

**A Guide to the identification of *Salix* (willows)
in Alaska, the Yukon Territory
and adjacent regions**

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July 2004 workshop on willow identification.

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PREFACE

This guide to the identification of *Salix* (willows) in Alaska and Yukon was written to accompany a workshop in *Salix* identification given at the University of Alaska in the summer of 2004. It provides a number of resources to aid in the identification of *Salix* in the field and the herbarium. These include a dichotomous key, access to a computerized interactive key, descriptions of the species, information on flowering time, habitat, general distribution, distribution maps, and taxonomic comments.

The accurate identification of *Salix* is not always easy to accomplish. Nor is it easy to write keys that will identify more than a small percent of unknowns. One experienced with willows comes to know the species by “the way they look,” but one must always be cautious because it is easy to be misled by superficial look-alikes or developmental variation. The recognition of a general pattern, however, brings into play many more characteristics than can be described in words. These include the general branching pattern, color, the way the leaves are borne on the shoot, growth form, the appearance of catkins and leaves when they are very young, etc. My attempts to put these subtle characters into words have not been successful because they are often variable as well as intangible. Nonetheless good field identification comes to rely on them.

A major difficulty in describing species, especially for incorporation into a computerized database, is to define the character accurately yet easily understandable. Over the years I have drafted and refined a list of *Salix* characters and character states. Some terminology may seem to be unduly technical but it is unavoidable if confusion is to be avoided. A comprehensive list of characters and character states along with definitions, comments on how the characters should be measured, a glossary, and illustrations some characters is included.

Once the characters are defined and understood there are other difficulties that bear on identification that need to be addressed.

(1) *Salix* are dioecious; this means that flowers of only one sex occur on a single individual. Most floras provide a single key using staminate, pistillate, and vegetative characters. Such keys are frustrating to use and have led many field botanists to ignore staminate or vegetative specimens because such material is impossible to run through such keys. Other floras have provided three separate keys but these keys are very difficult to construct, especially if the number of species in the flora exceeds 25-30 species. Computerized interactive key go a long way in overcoming these problem.

(2) *Salix* flowers are very simple. Staminate flowers consist of stamens and a reduced perianth consisting of one or more nectaries; pistillate flowers consist of an ovary and one or more nectaries. Each flower is subtended by a floral bract. The flowers are aggregated into catkins, which may be sessile on the branch or borne on a short, vegetative shoot. In any one individual, therefore, there are relatively few floral characteristics on which to draw for identification.

(3) Developmental variability poses practical problems. Because of differences in the time of opening of floral and vegetative buds, at any particular time, some plants may bear only flowers, others flowers and juvenile leaves, and yet other may have only leaves. There is also the variability due to stage of development. Degree of hairiness often changes as hairs are lost in age; quantitative characters vary with developmental stage, e.g. the length of catkins, flowering branchlets, stipes, and ovaries usually elongate in age; and some structures, e.g. stipules or floral bracts, may be lost in age. Characters, therefore, that may be useful in identification may not be present at all stages of development. The best way to understand developmental variation is to tag plants in the study area and to make collections from a single individual at several times during the year. These specimens should show juvenile leaves and catkins, fruiting catkins, mature leaves, and winter twigs.

(4) Most *Salix* species will vary phenotypically in response to moisture, nutrients, shade, and wind. Sometimes normally prostrate species growing in a protected niche may be erect, leaves of a usually small-leaved species may be very large in nutrient rich sites, under shade conditions leaves may be very large. In addition to this phenotypic variability there is also genetic variation. Many characters which at first seem to be diagnostic for a particular species, such as leaf shape, hairiness, tothing, and size, as well as plant stature, size of catkins, hairiness of ovaries, etc., are often distressingly variable. The best way to cope with this variability is to base identifications on “normal” growth or on an assessment of a population rather than on an individual.

(5) Hybridization is an important source of variability in willows. In the past it was sometimes overestimated and virtually every individual was seen as involving hybridization between two or three or more species. The reaction to this was to de-emphasize hybridization but we should avoid underestimating its importance. First of all, polyploidy is common in *Salix*. It is likely that most of these polyploids are allopolyploids which arose through hybridization (Argus 1997). This suggests that all polyploids, ca. 40% of *Salix*, have involved hybridization. Recent genetic evidence has revealed the presence of genomes from other species with minimal or no morphological expression (Brunsfeld et al. 1992). In a recent study of hybridization between *S. eriocephala* and *S. sericea* (Hardig et al. 2000) the point was made that, depending on the genetic control of character expression, some evidence of hybridization may not be expressed. The authors note that even when it is expressed, “hybrids may be imperfectly intermediate or highly variable resulting in an interpretation that unrecognized hybrid plants are merely part of the morphological variation in one of the species.” This finding has important taxonomic implications. While evidently we should avoid including too much morphological variation in a single species we also must avoid attributing every variation to hybridization. Since taxonomic decisions are primarily based on morphological characters we find ourselves walking a tightrope.

Occasionally hybrids can be recognized in the field by their intermediacy. Several putative hybrid swarms, which included apparent introgression, were studied in the field in Alaska (Argus 1973); they are *Salix phlebophylla* × *rotundifolia*, *S. athabascensis* × *pedicellaris*, *S. arctica* × *stolonifera*, and *S. barclayi* × *stolonifera*. In addition, a number of hybrids, such as *S. arctica* × *glauca* and others mentioned in species notes, were identified on the basis of a few specimens. Many species of *Salix* can be crossed but most are ephemeral and are sterile. Some synthetic hybrids made by Mosseler (1990) between *S. interior* (as *S. exigua* subsp. *interior*) and *S. bebbiana*, *S. discolor*, *S. eriocephala*, and *S. petiolaris* lived for only a few years before dying (Mosseler, pers. comm.). I believe the most practical approach is not to assume hybridization without confirmatory evidence. This may be expressed as intermediacy in a number of characters, patchy hairiness on ovaries, the presence of both putative parents in the area, and evidence of infertility (aborted ovaries, inviable pollen). Although such evidence may not always be available it should be sought when hybridization is suspected.

Intraspecific variation poses problems not only in identification, but also in gathering descriptive data. In preparing the database used in this study efforts were made to sample as much variation as possible. Despite this it is certain that not all variation was recorded. Therefore, when using quantitative data caution should be used to avoid eliminating a species because some measurement falls just outside the extremes recorded in the database. One way to do this is to measure several structures on the unknown and, when asked by the interactive key to enter a value, enter the data as a range rather than as a single measurement. Another way would be to calculate plus or minus 10% the measured value and enter this range. Despite the problems in creating a database for interactive identification the result is a more effective tool than the convention dichotomous key.

Finally, the best way to identify species is to get to know them. That may seem platitudinous but nevertheless it is true. One can learn the willows by making careful collections, keeping complete field

notes, tagging plants and collecting them in different stages of development, and examining many plants in a population. One good way to understand population variability is to sample a population by taking a branch, with leaves and catkins, from a plant at fixed intervals, such as every 5-10 paces. Skvortsov (1999) says that he often walks through a stand identifying every willow. This helps him understand not only the general variability in the population but sometimes reveals evidence of hybridization or introgression. The goal of this workshop is to provide you with some of the tools and the background on which you can then build.

Distribution maps. The maps are based on those published in Argus (1973), updated by collections in the National Herbarium of Canada made since 1970, distribution maps of Yukon Territory (Cody 1997), British Columbia (Brayshaw 1996). Ranges in the Northwest Territories are based on specimens in the National herbarium of Canada, and ranges in Russia are based on Skvortsov (1999), Nedoluzhko (1995), and specimens in ALA. Recent specimens sent for identification by Carolyn Parker, Mary Beth Cook, Steven Talbot, and many others, as well as my own recent collections were mapped. Distribution on the Kenai Peninsula was modified based on Collet (2002). I am particularly grateful to Al Batten for providing map coordinates for *Salix* in the University of Alaska Herbarium database and to Mary Argus who helped plot these records. Maps can be very useful in identifying unknowns and should be checked as identification proceeds to eliminate unlikely candidates as well as in the final verification.

Descriptions. The descriptions were made using DELTA and the *Salix* databases. For the most part descriptions are completely parallel, but in some cases additional, useful characteristics, not in the databases were added. The following convention are followed for quantitative characters: simple ranges, 12-50 mm; ranges and mean, 12-20-24 mm, ranges with uncommon extreme values in parentheses, (3)12-20-24(-30). Diagnostic characters are in bold italics. The descriptions of some Siberian taxa, not yet known in the New World, but to be expected there, were based, in part, on the cited floras. Several of these Siberian species are included in the computerized database.

Elevations apply to the entire range of the species.

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Finally, a cautionary comment written by C. K. Schneider, the foremost European Salicologist of his day, who was interned in the United States during World War I and placed in the custody of C. S. Sargent, director of the Arnold Arboretum, Harvard University, for the duration of the war. During that time he monographed the genus *Salix* in North America.

“In determining willows one is only too often entirely misled at first, and even by a slow and careful examination it is not always possible to determine the proper identity of the plant.”

(J. Arnold Arboretum 1: 85. 1919)

THE GENUS *SALIX* L.

IN ALASKA, THE YUKON TERRITORY, AND ADJACENT REGIONS

George W. Argus

SALICACEAE Mirbel - Willow Family

Trees and shrubs, sometimes forming colonies by root shoots (sobiliferous), deciduous; branching monopodial or sympodial. **Winter buds** with 3-10 imbricate scales or a single scale, the lowermost (or only) scale of lateral buds opposite the twig. **Leaves** alternate, rarely opposite or subopposite, spirally arranged, simple; stipules absent, rudimentary, or foliaceous, persistent or caduceous; leaf blades glandular-toothed or entire, petiolate. **Inflorescences**: unisexual catkins, pendulous or erect, racemose or spicate, sessile or terminating a leafy branchlet; **floral bracts**: subtend each flower, displaced onto pedicels or distinct, scale-like, entire, toothed, or lacinate, the pistillate deciduous or persistent. **Flowers** unisexual, the staminate and pistillate on separate plants; pedicellate or sessile, without a normal perianth, this replaced by a cup-shaped non-nectiferous disc or by 1 or 2 nectaries; **staminate** with 1-60-70) free or basally connate stamens; anthers versatile on slender filaments or basifixed, dehiscent by longitudinal slits; **pistillate** with a single, superior, unilocular ovary of 2-4 carpels, style 1 per carpel, generally connate, sometimes nearly obsolete, stigmas 2-4, simple, bilobed, or trilobed; ovules 1-25 per carpel, placentation parietal. **Fruits** thin-walled capsules, dehiscent by 2-4 valves. **Seeds** small, mostly unitegmic, surrounded by an arillate coma of long, silky hairs; endosperm scant or absent; embryo small, straight, with 2 semicircular or elliptic to oblong cotyledons.

Genera 2, species ca. 450, ca. 110 species in the New World: chiefly arctic, boreal, and temperate worldwide except Malaysia, Australasia, and Oceania.

