bebb  
*Salix caespitosa* P.B. Kenn.  
*Salix petrophila* Rydb. var. *caespitosa* (Kenn.) C.K. Schneid.

FNA7: "*Salix petrophila* is often included in *S. arctica* (G. W. Argus 1993), but southern cordilleran populations, extending as far north as southern British Columbia and Alberta, seem to be a distinct taxon (Argus 1997). The exact northern limit of this species still needs to be established, but in Alberta it does not seem to extend north of Waterton Lakes National Park, except for a population on springy slopes above Agness Lake, Banff National Park. Suitable alpine habitats between Waterton Lakes and Banff national parks, e.g., Mt. Armstrong, Tornado Mountain, and Crowsnest Pass, should be explored for *S. arctica* and

*S. petrophila*."

***Salix planifolia* Pursh [FNA7, HC2]**

Fl. Amer. Sept. 2: 611. 1813.

plane-leaf willow, tea-leaved willow

*Salix phylicifolia* L. [HC]

*Salix planifolia* Pursh var. *nelsonii* (C.R. Ball) C.R. Ball ex E.C. Sm.

FNA7: "*Salix planifolia* forms natural hybrids with *S. alaxensis* var. *alaxensis*, *S. argyrocarpa*, *S. brachycarpa* var. *brachycarpa*, *S. candida*, *S. drummondiana*, *S. humilis*, *S. pellita*, *S. pulchra*, and *S. scouleriana*. Hybrids with *S. glauca* var. *cordifolia* have been reported (C. K. Schneider 1921) but no convincing specimens have been seen."

**var. *planifolia* [HC2]**

diamondleaf willow

*Salix phylicifolia* L. ssp. *planifolia* (Pursh) Hiitonen

*Salix phylicifolia* L. var. *pennata* (C.R. Ball) Cronquist [HC]

*Salix phylicifolia* L. var. *planifolia* [HC]

*Salix planifolia* Pursh var. *pennata* (C.R. Ball) C.R. Ball ex Dutilly, Lepage & Duman

***Salix prolixa* Andersson [FNA7, HC2]**

Monogr. Salicum. 94, plate 5, fig. 52. 1867.

Mackenzie's willow

*Salix cordata* Muhl. var. *mackenzieana* Hook.

*Salix eriocephala* Michx. ssp. *mackenzieana* (Hook.) Dorn

*Salix eriocephala* Michx. var. *mackenzieana* (Hook.) Dorn

*Salix mackenzieana* (Hook.) Barratt ex Andersson

*Salix mackenzieana* (Hook.) Barratt ex Andersson var. *macrogemma* C.R. Ball

*Salix rigida* Muhl. ssp. *mackenzieana* (Hook.) A.E. Murray

*Salix rigida* Muhl. var. *mackenzieana* (Hook.) Cronquist [HC]

*Salix rigida* Muhl. var. *macrogemma* (C.R. Ball) Cronquist [HC]

***Salix pseudomonticola* C.R. Ball [FNA7, HC2]**

Contr. U.S. Natl. Herb. 22: 321. 1921.

false mountain willow

*Salix barclayi* Andersson var. *pseudomonticola* (C.R. Ball) Kelso

*Salix monticola* Bebb [FNA7, HC], misapplied

FNA7: "*Salix pseudomonticola* is characterized by precocious flowering; catkins sessile; juvenile leaf blades, petioles, and proximal midribs reddish; stipules prominent; and leaves and branchlets sparsely hairy. Branches older than two years have a distinctive pattern, which consists of a series of longitudinal splits in epidermis produced as the branch expands. The edge of epidermis around the split, where it has separated from the branch, is yellow and contrasts with the red-brown branch to which the epidermis still adheres. Vegetative specimens of *Salix pseudomonticola* with yellow-brown branches can be confused with *S. famelica*. They may be separated by their juvenile leaf margins prominently and closely gland-dotted; stipules usually prominent, sometimes early deciduous; leaves broader (1.4-3 times as long as wide versus 2.6-7 in *S. famelica*); and petioles slender and often longer in relation to blade length. The possibility of hybridization needs study. Vegetative specimens of *Salix pseudomonticola* can be distinguished from *S. pyrifolia* by juvenile leaves reddish and almost always with some ferruginous hairs, versus yellowish-green and glabrous or with white hairs, and mature leaves usually dull adaxially versus glossy."

**\**Salix purpurea* L. [FNA7, HC2]**

Sp. Pl. 2: 1017. 1753.

purple osier, basket willow, purple willow

***Salix scouleriana* Barratt ex Hook. [FNA7, HC, HC2]**

Fl. Bor.-Amer. 2: 145. 1838.

Scouler's willow

*Salix scouleriana* Barratt ex Hook. var. *brachystachys* (Benth.) M.E. Jones

*Salix scouleriana* Barratt ex Hook. var. *coetanea* C.R. Ball

*Salix scouleriana* Barratt ex Hook. var. *crassijulis* (Andersson) C.K. Schneid.  
*Salix scouleriana* Barratt ex Hook. var. *flavescens* (Nutt.) J.K. Henry  
*Salix scouleriana* Barratt ex Hook. var. *poikila* C.K. Schneid.  
*Salix scouleriana* Barratt ex Hook. var. *thompsonii* C.R. Ball  
*Salix stagnalis* Nutt.