The Salicaceae is described here in the traditional or strict sense. Recent molecular studies have indicated that some genera, formerly included in the Flacourtiaceae, should be included in the Salicaceae s.l. There is strong evidence indicating of a close relationship between the Salicaceae s.s. and some members of the Flacourtiaceae, but that circumscription is not followed here. For an overview of the new classification see papers by Chase, et al. (2002), the Angiosperm Phylogeny Group II (2003), and Judd (1997).

1. Buds with 3-10 overlapping scales, often resinous; leaf blades usually less than twice as long as wide, with a strong pair of basal secondary veins (except in *P. angustifolia*); stipules generally caducous; catkins pendulous, sessile; floral bracts lacinate, the pistillate deciduous after flowering; flowers with a non-glandular, cup- or saucer-like disc; stamens 6-70; stigmas 2-4, flattened or cylindrical, 2 mm or more long; capsules 2-4-valved, narrowly ovoid to spherical. *Populus*

1. Buds with a single scale, not resinous (oily in *S. barrattiana*); leaf blades often more than twice as long as wide, but highly variable, generally with pinnate venation; stipules foliaceous, rudimentary, or absent, sometimes early deciduous; catkins erect or spreading, rarely pendulous, sessile or on a leafy branchlet; floral bracts usually entire, sometimes slightly erose, or irregularly toothed, persistent or pistillate bracts deciduous after flowering; flowers with a single adaxial nectary or both abaxial and adaxial nectaries which may be distinct or connate and cup-shaped; stamens 1-7; stigmas 2, cylindrical or flattened, 1.5 mm or less long; capsules 2-valved, obclavate to ovoid. *Salix*

Salix L., Sp. Pl. 2: 1015. 1753 - Willow [Latin *salix*, willow]

Plants trees or shrubs, generally not clonal but some form clones by root shoots, rhizomes, layering, or branch fragmentation. Shoot growth sympodial. **Bud** scale single, margins fused into a calyptera or free and overlapping adaxially. **Leaves** with stipules that vary in presence and size on the first and later leaves; petioles sometimes glandular dotted or lobed at distal end; blades not distinctly heterophyllous, but proximal leaves differ in size and shape from later leaves; general shape varies from linear to circular; margins glandular-toothed to entire. **Catkins** erect, spreading, or somewhat pendulous; sessile or terminating leafy branchlets; generally unbranched; flowering before or as the leaves emerge or through the year; **floral bracts**: a single bract subtends each flower, apex entire, erose or irregularly toothed, generally persistent in fruit. **Flowers, staminate**: perianth reduced to an adaxial and sometimes also an abaxial nectary, if both present they may be distinct or connate into a shallow cup; stamens 2 or 3—10 or reduced to 1; filaments distinct or variously connate; **pistillate** nectary adaxially, rarely also abaxially, if two, the nectaries may be distinct or connate and cup-shaped; ovary one, 2-carpellate, unilocular, stipitate or sessile; styles 2, generally connate; stigmas 2, entire or bifid; ovules (2-)4-24(-42) per ovary. **Fruits** obclavate to ovoid or ellipsoidal capsules, with 2 valves opening to disperse small seeds each surrounded by a “parachute” of hairs. $x=19$.

Species ca. 450, ca. 104 native species in the New World; arctic, boreal, and temperate regions worldwide; absent or uncommon in tropical regions; absent in Malaysia, Australasia, and Oceania, except as introductions.

CLASSIFICATION OF SALIX (Based on Argus 1997)

I. *Salix* subg. *Salix*

- A. *Salix* sect. *Salicaster* Dumort, Fl. belge. 14. 1827
1. *Salix lasiandra* Benth. Pl. Hartweg. 335. 1857
 - 1a. *Salix lasiandra* Benth. var. *lasiandra*
 - 1b. *Salix lasiandra* Benth. var. *caudata* (Nutt.) Sudw. Bull. Torrey Bot. Club 20: 43. 1893.
 2. *Salix pentandra* L. Sp. pl. 2: 1016. 1753
 3. *Salix serissima* (L. H. Bailey) Fernald, Rhodora 6: 6. 1904
- B. *Salix* sect. *Salix*
4. *Salix xsepulcralis* Simonk. Oesterr. Bot. Zeitschr. 40: 424. 1890
- C. *Salix* sect. *maccallianae* Argus, Syst. Bot. Monogr. 52: 57. 1997
5. *Salix maccalliana* Rowlee, Bull. Torrey Bot. Club 34: 158. 1907

II. *Salix* subg. *Longifoliae*

- D. *Salix* sect. *Longifoliae* (Andersson) Andersson in DC. Prodr. 16(2): 214. 1868.
6. *Salix interior* Rowlee, Bull. Torr. Bot. Club 27:253. 1900.

III. *Salix* subg. *Chamaetia*

- E. *Salix* sect. *Chamaetia* Dumort. Verh. Gesl. Wilgen 15. 1825
7. *Salix reticulata* L. Sp. pl. 2: 1018. 1753
- F. *Salix* sect. *Herbella* Ser. Exemplaires desséchés de la révision inédit du genre *Salix*. 14th page. 1824
8. *Salix nummularia* Andersson in DC. Prodr. 16(2): 298. 1868.
- G. *Salix* sect. *Setchellianae* Argus, Syst. Bot. Monog. 52: 62. 1997
9. *Salix setchelliana* C.R. Ball, Univ. Calif. Publ. Bot. 17: 410. 1934
- H. *Salix* sect. *Myrtosalix* A. Kerner, Verh. Zool.-Bot. Ges. Vereins Wien 10: 203. 1860

10. *Salix arctophila* Cockerell ex A. Heller, Cat. N. Amer. Pl., ed. 3, 89. 1910
 11. *Salix chamissonis* Andersson in DC. Prodr. 16(2): 290. 1868
 12. *Salix fuscescens* Andersson, Monogr. Salicum 97. 1867
 13. *Salix phlebophylla* Andersson in DC., Prodr. 16(2): 290. 1868
 14. *Salix saxatilis* Turcz. ex Ledeb. Fl. Ross. 3, 2: 621. 1850
 15. *Salix tschuktschorum* A. K. Skvortsov, Bot. mat. Gerb. Bot. in-ta AN SSSR 21: 83, 90. 1961
 16. *Salix polaris* Wahl. Fl. Lapp. 261. 1812
 17. *Salix rotundifolia* Trautv. Nouv. Mem. Soc. Nat. Mosc. 2: 304. 1832
 I. *Salix* sect. *Ovalifoliae* (Rydberg) C. K. Schneider in Wils. Pl. Wils. 3: 140. 1916
 18. *Salix ovalifolia* Trautv. Nouv. Mem. Soc. Mosc. 2: 306. 1832
 18a. *Salix ovalifolia* var. *arctolitoralis* (Hultén) Argus, Canad. J. Bot. 47: 795. 1969
 18b. *Salix ovalifolia* var. *cyclophylla* (Rydb.) C.R. Ball, Proc. Nat. Acad. Sci. 21: 184. 1935
 18c. *Salix ovalifolia* var. *glacialis* (Andersson) Argus, Canad. J. Bot. 47: 798. 1969
 18d. *Salix ovalifolia* var. *ovalifolia*
 19. *Salix stolonifera* Coville, Proc. Wash. Acad. Sci. 3: 333. 1901
 J. *Salix* sect. *Diplodictyae* C. K. Schneider in Sarg. Pl. Wils. 3: 136. 1916
 20. *Salix arctica* Pall. Fl. Ross. 1: 86. 1788
 21. *Salix sphenophylla* A. K. Skvortsov in Tomatchev, Fl. Arct. URSS 5: 62. 1966.
 K. *Salix* sect. *myrtilloides* (Borrer) Andersson in DC., Prodr. 16(2): 229. 1868
 22. *Salix athabascensis* Raup, Rhodora 32: 111. 1930
 23. *Salix pedicellaris* Pursh, Fl. Am. Sept. 2: 611. 1814
 24. *Salix raupii* Argus, Canad. J. Bot. 52: 1303. 1974
 L. *Salix* sect. *Glaucæ* (Fries) Andersson in DC. Prodr. 16: 273. 1868.
 25. *Salix brachycarpa* Nuttall N. Am. Sylva 1: 69. 1842.
 26. *Salix glauca* L. Sp. pl. 2: 1019. 1753
 26a. *Salix glauca* subsp. *acutifolia* (Hook.) Hultén, Ark. f. Bot. 7: 40. 1967
 26b. *Salix glauca* subsp. *stipulifera* (Flod. ex Häyrén) Hiitonen, Suomen kasvio, 272. 1933
 26c. *Salix glauca* subsp. *glabrescens* (Andersson) Hultén, Ark. Bot. (n.s.) 7(1): 40. 1968.
 27. *Salix niphoclada* Rydb. Bull. N. Y. Bot. Gard. 1: 272. 1899
 28. *Salix reptans* Rupr. Fl. samojed. cisur. 54. 1845
- IV. *Salix* subg. *Vetrix***
- M. *Salix* sect. *Hastatae* (Fries) A. Kerner, Verh. Zool.-Bot. Ges. Vereins Wien 10: 241. 1860
 29. *Salix barclayi* Andersson, Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 15: 125. 1858
 30. *Salix commutata* Bebb, Bot. Gaz. 13: 110. 1888
 31. *Salix hastata* L. Sp. pl. 2: 1017. 1753
 32. *Salix myrtilifolia* Andersson, Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 15: 132. 1858
 33. *Salix pseudomonticola* C.R. Ball, Standley, Contr. U. S. Natl. Herb. 22: 321. 1921
 34. *Salix pseudomyrsinites* Andersson, Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 15: 130. 1858
 35. *Salix pyrifolia* Andersson, Monogr. Salicum 162. 1867
 N. *Salix* sect. *Cordatae* J. Barratt ex Hook. Fl. bor.-amer. 2: 149. 1838
 36. *Salix eriocephala* Michx. var. *famelica* (C.R. Ball) Dorn, Brittonia 47: 165. 1995
 37. *Salix proluxa* Andersson, Monogr. Salicum 94. 1867
 O. *Salix* sect. *Fulvae* J. Barratt, Salices Americanae. Sect. VII. (no pagination) 1840
 38. *Salix bebbiana* Sarg. Gard. & For. 8: 463. 1895
 P. *Salix* sect. *Cinerella* Ser. Exemplaires desséchés de la révision inédit du genre *Salix*. 2nd page. 1824
 39. *Salix hookeriana* Barratt ex Hook. Fl. bor.-amer. 2: 145. 1838
 40. *Salix scouleriana* Barratt ex Hook. Fl. Bor.-amer. 2: 145. 1838
 Q. *Salix* sect. *Phylicifoliae* (Fries) Andersson in DC. Prodr. 16: 240. 1868
 41. *Salix drummondiana* J. Barratt ex Hook. Fl. bor.-am. 2: 144. 1838
 42. *Salix planifolia* Pursh, Fl. Am. Sept. 2: 611. 1814

43. *Salix pulchra* Cham. Linnaea 6: 543. 1831
 R. *Salix* sect. *Arbuscella* Ser. Exemplaires desséchés de la révision inédit du genre *Salix*. 5th page. 1824
 44. *Salix arbusculoides* Andersson, Monogr. Salicum 147. 1867
 45. *Salix boganidensis* Trautv. in Middendorff, Reise Sibir. 1, 2: 154. 1847
 S. *Salix* sect. *Candidae* C. K. Schneider, Ill. Handb. Laubholzk. 1: 46. 1904
 46. *Salix candida* Flügge ex Willd. Sp. pl. 4: 708. 1806
 47. *Salix krylovii* E. Wolf, Trudy SPb. bot. sada 28: 537. 1911
 T. *Salix* sect. *Lanatae* (Andersson) Koehne, Deut. Dendrol. 87, 93. 1893
 48. *Salix richardsonii* Hook. Fl. bor.-amer. 2: 147. 1838
 U. *Salix* sect. *Villosae* (Andersson) Rouy, Fl. France. 12: 200. 1910
 49. *Salix alaxensis* (Andersson) Coville Proc. Wash. Acad. Sci. 2: 280. 1900
 49a. *Salix alaxensis* var. *alaxensis*
 49b. *Salix alaxensis* var. *longistylis* (Rydb.) C. K. Schneider, J. Arnold Arb. 1: 225. 1919
 50. *Salix barrattiana* Hook., Fl. bor.-amer. 2: 146. 1838
 V. *Salix* sect. *Geyerianae* Argus, Syst. Bot. Monogr, 52: 85. 1997
 51. *Salix petiolaris* Sm. Trans. Linn. Soc. 6: 122. 1802
 W. *Salix* sect. *Sitchenses* (Bebb) C. K. Schneider J. Arnold Arbor. 1: 91. 1919
 52. *Salix sitchensis* Sanson ex Bong. Mem. Acad. St. Petersb. 6. 2: 162. 1833

KEY TO THE SPECIES

Modified from key in Argus 1973. For other keys to *Salix* see: Hultén 1968, Viereck & Little 1972, Welsh 1974, Porsild & Cody 1980, Cody 1996, Argus 2000. Number in parentheses are source of the lead.

- 1 Dwarf or prostrate, trailing shrubs under 2 dm tall. 2
 1. Erect shrubs, greater than 2 dm tall, or trees. 22
- 2(1) Leaves prominently reticulate veined adaxially and pale abaxially; catkins borne terminally on previous year's branches; pistillate and staminate flowers with adaxial and abaxial nectaries. *Salix reticulata*
 2. Leaves not as prominently reticulate veined; catkins borne laterally on previous year's branches; pistillate flowers with only adaxial nectaries. 3
- 3(2) Ovaries hairy, sometimes only on beak. 4
 3. Ovaries glabrous. 13
- 4(3) Leaves distinctly serrulate. *Salix chamissonis*
 4. Leaves entire or toothed on lower half. 5
- 5(4) Leaves not glaucous abaxially. 6
 5. Leaves glaucous abaxially. 7
- 6(5) Branches with persistent, skeletonized leaves; leaf margins usually ciliate; nectaries usually shorter than the stipes. *Salix phlebophylla*
 6. Branches lacking persistent leaves; leaf margins rarely ciliate; nectaries longer than the stipes. *Salix polaris*
- 7(5) Leaves 8.5-14 mm long; margins prominently ciliate; catkins usually globose .
 *Salix ovalifolia* var. *glacialis*
 7. Leaves longer than 14 mm long; margins not ciliate, catkins usually stout to slender..... 8

- 8(7) Styles 0-0.5 mm long. 9
8. Styles longer than 0.5 mm. 10
- 9(8) Leaves mostly obovate to elliptic, 1.4-2.5 times as long as wide, glabrous adaxially; margins distinctly toothed on lower half; ovaries sparsely hairy with ferruginous hairs. *Salix fuscescens*
9. Leaves mostly narrowly elliptic to narrowly obovate, 1.6-3.8 times as long as wide, hairy on both surfaces; margins entire; ovaries densely white hairy. *Salix niphoclada*
- 10(8) Ovaries sparsely hairy with crinkled, refractive hairs, nectaries shorter than the stipes; branchlets slender and trailing, glabrous; leaves glabrous. *Salix arctophila*
10. Ovaries sparsely or densely hairy with non-refractive hairs, nectaries equal to or longer than stipes; branchlets and leaves various. 11
- 11(10) Ovaries usually densely hairy; leaves dark green and usually shiny adaxially, bases cuneate to rounded; branchlets trailing to erect. *Salix arctica*
11. Ovaries glabrous to sparsely hairy on beak; leaves shiny to glossy adaxially; branchlets trailing and rooting. 12
- 12(11) Leaf bases usually cuneate, sometimes acute, blades shiny adaxially. *Salix sphenophylla*
12. Leaf bases acute to rounded or subcordate, blades glossy adaxially. *Salix stolonifera*
- 13(3) Leaves green (not glaucous) abaxially. 14
13. Leaves glaucous abaxially. 16
- 14(13) Decumbent or trailing boreal shrub; leaves narrowly elliptic to narrowly obovate, 17-74 mm long; margins crenate to crenate-serrulate. *Salix myrtilifolia*
14. Dwarf, sometimes trailing arctic shrubs; leaves circular to obovate or narrowly elliptic, 4-22 mm long; margins entire or toothed only at bases. 15
- 15(14) Leaves usually subcircular, somewhat reticulate adaxially; margins glandular-toothed on lower half, not ciliate; branches more or less trailing. *Salix nummularia*
15. Leaves circular or sometimes broadly elliptic, not prominently reticulate; margins entire and ciliate; branches erect, not trailing. *Salix rotundifolia*
- 16(13) Branchlets usually densely woolly; leaves lemon green, coriaceous, obovate to narrowly obovate and tapering to a short petiole, 0-0.3 mm long; ovaries brick red. *Salix setchelliana*
16. Branchlets glabrous to sparsely hairy; leaves thin, elliptic to subcircular, petioles 1.1-2.5 mm long; bracts brown to blackish; ovaries reddish, purple, or greenish. 17
- 17(16) Pistillate nectaries shorter than stipes; leaf margins distinctly toothed on lower half, petioles 2-5.6 mm long. *Salix fuscescens*
17. Pistillate nectaries longer than or equal to stipes; leaf margins usually entire, petioles usually 4-20 mm long. 18
- 18(17) Leaf bases usually cuneate, blades shiny adaxially. *Salix sphenophylla*
18. Leaf bases acute to rounded or subcordate, blades glossy adaxially. 19
- 19(18) Branches short and erect, sometimes trailing, often glaucous; plants often rhizomatous; styles 0.6-1.6 mm long. *Salix stolonifera*
19. Branches usually long and trailing, not glaucous; styles 0.2-0.8 mm long. 20

- 20(19) Leaves circular to subcircular. *Salix ovalifolia* var. *cyclophylla*
 20. Leaves narrowly elliptic to broadly elliptic, obovate, or subcircular 21
- 21(20) Leaves elliptic to subcircular, 13-28 mm long; pistillate catkins 8-31 mm long.
 *Salix ovalifolia* var. *ovalifolia*
 21. Leaves narrowly elliptic to broadly elliptic or obovate, 25-46 mm long; pistillate catkins 17-40 mm
 long. *Salix ovalifolia* var. *arctolitoralis*
- 22(1) Flowering before leaves emerge, catkins not on distinct leafy branchlets. 23
 22. Flowering as or just before the leaves emerge, catkins on distinct leafy branchlets. 32
- 23(22) Ovaries glabrous. 24
 23. Ovaries hairy. 27
- 24(23) Stipules absent; branchlets brittle at bases and with persistent, long, villous hairs at bases.
 *Salix hookeriana*
 24. Stipules foliaceous, often persistent; branchlets flexible, lacking long, villous hairs at bases. 25
- 25(24) Stipules linear to ovate, apices acuminate, persisting for several years; styles 1.6-2.8 mm long;
 nectaries 2-3 times as long as the stipes. *Salix richardsonii*
 25. Stipules broadly ovate, apices rounded, not persistent for more than one year; styles usually shorter than
 1.6 mm long; nectaries shorter than stipes. 26
- 26(25) Catkins flowering before leaves emerge; flowering branchlets 0-5 mm long; styles 0.6-1.8 mm long;
 branchlets often glabrous or sparsely hairy; leaves broadly elliptic to obovate. *Salix pseudomonticola*
 26. Catkins flowering as, or sometimes just before, leaves emerge; flowering branchlets 0.5-6 mm long;
 styles 0.3-1 mm long; branchlets glabrescent to villous; leaves narrowly oblong to obovate.
 *Salix prolixa*
- 27(23) Leaves densely white woolly abaxially, bright green adaxially; stipes 0-0.4 mm long. *Salix alaxensis*
 27. Leaves silky or densely villous to glabrescent abaxially; stipes 0.2-2.7 mm long. 28
- 28(27) Branchlets distinctly glaucous. *Salix drummondiana*
 28. Branchlets not glaucous, or thinly so in *Salix planifolia*. 29
- 29(28) Buds and stipules oily; stipules broadly ovate; margins prominently glandular; leaves white, silky-
 woolly abaxially. *Salix barrattiana*
 29. Buds and stipules not oily; stipules ovate to linear; leaves glabrous or silky to glabrescent beneath..... 30
- 30(29) Branchlets velvety; styles 0.2-0.6 mm long; often leaves oblanceolate, abaxial surfaces with
 scattered white and ferruginous hairs *Salix scouleriana*
 30. Branchlets pubescent or villous to glabrescent; styles 0.3-1.8 mm long; usually leaves elliptic to
 narrowly elliptic, oblong or rhomboid 31
- 31(30) Stipules oblong, narrowly elliptic, or ovate, often rudimentary, rarely persistent for more than one
 year, 0.8-3 mm long, shorter than petioles; juvenile leaves usually more hairy; mature leaves usually
 narrowly elliptic. *Salix planifolia*
 31. Stipules linear, often persistent for two to four years, 3-32 mm long, longer than petioles; juvenile leaves
 glabrous or sparsely pilose; mature leaves often rhombic, or narrowly elliptic to obovate... *Salix pulchra*