FNA7: "Western *Salix scouleriana* and eastern *S. humilis* are closely related and are sometimes difficult to separate. Although there is an apparent range disjunction between them in western Manitoba, it may be a collecting gap. In general, *S. scouleriana* differs from *S. humilis* in being a taller shrub, sometimes even tree-like, with broader leaves and longer catkins, floral bracts, stigmas, and styles, but these quantitative characteristics all overlap. The apparent difference in anther length (*S. scouleriana* 0.7-1.2 mm; *S. humilis* 0.4-0.6 mm) may be correlated with a difference in chromosome number. *Salix scouleriana* is tetraploid (Y. Suda and G. W. Argus 1968); *S. humilis* has been reported to be both diploid (Suda and Argus; L. Zsuffa and Y. Raj, unpubl.) and tetraploid (R. D. Dorn 1976). The latter count was from the same population as the one by Suda and Argus. Further chromosome counts are indicated. *Salix scouleriana* forms natural hybrids with *S. hookeriana*, *S. planifolia*, and *S. pulchra*."

\**Salix xsepulcralis* Simonk. [HC2]

Természetrázi Fü. 12: 157 (-158). 1890.  
weeping willow

*Salix babylonica* L. [FNA7, HC, HC2], misapplied  
*Salix xpendulina* Wender. [FNA7, HC2], misapplied

FNA7: "*Salix xpendulina* Wenderoth: Weeping willow, *S. babylonica* x *S. euxina*, is introduced from Europe and grown throughout the world."

*Salix sessilifolia* Nutt. [FNA7, HC, HC2]

N. Amer. Sylv. 1: 68. 1842.  
sessile-leaf willow

*Salix exigua* Nutt. var. *sessilifolia* (Nutt.) Dorn  
*Salix fluviatilis* Nutt. var. *sessilifolia* (Nutt.) Scoggan  
*Salix longifolia* Muhl. var. *sessilifolia* (Nutt.) M.E. Jones  
*Salix macrostachya* Nutt.  
*Salix macrostachya* Nutt. var. *cusickii* Rowlee  
*Salix sessilifolia* Nutt. var. *villosa* Andersson

FNA7: "*Salix sessilifolia* forms natural hybrids with *S. columbiana* and *S. melanopsis*."

*Salix sitchensis* Sanson ex Bong. [FNA7, HC, HC2]

Mém. Acad. Imp. Sci. St.-Petersbourg, Sér. 6, Sci. Math. 2: 162. 1832.  
Sitka willow

*Salix coulteri* Andersson  
*Salix cuneata* Nutt.  
*Salix sitchensis* Sanson ex Bong. var. *congesta* Andersson  
*Salix sitchensis* Sanson ex Bong. var. *denudata* (Andersson) Andersson  
*Salix sitchensis* Sanson ex Bong. var. *parviflora* (Jeps.) Jeps.

FNA7: "Ovary hairiness in some *Salix sitchensis* populations varies from uniformly hairy to glabrescent, with intermediates with patchy or streaky hairiness. All three variations can occur together and do not seem to indicate hybridization. Both *Salix sitchensis* and *S. scouleriana* have similar variants with leaves having very densely curly hairs on abaxial surfaces [*S. sitchensis* forma *coulteri* (Andersson) Jepson and *S. scouleriana* forma *poikila* (C. K. Schneider) C. K. Schneider]. Plants resembling *S. drummondiana* but with similar indumentum probably are hybrids with *S. alaxensis* (see 84. *S. drummondiana*). The *coulteri* taxon resembles *S. delnortensis* in having stipules with adaxial surfaces glabrous and very sparsely glandular toward the base, densely hairy abaxially, and with gland-dotted margins; its branchlets have wavy to crinkly hairs. The possible hybrid origin of *S. delnortensis* needs study (R. D. Dorn 2000). *Salix sitchensis* forms natural hybrids with *S. alaxensis* var. *longistylis* and *S. melanopsis*. Hybridization with *S. geyeriana* reported by J. K. Henry (1915) is not based on convincing specimens."

var. *sitchensis* [HC2]

Mém. Acad. Imp. Sci. St.-Petersbourg, Sér. 6, Sci. Math. 2: 162. 1832.

Sitka willow

***Salix tweedyi*** (Bebb ex Rose) C.R. Ball [FNA7, HC, HC2]

Bot. Gaz. 40: 377. 1905.

Tweedy's willow

*Salix barrattiana* Hook. var. *tweedyi* Bebb ex Rose

*Salix rotundifolia* Nutt., homonym (illegitimate)

***Salix vestita*** Pursh [FNA7, HC, HC2]

Fl. Amer. Sept. 2: 610. 1813.

rock willow

*Salix vestita* Pursh ssp. *leiolepis* (Fernald) Argus

*Salix vestita* Pursh var. *erecta* Andersson [HC]

*Salix vestita* Pursh var. *humilior* Andersson

FNA7: "Salix vestita is an ancient amphiberingian species. Its distribution includes a series of isolated, disjunct populations in Central Siberia, the northern Rocky Mountains, the west coast of Hudson Bay, and the northeastern arctic and subarctic. Occurrence in Nunavut is on Akpatok Island in Ungava Bay and on the Belcher Islands in Hudson Bay. It may be extirpated in Washington. The flowering and vegetative branchlets sometimes have relatively short internodes. In subsequent years, branches have the appearance of short shoots similar to those in Alnus. Short shoots do not appear on all branches or in all years. The formation of short shoots may be related to adverse growing conditions."