32(22) Introduced, cultivated species.	33
32. Indigenous species.	34
33(32) Leaves broadly ovate to narrowly elliptic, green or pale abaxially; branches not pendulous; stamens five; stipes 0.5-1.6 mm long, styles 0.4-0.6 mm long.	<i>Salix pentandra</i>
33. Leaves narrowly ovate, glaucous abaxially; branches pendulous; stamens two; stipes 0-0.2 mm long, styles 0.15-2 mm long.	<i>Salix ×sepulcralis</i>
34(32) Ovaries glabrous.	35
33. Ovaries hairy.	49
35(34) Leaves green or pale abaxially, not glaucous.	36
35. Leaves glaucous abaxially.	41
36(35) Petioles with glandular dots or lobes at distal ends.	37
36. Petioles lacking glandular dots of lobes at distal ends.	38
37(36) Stipules foliaceous; leaf apices long-acuminate to caudate; branches often highly brittle at bases, hairy or glabrous; flowering early in the season.	<i>Salix lasiandra var. caudata</i>
37. Stipules absent or rudimentary; leaf apices acuminate to acute; branches flexible at bases, glabrous; flowering late in the season.	<i>Salix serissima</i>
38(36) Leaves linear, 7-19 times as long as wide; margins distantly denticulate; catkins sometimes branched; pistillate bracts deciduous after flowering.	<i>Salix interior</i>
38. Leaves not linear, only 2-5 times as long as wide; margins serrulate or crenate; catkins not branched; pistillate floral bracts persistent.	39
39(38) Leaves coarsely villous on both surfaces; margins glandular serrulate or partly entire.	<i>Salix commutata</i>
39. Leaves glabrous or becoming so; margins glandular crenate to crenate-serrulate.	40
40(39) Shrubs decumbent, 0.1-0.6 (-1) m tall; stipules rudimentary to 1-2 mm long; styles 0.3-0.7 mm long; proximal leaf margins crenulate.	<i>Salix myrtilifolia</i>
40. Shrubs erect, 0.6-7 m tall; stipules foliaceous, 1-5 mm long; styles 0.4-1.6 mm long; proximal leaf margins entire or serrulate.	<i>Salix pseudomyrsinites</i>
41(35) Juvenile leaves translucent, glabrescent and green on both surfaces, becoming glaucous abaxially; leaves and buds with persistent balsam-like odor.	<i>Salix pyrifolia</i>
41. Juvenile leaves opaque, glabrous to pubescent on both surfaces; lacking a balsam-like odor.	42
42(41) Petioles glandular dotted or lobed at distal end; stamens 5; leaf apices caudate to acuminate.	<i>Salix lasiandra var. lasiandra</i>
42. Petioles not glandular at distal ends; stamens 2; leaf apices acute to rounded.	43
43(42) Stipules rudimentary or absent.	44
43. Stipules foliaceous.	46

- 44(43) Low-growing bog or fen species; styles 0.1-0.2 mm long; catkins loosely flowered; largest medial leaf blades leathery; glaucous adaxially; ovules 4-6 per ovary; stipes 2.1-3.2 mm long. *Salix pedicellaris*
44. Taller shrubs not growing in bogs or fens; styles 0.2-6 mm long; catkins moderately to densely flowered; largest medial leaf blades herbaceous, not glaucous adaxially; ovules 12-26; stipes 0.5-2.4 mm long. . 45
- 45(44) Branches yellow-brown or gray-brown; leaves narrower (length/width 2.6-7); styles 0.2-0.6 mm long; pistillate flowering branchlets 0.5-9 mm long. *Salix eriocephala* var. *famelica*
45. Branches red-brown; leaves broader (length/width 1.5-2.1); styles 1.1-2.3 mm long; pistillate flowering branchlets 10-35 mm long. *Salix hookeriana*
- 46(43) Floral bracts glabrous, tawny; petioles deeply grooved adaxially; staminate abaxial nectary present; pistillate adaxial nectary equal to or longer than stipes. *Salix raupii*
46. Floral bracts hairy, brown or black; petioles flat or shallowly grooved adaxially; staminate abaxial nectaries absent; pistillate adaxial nectary shorter than stipes. 47
- 47(46) Styles 0.2-0.4 mm long; leaves with minute ferruginous hairs on adaxial midrib; inner bud scale membrane free but not separating from outer membrane *Salix hastata*
47. Styles 0.5-1.6 mm long. leaves with white hairs, if any; inner bud scale membrane free and separating from outer..... 48
- 48(47) Leaves elliptic or obovate; juvenile leaves green and opaque; petioles green; branchlets densely to sparsely villous; styles 0.6-1.6 mm long. *Salix barclayi*
48. Leaves narrowly oblong to narrowly obovate; juvenile leaves reddish and translucent; petioles reddish; branches glabrescent; styles 0.5-0.75 mm long. *Salix prolixa*
- 49(34) Flowering just before leaves emerge, staminate catkins appearing just before leaves, flowering branchlets 0-8 mm long, pistillate catkins appearing after leaves, flowering branchlets 1-7 mm long; stipules absent or rudimentary; styles 0.1-0.5 mm long; stipes 1.5-5 mm long.50
49. Plants without this set of characters. 51
- 50(49) Leaves lorate to very narrowly elliptic, 5-9 times as long as wide; branchlets yellowish or yellow-green; ovaries short beaked, pyriform. *Salix petiolaris*
50. Leaves narrowly oblong to elliptic or obovate, 2-3.8 times as long as wide; branchlets red-brown; ovaries long-beaked, obclavate. *Salix bebbiana*
- 51(49) Stipes 2.8-4.8 mm long, about 10 times as long as the nectaries. *Salix bebbiana*
51. Stipes 0-2 mm long, 1-2 times as long as the nectaries. 52
- 52(51) Leaves silky abaxially; margins glandular serrulate to distantly so. 53
52. Leaves densely pubescent to glabrescent abaxially, not silky. 54
- 53(52) Leaves very narrowly elliptic to elliptic, 5-7 times as long as wide, silky abaxially with short, white or ferruginous hairs; margins prominently glandular-serrulate; styles 0.3-0.5 mm long. *Salix arbusculoides*
53. Leaves narrowly elliptic to obovate, 2-5-3 times as long as wide, appearing satiny beneath with appressed, silky hairs; margins distantly and inconspicuously glandular-serrulate to glandular-crenate; styles 0.5-0.8 mm long. *Salix sitchensis*
- 54(52) Juvenile leaves with white and ferruginous hairs.55
54. Juvenile leaves with white hairs.56

- 55(54) Leaves pale green (not glaucous) and glabrous abaxially; margins prominently glandular-dotted to glandular-serrulate; Juvenile leaves silky with white and ferruginous hairs; stipes 0.8-2 mm long. *Salix maccalliana*
55. Leaves glaucous, glabrous or sparsely hairy abaxially; margins entire. *Salix athabascensis*
- 56(54) Juvenile leaves very densely tomentose; petioles woolly; mature leaves densely dull white woolly abaxially, floccose to glabrescent adaxially, blades 3.3-12 times as long as wide; styles red. *Salix candida*
56. Juvenile leaves long-silky to villous; petioles glabrate to villous; mature leaves not hairy as above, blades 1.5-4.8 times as long as wide; styles yellow-green. 57
- 57(56) Petioles 3-15 mm long, yellowish; stipes 0.5-2 mm long. *Salix glauca*
57. Petioles 1-3 mm long, often reddish; stipes 0-0.5 mm long. 58
- 58(57) Pistillate catkins subglobose, densely flowered; styles 0.5-0.8 mm long. *Salix brachycarpa*
58. Pistillate catkins cylindrical, loosely flowered; styles 0.2-0.5 mm long. *Salix niphoclada*

TAXONOMIC TREATMENT

Salix alaxensis (Andersson) Coville

felt-leaf willow

Mid shrubs to trees, not colonial. **Stems** erect; **branches flexible at bases**; **branchlets** gray- or red-brown; **buds with caprea-type gradation**. **Leaves, stipules** foliaceous, *sometimes persistent for 2 or more years*, apices acuminate to acute; **petioles** convex to flat or shallowly grooved adaxially, 3-20 mm, adaxial surfaces tomentose; **juvenile leaves** reddish or yellowish green, often obscured by hairs, abaxial surfaces very densely, woolly-tomentose, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, broadly oblong, narrowly oblong, very narrowly elliptic, narrowly elliptic, elliptic, narrowly oblanceolate, oblanceolate, obovate, or broadly obovate, 50-110 × 13-35 mm, length-width ratio 2-4; bases cuneate, convex, or slightly decurrent, angles < 90°; margins strongly revolute, entire or crenate, glands submarginal; apices acuminate, acute, or convex, angles < or > 90°; abaxial surfaces obscured by hair, very densely woolly-tomentose or tomentose, hairs spreading or erect, white, wavy; adaxial surfaces dull, not glaucous, sparsely or moderately densely villous (floccose) to glabrescent, hairs white or gray. **Catkins flowering before leaves emerge**, lateral; **staminate** 23-55 × 13-27 mm, flowering branchlets 0-6 mm; **pistillate densely flowered**, slender to stout; **floral bracts** brown or black, 1.5-2-2.5 mm, abaxial surfaces hairy all over, hairs straight; bract apices acute to convex, entire; pistillate bracts persistent after flowering. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.5-1.4 mm; stamens 2, anthers purple becoming yellow, *long-cylindrical*, 0.6-0.9 mm; filaments distinct, glabrous; **pistillate** adaxial nectaries narrowly oblong, 0.6-1.6 mm, longer than stipes, thin; **stipes 0-0.4 mm**; ovaries pyriform, beaks gradually tapering to styles, sparsely to moderately densely villous, hairs white, wavy, flattened, refractive; styles connate, 1.3-2.8 mm; stigmas slender-cylindrical, 0.4-0.99-1.28 mm; 14-18 ovules per ovary. **Capsules** 4-5 mm.

1. Branchlets very densely villous, not evidently glaucous; leaf blades with an evident, yellowish midrib that is moderately densely tomentose to sparsely pubescent. *Salix alaxensis* var. *alaxensis*
1. Branchlets glabrescent, strongly glaucous; leaf blades with a prominent, yellowish midrib that is sparsely pubescent or glabrescent. *Salix alaxensis* var. *longistylis*

Salix alaxensis* (Andersson) Coville var. *alaxensis**felt-leaf willow**

Salix alaxensis var. *obovalifolia* C.R. Ball, *S. speciosa* Hooker & Arnott β (var.) *alaxensis* Andersson in DC. Prodr. 16(2): 275. 1868

Mid shrubs to trees 1-7 m. **Stems, branches** *not evidently glaucous, red-brown, densely villous*; **branchlets** *not evidently glaucous, very densely villous*, hairs white or yellowish, spreading, straight or wavy. **Leaves, largest medial blades:** midribs evident, yellowish, moderately densely tomentose to sparsely pubescent. **Catkins, staminate** stout; **pistillate** 33-85 (to 90 mm in fruit) \times 10-22 mm, **flowering branchlets** **0-2 mm**. $2n = 38$, $2x$ (Johnson & Packer 1968; Löve & Löve 1982; Suda & Argus 1969). Russia: $2n = 38$, $2x$ (Petrovsky & Zhukova 1983; Zhukova 1967, 1969).

Flowering mid-April to mid-July. River and lake shores and terraces on coarse, calcareous gravel, well-watered scree slopes, well-drained to wet sand plains and dune remnants on river delta, wet alpine and subalpine meadows and thickets; 1-975 m; Alta., B.C., Man., N.T., Nunavut, Que., Yukon; Alaska. Asia (northern and eastern Siberia). Map 1.

Salix alaxensis var. *alaxensis* is characterized by flowering before leaves emerge; leaves narrowly ovate to obovate, bright green adaxially, and densely white woolly abaxially; branchlets densely white villous-woolly; petioles often inflated around the large floral buds; catkins large and sessile; ovaries hairy and long styles.

Salix alaxensis* (Andersson) Coville var. *longistylis* (Rydb.) C.K. Schneider*felt-leaf willow**

Salix longistylis Rydberg, Bull. N. Y. Bot. Gard. 2: 163. 1901; *S. alaxensis* (Andersson) Coville subsp. *longistylis* Hultén

Mid shrubs to trees 1-4 m. **Stems, branches** yellow- or red-brown, **strongly glaucous**, glabrous or sparse villous; **branchlets** **strongly glaucous**, glabrous or sparsely to moderately densely villous; **largest medial blades:** abaxial surfaces glaucous, midrib prominent, yellowish, sparsely pubescent or glabrescent. **Catkins, staminate** stout to subglobose; **pistillate** 37-103 \times 8-20 mm, flowering branchlets 0-13 mm.

Flowering late March to early July. Pioneer thickets on river alluvium and glacial moraines, subalpine thickets, alpine tundra, moist to mesic talus slopes, and forest openings; 1-975 m; B.C., Man., N.T., Yukon; Alaska. Map 2.

Salix alaxensis var. *longistylis* differs from var. *alaxensis* mainly in branchlets glaucous and less densely hairy. Some specimens of var. *alaxensis*, in which the indumentum has been partially removed by wind erosion, show that they too have glaucous branchlets. The only fundamental difference between the two may be the density of branchlet indumentum. The other differences, which appear in the varietal descriptions, may represent inadequate sampling. The taxa are maintained only because of the conspicuous difference between the extremes. See Table 5 for comparison with *S. drummondiana*.

Salix arbusculoides* Andersson*little-tree willow**

Mid to tall shrubs or trees 1-6 m, *not colonial*. **Stems** erect; **branches** flexible at bases, gray- to red-brown, not glaucous, glabrous; **branchlets** **red-brown**, not glaucous, **glabrous or puberulent**, hairs spreading; **buds with alba-type gradation**. **Leaves, stipules on first leaves minute rudiments**, on later leaves foliaceous or minute rudiments, deciduous in autumn, apices acute; **petioles shallowly grooved adaxially**, 3-11 mm, **not glandular at distal ends**, adaxial surfaces puberulent or glabrescent; **juvenile leaves** yellowish green, **abaxial surfaces very densely long-silky**, hairs white and ferruginous or white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, very narrowly elliptic,

narrowly elliptic, to elliptic, 38-78 × 7-18 mm, length-width ratio 3-6.5; bases cuneate, slightly decurrent, or convex, angles < 90°; margins slightly revolute, serrulate all around margins, glands marginal or submarginal; apices acuminate, acute, or convex, angles < 90°; abaxial surfaces glaucous or obscured by hair, sparsely to very densely long-silky, hairs appressed, white or white and ferruginous, straight; adaxial surfaces highly glossy or shiny, glabrous. **Catkins flowering as or just before leaves emerge**, lateral; **staminate** stout or slender, 17-43 × 5-10 mm, flowering branchlets 0-2.5 mm; **pistillate** densely to loosely flowered, stout to slender, 20-46 × 6-15 mm, flowering branchlets 0-6 mm; **floral bracts** tawny or brown, 0.8-1.2 mm, abaxial surfaces hairy all over, hairs white, straight or wavy; bract apices convex to rounded, entire; pistillate bracts persistent after flowering. **Flowers, staminate** adaxial nectaries oblong, 0.55-0.93 mm; stamens 2, anthers purple becoming yellow, ellipsoid to globose, 0.3-0.6 mm; filaments distinct, glabrous; **pistillate** adaxial nectaries oblong or ovate, 0.6-1 mm, **equal to or longer than stipes**, flat, thick; stipes 0.6-0.9 mm; ovaries pyriform, beaks gradually tapering to styles, very densely short-silky, hairs white or white and ferruginous, flattened; styles connate or slightly distinct, 0.3-0.5 mm; stigmas slender- to broad-cylindrical or two plump lobes, 0.16-0.29-0.44 mm; 16-18 ovules per ovary. **Capsules** 4-6 mm. $2n = 38, 2 \times$ (Löve & Löve 1982; Suda & Argus 1968, 1969).

Flowering mid-May to early July. River and stream margins and lake shores, openings in white spruce forests, treed bogs, sedge fens, and edges of alpine and arctic tundra; 1-1970 m; Alta., B.C., Man., N.T., Nunavut, Ont., Que., Sask., Yukon; Alaska. Map 3.

Salix arbusculoides is characterized by leaves narrowly elliptic, margins finely glandular-serrulate, blades glabrous adaxially, and silky abaxially with white or ferruginous hairs.

***Salix arctica* Pall.**

Arctic willow

Salix arctica subsp. *crassijulis* (Trautv.) A. Skvortsov; *S. arctica* subsp. *tortulosa* (Trautv.) Hultén; *S. arctica* var. *antiplasta* (C.K. Schneider) Fernald; *S. arctica* var. *araioclada* (C.K. Schneider) Raup; *S. arctica* (var.) *brownei* Andersson; *S. arctica* var. *kophophylla* (C.K. Schneider) Polunin; *S. arctica* var. *pallasii* (Andersson) Kurtz; *S. crassijulis* Trautv.

Dwarf shrubs 3-25 cm (to 1-2 m on Attu Isl.), not colonial or forming colonies by layering. **Stems** erect, decumbent or trailing; **branches** flexible at bases, yellow-, gray-, or red-brown, shiny, not or strongly glaucous, glabrous or glabrescent; **branchlets yellow-or red-brown, or violet**, not to strongly glaucous, glabrous, pilose, or densely villous, hairs geniculate, wavy, curved, or straight, generally appearing unkempt; **buds** with *arctica*-type gradation. **Leaves, stipules** on first leaves foliaceous, minute rudiments, or absent, **on later leaves foliaceous, early deciduous**, apices acute; **petioles** deeply grooved adaxially, 2-35 mm, not glandular at distal ends, adaxial surfaces puberulent or glabrous; **juvenile leaves** yellowish green, abaxial surfaces **glabrous or sparsely villous with long, straight, hairs pointing toward tip**, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, narrowly elliptic, elliptic, broadly elliptic, subcircular, circular, oblanceolate, obovate, or broadly obovate, 10-85 × 5.5-60 mm, length-width ratio 1-3.6(-4.9); bases cuneate, convex, rounded, or slightly decurrent, angles < or > 90°; margins slightly revolute or flat, entire or remotely serrate at proximal ends, **glands submarginal**; apices acuminate, acute, convex, or rounded, angles < or > 90°, **abaxial surfaces glaucous, pilose or sparsely short-silky on midrib or long-silky bearded tip**, hairs generally straight or wavy, white; **adaxial surfaces shiny or dull**, glabrous, pilose or long-silky near margins. **Catkins** flowering as leaves emerge, lateral; **staminate** 14-65 × 5-18 mm, flowering branchlets 2-36 mm; **pistillate** densely to moderately densely flowered, slender, stout, or subglobose, 20-145 × 8-22 mm, flowering branchlets 2-40 mm; **floral bracts brown or black**, 1.6-3.7 mm, **abaxial surfaces sparsely hairy all over, hairs white, long, straight**; bract apices broadly rounded convex, or retuse, entire or undulate; pistillate bracts persistent after flowering. **Flowers, staminate abaxial nectaries** (0-)0.3-0.8 mm, adaxial nectaries narrowly oblong,

oblong, or square, 0.5-1.2 mm, **abaxial and adaxial nectaries distinct**; stamens 2, anthers purple or red generally becoming yellow, **ellipsoid**, 0.32-0.9 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong, ovate, or narrowly oblong, 0.4-1.8 mm, longer than stipes, stipes 0.2-1.6 mm, ovaries obclavate or pyriform, beaks abruptly to gradually tapering to styles, **villous**, hairs white, wavy, flattened, sometimes refractive, styles connate to distinct about half, 0.6-2.2 mm, stigmas slender-cylindrical, 0.35-0.56-0.88(-1.13) mm, 12-15 ovules per ovary. **Capsules** 4-9 mm. $2n = 76$, $4\times$ (Dawson pers com.; Holmen 1952; Johnson & Packer 1968; Mosquin & Haley 1966) or $2n = 114$, $6\times$ (Suda & Argus 1969). Russia: $4\times$ (Zhukova & Petrovsky 1980), $6\times$ (Zhukova et al 1973; Petrovsky & Zhukova 1983; Zhukova & Petrovsky 1987).

Flowering early June to mid-August (20 October on Aleutian Islands). Arctic-alpine; wet to mesic or dry habitats including hummocks in wet *Sphagnum* bogs and sedge meadows, polygonal tundra, solifluction slopes, snow beds; margins of pools, beach ridges, shale and gypsum ridges, gneissic cliffs, colluvial slopes, talus slopes, glacial moraines, imperfectly drained calcareous silty till, muddy salt flats, frost-heaved clay polygons, dry calcareous gravel, and coarse sandy soil; 1-1981 m; Alta., B.C., Lab., Man., Nfld., N.T., Nunavut, Ont., Que., Yukon; Alaska, Idaho, Mont., Oreg., Wash.; Greenland; Eurasia: Iceland; Russia (Arctic Europe, Novaya Zemlya, East Siberia, Arctic Siberia, the Far East, Chukotka), China (Xinjiang). Map 4.

Salix arctica is a dwarf shrub often forming prostrate mats spreading from a central caudex, sometimes its branches are long and trailing and root where they touch the surface. Leaf size and shape are highly variable but the abaxially surfaces of the leaves is always glaucous and usually sparsely clothed with long, straight, appressed hairs that may persist as a "beard" at the tip, the margins are entire. Floral bracts are dark brown and clothed with long, straight hairs.

This circumpolar species is morphologically polymorphic and nomenclaturally complex. 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 the recognition of three races is appealing they are actually very difficult or impossible to separate morphologically and are not recognized here. The basis for some of the variability may be environmental modification (Argus 1973; Saville 1964; Soper & Powell 1985). For example, on Attu I., Alaska, there are plants up to 2 m tall growing together with low-growing plants (Parker, pers. com.). Their tall stature, however, cannot be accounted for by habitat alone. The question of whether the some of the morphological variability within *S. arctica* is ecophenic or ecotypic deserves study.

Dawson (1987) showed that the female-biased sex ratio in *S. arctica* is environmentally controlled; female plants are significantly over-represented in mesic-wet, more fertile, low soil temperature sites, whereas, male plants are predominant in drier, less fertile sites. The reported ages of *Salix arctica* is 236 years on Greenland (Raup 1965) and 85 years on Ellesmere Island (Savile 1979).

Salix arctica \times *S. glauca* (*S. \times waghornei* Rydb.) is very common. It is characterized by various combinations of the characteristics of *S. arctica* and *S. glauca* (Argus 1965, 1973, 2003, Bay 1992). It resembles *S. arctica* in its prostrate habit, glaucous branches and buds, sparse branchlet hairiness, dark-colored bracts with long, straight hairs, leaves with long, straight hairs on the abaxial surfaces projecting in a "beard" at the apices, capsules reddish with long stigmas, and dark colored anthers. It resembles *S. glauca* in its erect habit, leaves less oblanceolate and without the attenuate bases of *S. arctica*, shorter petioles, bracts light-colored with shorter wavy hairs, and divided styles. The presence of glaucous branches should be used with caution because it could also be an indication of hybridization *S. glauca* with *S. planifolia* or *S. pellita*

as well as with *S. arctica*. *Salix arctica* × *S. pedicellaris* (*S. ×hebecarpa* Fern., pro var.). See *S. pedicellaris*. *Salix arctica* × *S. polaris*. See *S. polaris*.

Salix arctica × *S. stolonifera* occurs wherever the two species come into contact. Putative hybrids and intergrades have ovaries with bare patches or with hairs only on the beaks. The leaves are often glabrous or ciliate. Further study is needed.

Salix arctica × *S. rotundifolia* has been inferred as the identity of plants of *S. rotundifolia* which have partly hairy ovaries and leaves more or less glaucous abaxially.

Salix arctica also hybridizes with *S. barclay* (Argus 1973, 1999); see those species for discussion. See Table 1 for comparison with *S. arctophila* and Table 7 for a comparison with similar species.

Table 1. Comparison of *Salix arctica* and *Salix arctophila*.

	<i>S. arctica</i>	<i>S. arctophila</i>
Stems	usually stout, erect or trailing	slender, trailing
	brownish	yellow-green
	sparsely hairy	glabrous
Leaf margins	entire or toothed at proximal ends	toothed all around or at proximal ends
Leaf indumentum	hairy	glabrous
Ovary hairs	flattened-cylindrical,	flat, ribbon-like
	straight or curly	crinkled
	weakly refractive	strongly refractive
Nectaries	longer than stipes	shorter than stipes

***Salix arctophila* Cockerell ex A. Heller**

northern willow

Salix arctophila var. *lejocarpa* (Lange) C.K. Schneider; *S. groenlandica* var. *lejocarpa* Lange

Dwarf shrubs 3-15 cm, **forming colonies by layering**. **Stems** prostrate, slender, long-trailing; **branches** flexible at bases, yellow-, red-, or green-brown, not glaucous or weakly so, shiny to highly glossy, glabrous; **branchlets** yellow-green or yellow- to red-brown, not glaucous or weakly so, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** on first leaves minute rudiments, absent, or foliaceous, on later leaves foliaceous or minute rudiments, deciduous in autumn, **35-61 mm**, apices acuminate or acute; **petioles** deeply grooved adaxially, 3-7.8-15 mm, not glandular at distal ends, glabrous; **juvenile leaves** yellowish green, glabrous; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, elliptic, obovate, broadly elliptic, broadly obovate, subcircular, or oblanceolate, 15-31-60 × 6.5-16-35 mm, length-width ratio 1.2-3-4.3; bases cuneate, convex, slightly decurrent, or rounded, angles < or > 90°; margins slightly revolute, entire or crenulate all around margins or at proximal ends, glands marginal or submarginal; apices acute to convex, angles < or > 90°; abaxial surfaces glaucous, glabrous, adaxial surfaces shiny or highly glossy, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral; **staminate** stout to subglobose, 19-54 × 7-16 mm, flowering branchlets 4-20 mm; **pistillate** densely to moderately densely flowered, slender to subglobose, 30-79 (to 130 mm in fruit) × 10-20 mm, flowering branchlets 8-57 mm; **floral bracts** brown, black, or bicolor, 0.8-2.4 mm, abaxial surfaces **densely hairy all over**, hairs white, straight; bract apices rounded or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, square, narrowly oblong, or ovate, 0.4-1 mm; stamens 2, **anthers purple becoming yellow**, ellipsoid or long cylindrical, 0.5-0.7 mm, filaments distinct or connate less than half, glabrous or hairy on lower half; **pistillate** adaxial nectaries oblong or narrowly oblong, 0.5-0.9 mm, **shorter than stipes, stipes 0.8-1.4 mm**, ovaries pyriform or obclavate, beaks gradually tapering to styles, pubescent or short-silky (dusty appearance), hairs gray or white and ferruginous, wavy or crinkled, ribbon-like, styles connate or distinct about half their lengths, 0.6-1.4 mm, stigmas

slender- or broad-cylindrical, 0.24-0.47-0.72 mm, 8-16 ovules per ovary. **Capsules** 5-9 mm. $2n = 76$, $4\times$ (Jorgensen et al. 1958; Löve & Löve 1982).

Flowering late May to late July. Arctic-alpine, subarctic; hummocks in wet, mossy, grass or sedge meadows; margins of streams or ponds, among granitic boulders, on alluvial plains, or sometimes in snow beds; 45-570 m; Greenland. Lab., Man., Nfld., N.T., Nunavut, Ont., Que., Sask., Yukon; Alaska, Maine. Map 5.

Salix arctophila is characterized by a dwarf habit and with long, trailing, glabrous branches and branchlets; leaves glabrous and sparsely toothed; and ovaries puberulent to sparsely silky with flat, crinkled, ribbon-like, refractive hairs. See Table 1 for comparison with *S. arctica*.

***Salix athabascensis* Raup**

Athabasca willow

Salix fallax Raup; *S. pedicellaris* var. *athabascensis* (Raup) Boivin

Mid shrubs 0.6-1.3 m, not colonial. **Stems** erect; **branches** flexible at bases, **gray-brown**, not glaucous, glabrescent; **branchlets red-brown**, not glaucous, sparsely or moderately densely pubescent, hairs geniculate; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments, on later leaves minute rudiments or rarely foliaceous; **petioles** shallowly grooved adaxially, 3-10 mm, **not glandular at distal ends**, adaxial surfaces puberulent or villous; **juvenile leaves** yellowish green, abaxial surfaces sparsely to moderately densely villous or long-silky, **hairs white and ferruginous**; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, oblong, narrowly elliptic, elliptic, oblanceolate, or obovate, 17-50 × 8-18 mm, length-width ratio 1.9-3.2; bases cuneate, slightly decurrent, or convex, angles < 90°; margins flat or slightly revolute, entire, **glands marginal, at proximal ends**; apices acuminate or convex, angles < or > 90°; abaxial surfaces glaucous, glabrescent, adaxial surfaces dull or shiny, not glaucous, glabrous or pilose or sparsely long-silky along midribs and at margins, hairs white or white and ferruginous. **Catkins** flowering as leaves emerge, lateral; **staminate** stout to subglobose, 14-31 × 8-18 mm, flowering branchlets 1.5-9 mm; **pistillate loosely flowered**, stout to globose, 10-58 × 7-25 mm, flowering branchlets 3.5-26 mm; **floral bracts** tawny, 1-1.6 mm, abaxial surfaces sparsely hairy all over, almost glabrous, hairs white, wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries (0-)0.28-0.63 mm, adaxial nectaries oblong or ovate, 0.4-1.2 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers purple becoming yellow, globose, 0.4-0.6 mm, filaments distinct, hairy on lower halves; **pistillate** adaxial nectaries oblong, 0.4-1.25 mm, shorter than stipes, flattened; **stipes 0.8-1.3 mm**; ovaries pyriform, beaks slightly bulged below styles, **very densely long-silky**, hairs white or white and ferruginous, wavy, flattened; styles connate or slightly distinct, 0.48-1 mm; stigmas broad-cylindrical, 0.28-0.35-0.48 mm, 6-14 ovules per ovary. **Capsules** 5.6-7.2 mm. $2n = 76$, $4\times$ (Argus 1965; Löve & Löve 1982; Suda & Argus 1969); $2n = 95$, $5\times$ (Argus 1965); and $2n = 114$, $6\times$ (Suda & Argus 1969)

Flowering late May to late July. Fens, bogs, and treed bogs; 5-1800 m; Alta., B.C., Man., N.T., Sask., Yukon; Alaska. Map 6.

Salix athabascensis is characterized by leaves narrowly elliptic, sparsely pilose to glabrescent with appressed white or ferruginous hairs; catkins loosely flowered, ovaries silky, sometimes with some ferruginous hairs, long stipes (0.8-1.3 mm), and short nectaries. *Salix athabascensis* commonly hybridizes with *S. pedicellaris* to form hybrid swarms (see *S. pedicellaris*). See Table 2 for comparison with *S. pedicellaris*.

Table 2. Comparison of *Salix athabascensis* and *Salix pedicellaris*.

	<i>S. athabascensis</i>	<i>S. pedicellaris</i>
Ovaries	long-silky	glabrous
Style length	0.48-1 mm	0.1-0.24 mm
Branchlet hairs	short, geniculate	very minute, straight
Leaves	sparsely silky	glabrous

Salix barclayi* Andersson*Barclay's willow**

Mid to tall shrubs (0.3-)1-3(-5) m, not colonial. **Stems** erect or decumbent in alpine; **branches** flexible at bases, **red-brown** (sometimes yellowish brown), not to strongly glaucous, glabrous or villous; **branchlets** yellow-green, yellow- or red-brown, not glaucous, densely villous to pubescent, hairs spreading, curved, wavy, or straight; bud scale margins connate. **Leaves, stipules foliaceous**, deciduous in autumn, apices acuminate, acute, or rounded; **petioles** shallowly grooved or convex to flat adaxially, 3-14(-20) mm, **not glandular at distal ends**, adaxial surfaces villous or pilose; **juvenile leaves** yellowish green or reddish, abaxial surfaces densely villous, persistent on midribs, or glabrous, hairs white; **proximal leaves** serrulate, crenulate, or entire; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, oblong, narrowly elliptic, elliptic, oblanceolate, or obovate, 33-70(-100) × 12-35(-48) mm, length-width ratio 1.6-2.8(-4); bases rounded, convex, or slightly decurrent, sometimes subcordate, angles < or > 90°; **margins flat**, serrulate all around margins, glands marginal or submarginal; apices acute, acuminate, or convex, angles < or > 90°; **abaxial surfaces glaucous**, glabrous or glabrescent, hairs spreading, white, straight; adaxial surfaces shiny or dull, not glaucous, glabrous or sparsely pilose to glabrescent, all over or midrib remaining pilose, hairs white. **Catkins flowering as leaves emerge**, lateral; **staminate** stout, 13-60 × 10-25 mm, flowering branchlets 0-17 mm; **pistillate moderately densely flowered**, stout, subglobose, or slender, 26-80 × 9-18 mm, **flowering branchlets 4-24 mm**; **floral bracts** brown or black, 1.6-2.8 mm, **abaxial surfaces moderately densely hairy all over**, hairs straight, wavy, or curly; bract apices acute or rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, 0.45-0.8 mm; stamens 2, **anthers yellow**, ellipsoid or short-cylindrical, 0.6-1 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong or ovate, 0.4-0.8 mm, shorter than or equal to stipes, thin; stipes 0.4-1.5 mm, ovaries obclavate or pyriform, beaks gradually tapering to styles, **glabrous**; styles connate or slightly distinct, 0.6-2.5 mm, stigmas flat, undivided or slender-cylindrical, 0.28-0.48-0.72 mm, 18-24 ovules per ovary. **Capsules** 3-8 mm. $2n = 76, 4\times$ (Dorn 1976).

Flowering late May to early August. Lake and river shores, fens, moist to mesic forest openings, subalpine and alpine slopes, glacial moraines; 1-2835 m.; Alta., B.C., N.T., Yukon; Alaska, Idaho, Mont., Oreg., Wash. Map 7.

Salix barclayi is characterized by leaves elliptic to obovate, sparsely hairy adaxially and glabrous and glaucous abaxially, often drying brownish; margins serrulate; stipules prominently glandular dotted; ovaries glabrous and nectaries about half as long as the stipes. This species commonly hybridizes and intergrades with *S. richardsonii*. Hybrids resemble *S. barclayi* in catkins borne on distinct flowering branchlets, small stipules, anthers yellow, and longer. They resemble *S. richardsonii* in persistent stipules and pistillate nectaries longer than stipes. *Salix barclayi* also hybridizes with *S. arctica*, *S. commutata*, and *S. stolonifera* (Argus 1973). See Tables 3 and 8 for comparisons with similar species.

Table 3. Comparison of *Salix barclayi* and *Salix richardsonii*

	<i>S. barclayi</i>	<i>S. richardsonii</i>
Branch epidermis	not flaky	flaky
Stipules	deciduous in autumn	sometimes persistent 2 or more years
Proximal leaf margins	serrulate	entire or serrulate
Juvenile leaf hairs	white	white or white and ferruginous
Leaf hairs	white	white or white and ferruginous
Leaf bases	convex or rounded	cuneate, convex or concave
Leaf margins	serrulate	entire or serrulate
Catkins flowering	as leaves emerge	before leaves emerge
flowering branchlets	leafy, 4-24 mm long	not leafy, 0-2 mm long

Salix barrattiana* Hook.*Barratt's willow**

Salix albertana Rowlee; *S. barrattiana* var. *marcescens* Raup.

Low to mid shrubs 0.3-1.5 m, not colonial. **Stems** erect or decumbent; **branches** flexible at bases, red-brown, not glaucous or weakly so, glabrous or villous in patches; **branchlets red-brown or violet**, not glaucous, moderately densely, coarsely villous, hairs spreading; **buds** with *caprea*-type gradation. **Leaves, stipules** foliaceous, *sometimes persistent for 2 or more years*, resinous, apices acute; **petioles** shallowly grooved or convex to flat adaxially, 4-15 mm, *not glandular at distal ends*, adaxial surfaces villous or puberulent; **juvenile leaves** yellowish green or obscured by hairs, abaxial surfaces very densely long-silky, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, elliptic, broadly elliptic, oblanceolate, or obovate, 35-95 × 10-29 mm, length-width ratio 2.2-4.2(-5); bases convex, rounded, cuneate, or slightly decurrent, sometimes cordate, angles < 90°; margins flat, entire, **glands marginal** all around margins or at proximal ends; apices acute, convex, or acuminate, angles < or > 90°; abaxial surfaces *not glaucous*, moderately densely to very densely long-silky-tomentose to glabrescent, **hairs appressed**, white, wavy; adaxial surfaces shiny, not glaucous, sparsely villous, pubescent, or glabrescent, hairs white. **Catkins flowering before leaves emerge**, lateral; **staminate** stout or subglobose, 20-57 × 13-18 mm, flowering branchlets 0-2 mm; **pistillate densely flowered**, slender to stout, 28-92 (to 105 in fruit) × 12-19 mm, flowering branchlets 0-5 mm; **floral bracts** brown or black, 2.8-5.2 mm, abaxial surfaces hairy all over, hairs white, straight; bract apices acute to convex, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.4-1.8 mm; stamens 2, anthers yellow or purple becoming yellow, ellipsoid or short-cylindrical, 0.4-0.6 mm; filaments distinct, glabrous; **pistillate** adaxial nectaries oblong narrowly to oblong, 0.6-1.3 mm, longer than stipes, flattened; **stipes 0.2-0.6 mm**; ovaries pyriform, beaks gradually tapering to styles, densely villous, hairs white, wavy, flattened, refractive; styles connate or slightly distinct, 0.6-1.8 mm; stigmas slender- to broad-cylindrical, 0.28-0.47-0.64 mm; 16-21 ovules per ovary. **Capsules** 4.5-6 mm.

Flowering late May to late July. Moist to wet gravel bars, fans and terraces, stream banks, shrub tens, thickets and meadows, wet alpine tundra; often on limestone substrate; 162-3200 m.; Alta., B.C., N.T., Yukon; Alaska, Mont., Wyo. Map 8.

Salix barrattiana is characterized by stems gray-hairy and erect; leaves gray-hairy and typically crowded on the branchlets with short internodes; and buds and stipules that are strongly resinous, staining pressing sheets yellow, and emitting a noticeable blasamic odor. *Salix barrattiana* × *S. commutate* generally resembles with *S. barrattiana* but the ovaries are hairy in patches, the stipes are 1 mm long, and the buds are not resinous.

Salix bebbiana* Sarg.*gray willow, Bebb's willow, long-beaked willow**

S. rostrata Richardson, non Thuill., *S. depressa* L. subsp. *rostrata* (Richardson) Hiitonen.

Mid shrubs to trees 0.5-10 m; not colonial. **Stems** erect; **branches** flexible or somewhat brittle at bases, **dark red-brown**, not glaucous or weakly so, glabrous or pilose; **branchlets** yellow-green or red-brown, not glaucous or weakly so, villous, hairs appressed or spreading, wavy, straight, or geniculate, **buds** with *alba*-type gradation. **Leaves, stipules** on first leaves minute rudiments or absent, on later leaves foliaceous or minute rudiments, sometimes early deciduous, apices acute or convex; **petioles** *convex to flat adaxially*, 2-5.5-13 mm, not glandular at distal ends, adaxial surfaces pubescent; **juvenile leaves** yellowish green or reddish, abaxial surfaces pilose or sparsely to moderately densely tomentose or long-silky, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly oblong, narrowly elliptic, elliptic, oblanceolate, or obovate, 20-44-87 × 10-16-45 mm, length-width ratio 1.7-2.8-3.9; bases cuneate, convex, rounded, or slightly decurrent, angles < or > 90°; margins flat, entire, crenate, or irregularly serrate all around margins, **glands submarginal**; apices acute, acuminate, or convex, angles <90°; abaxial surfaces glaucous, moderately densely pubescent-long-silky to glabrescent, **hairs spreading**, white, wavy; adaxial surfaces dull or shiny, finely impressed-reticulate, not glaucous, moderately densely pubescent-short-silky to glabrescent. **Catkins**, pistillate flowering as leaves emerge, staminate flowering just before leaves emerge, both lateral; **staminate** stout, subglobose, or globose, 10-42 × 7-16 mm, flowering branchlets 0.5-11 mm; **pistillate loosely flowered**, stout, slender, or subglobose, 16.5-85 × 9-32 mm, flowering branchlets 1-26 mm; **floral bracts tawny**, 1.2-3.2 mm, abaxial surfaces hairy all over or glabrescent, hairs white, straight or wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or ovate, 0.3-0.8 mm; stamens 2, anthers yellow or purple becoming yellow, ellipsoid or short- or long-cylindrical, 0.5-0.8 mm; filaments distinct or connate less than half, glabrous or hairy on lower halves; **pistillate** adaxial nectaries oblong or square, 0.3-0.75 mm, much shorter than stipes, flattened; **stipes 2-6 mm**; ovaries obclavate, long-beaked, beaks slightly bulged below styles, **short-silky**, hairs straight, flattened, refractive; styles connate, 0.1-0.4 mm; stigmas slender- to broad-cylindrical, 0.32-0.44-0.64 mm, 6-16 ovules per ovary. **Capsules** 5-9 mm. $2n = 38$. $2n = 38$, 2× (Dorn 1975b, 1976; Löve 1954; Löve & Löve 1982). Russia: 2× (Yurtsev & Zhukova 1982; Zhukova et al. 1977).

Flowering early April to late June. Riparian and upland conifer forests, wet lowland thickets, *Picea mariana* treed bogs, stream margins, lake shores, prairie margins, dry south-facing slopes, cienegas, seeps, and disturbed areas; 2-3300 m.; Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Nunavut; Ont., P.E.I., Que., Sask., Yukon; Alaska, Ariz., Calif., Colo., Conn., Idaho, Ill., Ind., Iowa, Maine, Md., Mass., Mich., Minn., Mont., Nebr., Nev., N.H., N.J., N.Mex., N.Dak., N.Y., Ohio, Oreg., Pa., R.I., S.Dak., Utah, Vt., Wash., Wis., Wyo. Asia. Map 9.

Salix bebbiana is characterized by leaves rugose; margins entire to crenate; stipules early deciduous; ovaries on very long stipes (2-6 mm), nectaries about 1/10 as long as the stipes, and tawny floral bracts. It often has contrasting yellowish buds and red-brown branchlets.

***Salix boganidensis* Trautv.**

Mid shrubs to trees 1-5 m, not colonial. **Stems** erect; **branches** red-brown, not glaucous, short-silky, glabrous or glabrescent; **branchlets** *yellowish or yellow-brown*, not glaucous, short-silky, pubescent, tomentose, velvety, hairs appressed or erect; **buds with alba-type gradation**. **Leaves, stipules** on first leaves *minute rudiments*, on later leaves foliaceous, deciduous in autumn or persisting for 2 or more years, apices acuminate or acute; **petioles** *convex to flat adaxially*, 2.5-9 mm, not glandular at distal ends, adaxial surfaces velvety; **juvenile leaves** reddish or yellowish green, abaxial surfaces sparsely to very densely silky, hairs white; **proximal leaves serrulate**; **largest medial blades** hypostomatous or amphistomatous, venation

pinnate, very narrowly elliptic, narrowly elliptic, or elliptic, 36-87 × 6.5-16 mm, length-width ratio 3-6.6; bases cuneate, convex, or slightly decurrent, angles < 90°; margins slightly revolute, entire or serrulate all around margins, glands marginal or submarginal; apices acute or acuminate, angles < 90°; abaxial surfaces glaucous, sparsely short- or long-silky to glabrescent, hairs appressed, white or white and ferruginous, straight; adaxial surfaces shiny or highly glossy, not glaucous, sparsely short-silky to glabrescent, hairs white. **Catkins flowering before or just before leaves emerge**, lateral; **staminate flowering branchlets 0 mm**; **pistillate** very densely flowered to loosely flowered, flowering branchlets 0-6 mm; **floral bracts** tawny or brown, 1-1.8 mm, **abaxial surfaces sparsely hairy all over**, hairs white, straight or wavy; bract apices acute or rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or square, 0.38-0.9 mm; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.45-0.6 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong or narrowly oblong, 0.6-1 mm, longer to shorter than stipes, **stipes 0.5-1.6 mm**, ovaries pyriform, beaks gradually tapering to styles, **densely short-silky**, hairs white, straight, flattened, styles connate or slightly distinct, 0.3-0.63 mm, stigmas slender- or broad-cylindrical, 0.3-0.5 mm; 8-15 ovules per ovary. **Capsules** 4-6 mm. 2n = 38 2× (Zhukova 1967, 1969, Zhukova & Petrovsky 1975, 1976, Zhukova et al. 1977, Yurtsev & Zhukova 1982.)

River valleys and terraces, larch stands, *Chosenia* groves, dwarf birch thickets, and fresh pebble alluvium (Skvortsov 1999). Siberia, Russian Far East. Map 10.

Salix boganidensis and *S. arbusculoides* are closely related and may be conspecific.

***Salix brachycarpa* Nuttall**

small-fruit willow

Salix brachycarpa var. *antimima* (C.K. Schneider) Raup; *S. brachycarpa* var. *glabellcarpa* C.K. Schneider; *S. brachycarpa* var. *sansonii* C.R. Ball

Low or mid shrubs 0.2-1.5 m, **not colonial**. **Stems** erect or decumbent; **branches** flexible at bases, gray- or red-brown, not glaucous, short-silky or villous to glabrescent; **branchlets** red-brown, not glaucous, densely villous, woolly, or long-silky, hairs spreading or appressed, wavy, straight, or geniculate; **bud gradation of arctica-type**. **Leaves, stipules on first leaves absent or minute rudiments**, on later leaves foliaceous or minute rudiments, deciduous in autumn, apices acute; **petioles** deeply to shallowly grooved adaxially, (0.5-)1-3(-4) mm, generally shorter than or barely exceeding bud, not glandular at distal ends, adaxial surfaces villous or long-silky to glabrescent; **juvenile leaves** yellowish green, **abaxial surfaces very densely long-silky**, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly oblong, oblong, narrowly elliptic, elliptic, narrowly oblanceolate, or obovate, (10-)23-30(-40) × 5-16 mm, length-width ratio (1.5-)2.8-3(-4); bases rounded, convex, or subcordate, angles < 90°; margins flat, entire; apices acute or convex, angles < 90°; abaxial surfaces glaucous or obscured by densely villous or long-silky hairs, hairs spreading or appressed, white, straight or wavy; adaxial surfaces shiny, pilose, moderately densely villous or long-silky to glabrescent. **Catkins flowering as leaves emerge**, lateral, **staminate** subglobose, globose, stout 5.25-21 × 4-10 mm, flowering branchlets 0.25-4(-10) mm; **pistillate very densely flowered**, stout to globose, 6-28 (to 30 mm in fruit) × 4-15 mm, flowering branchlets 0.5-11(-20) mm; **floral bracts** tawny, 1-3 mm, abaxial surfaces moderately densely hairy all over, hairs white, straight or wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.45-1.1 mm, adaxial nectaries oblong or narrowly oblong 0.5-1.4 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.3-0.5 mm, filaments distinct or connate less than half, **glabrous or hairy on lower halves**; **pistillate** abaxial nectaries (0-)0.4-1.4 mm, adaxial nectaries oblong, 0.8-2 mm, **longer than stipes**, flattened, abaxial and adaxial nectaries distinct or connate and cup-shaped; **stipes 0-0.56 mm**; ovaries pyriform, beaks slightly bulged below styles, very densely villous, woolly, or long-silky; styles connate to

distinct about half, 0.5-1.5 mm, stigmas slender- or broad-cylindrical, 0.24-0.32-0.4 mm, **2-5 ovules per ovary**. **Capsules** 3-6 mm. $2n = 38$, $2\times$ (Argus 1965, Löve & Löve 1975, 1982; Suda & Argus 1968).

Flowering mid-June to late August. Moist to mesic open forests, sedge fens, seepage on limestone, scree slopes, and gravel floodplains; 2-4025 m; Alta., B.C., Man., N.T., Ont., Que., Sask., Yukon; Calif., Colo., Idaho, Mont., N.Mex., Oreg., Utah, Wash., Wyo.; St. Pierre and Miquelon. Map 10.

Salix brachycarpa is characterized by a low, shrubby habit; very short petioles (1.3-4 mm); stout to globose catkins; densely white woolly ovaries, short stipes (0-0.5 mm), and small anthers (0.3-0.5 mm). See Table 4 for a comparison with *S. glauca* and *S. niphoclada*. The taxon formerly treated as *S. brachycarpa* subsp. *niphoclada* is here treated as *S. niphoclada*.

Table 4. Comparison of *Salix brachycarpa*, *Salix niphoclada*, and *Salix glauca* s.l.

	<i>S. brachycarpa</i>	<i>S. niphoclada</i>	<i>S. glauca</i> s.l.
Proximal leaves	narrowly oblong	narrowly oblong,	obovate to oblong
	apices rounded	apices rounded	apices acute to convex
Petiole length	1-3(-4) mm	2-5.5 mm	1-27
♀ Catkin shape	stout to subglobose	slender to subglobose	slender to subglobose
Anther length	0.3-0.5 mm	0.3-0.5	0.4-0.8 mm
Style length	0.5-1.5 mm	0.24-0.8 mm	0.3-1.4 mm
Stipe length	0-0.56 mm	0-0.5 mm	0.3-2.8 mm

***Salix candida* Flügge ex Willd.**

sage willow, sage-leaf willow

Salix candida f. *denudata* (Andersson) Rouleau.

Low to mid shrubs 0.3-2.5 m; not colonial or forming colonies by layering. **Stems** erect; **branches** flexible at base, **dark gray-brown**, not glaucous, woolly in patches or floccose to glabrescent; **branchlets** **yellow- to gray-brown**, not glaucous, densely woolly, sometimes floccose, hairs spreading or appressed, **crinkled**; **buds** of *alba*-type gradation. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, deciduous in autumn, apices acute; **petioles** shallowly to deeply grooved adaxially, obscured by hairs, 3-10 mm, **not glandular at distal ends**, adaxial surfaces tomentose or densely woolly; **juvenile leaves** yellowish green, abaxial surfaces very densely tomentose, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, lorate, very narrowly elliptic, narrowly elliptic, or oblanceolate, 47-103 × 5-20 mm, length-width ratio 3.3-7.8(-12); bases convex or cuneate, angles < 90°; margins strongly to slightly revolute, entire or undulate all around margins, glands marginal or submarginal; apices acute or convex, angles < 90°; abaxial surfaces glaucous or obscured by hair, **very densely to sparsely tomentose-woolly, cobwebby in age**, hairs spreading, dull white, **crinkled**; adaxial surfaces dull or shiny, not glaucous, moderately densely to sparsely tomentose, cobwebby, hairs dull white. **Catkins flowering as leaves emerge**, lateral; **staminate** stout or subglobose, 17-39 × 8-16 mm, flowering branchlets 0.5-7 mm; **pistillate densely flowered**, stout or slender, 20-66 × 9-18 mm, flowering branchlets 1-24 mm; **floral bracts** tawny or brown, 1.2-1.8 mm, abaxial surfaces sparsely hairy all over, hairs white, straight; bract apices rounded or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.58-1 mm; stamens 2, anthers purple becoming yellow, ellipsoid, long-cylindrical, or globose, 0.5-0.6 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong, 0.4-1 mm, shorter to longer than stipes, flat, thick; **stipes 0.1-1.2 mm**; ovaries pyriform, beaks slightly bulged or gradually tapering to styles, **very densely tomentose or woolly**, hair dull

white or gray, wavy, cylindrical; styles connate, 0.3-1.9 mm; stigmas broad-cylindrical, 0.4-0.45-0.52 mm, 12-18 ovules per ovary. **Capsules** 4-6 mm. $2n = 38$, $2\times$ (Löve & Löve 1982; Suda & Argus 1968).

Flowering mid-April to early July. River floodplains, marl bogs, fens, and meadows; calcareous substrate. 800-2805 m.; St. Pierre and Miquelon; Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., P.E.I., Que., Sask., Yukon; Alaska, Colo., Conn., Idaho, Ill., Ind., Iowa, Maine, Mass., Mich., Minn., Mont., N.H., N.J., N.Dak., N.Y., Ohio, Pa., S.Dak., Vt., Wash., Wis., Wyo. Map 11.

Salix candida is characterized by leaves narrowly elliptic, densely dull-woolly abaxially and dark green adaxially with dull white, floccose hairiness; and densely woolly branchlets and ovaries. It is known to hybridize with *Salix bebbiana* (*Salix ×cryptodonta* Fernald), *S. myrtilifolia*, and *S. petiolaris*. It is possible that the glabrescent form, *Salix candida* f. *denudata*, also may be of hybrid origin.

***Salix chamissonis* Andersson**

Chamisso's willow

Dwarf shrubs 3-10 cm, forming colonies by layering. **Stems** long, **trailing**; **branches** flexible at base, red-brown, not glaucous, glabrous; **branchlets** *yellow-green*, not glaucous, glabrous; **buds** of *arctica*-type gradation. **Leaves**, **stipules** *foliaceous*, early deciduous or in autumn; **petioles** deeply grooved adaxially, 5-13 mm, not glandular or with 1-2 pair of spherical glands at distal ends; adaxial surfaces glabrous; **juvenile leaves** yellowish green, abaxial surfaces glabrous or very sparsely long-silky, hairs white; **proximal leaves** entire and closely gland-dotted to serrulate; **largest medial blades** hypostomatous, venation pinnate, broadly elliptic, subcircular, or obovate, 30-50 × 17-30 mm, length-width ratio (1.1-)1.6-1.9(-2.1); bases cuneate or slightly decurrent, angles < 90°; margins flat, serrulate or spinulose-serrulate all around margins, **glands** *marginal*; apices acuminate, convex, acute, or rounded, angles > 90°, abaxial surfaces glaucous, glabrous, adaxial surfaces shiny, glabrous. **Catkins** flowering as leaves emerge, lateral, **staminate** stout, 30-64 × 12-22 mm, flowering branchlets 4-28 mm; **pistillate** densely flowered, stout, 32-73 (to 105 mm in fruit) × 10-17 mm, flowering branchlets 4-28 mm; **floral bracts** brown or black, 1.2-2.8 mm, abaxial surfaces moderately densely hairy all over, hairs white, straight; bract apices convex or rounded, entire; pistillate bracts persistent. **Flowers**, **staminate** adaxial nectaries square, 0.5-0.9 mm; stamens 2, **anthers** *purple*, ellipsoid or short-cylindrical, 0.5-0.6 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries square or oblong, 0.3-1 mm, equal to or longer than stipes, flat, thick; **stipes** *0.2-0.4 mm*; ovaries obclavate, beaks gradually tapering to styles, pilose or villous, sometimes in patches or streaks, hairs gray, straight, crinkled, or ribbon-like; styles connate or slightly distinct, 0.8-1.2 mm, stigmas slender-cylindrical, 0.36-0.46-0.68 mm, 12-18 ovules per ovary. **Capsules** 5-7 mm. $2n = 114$, $6\times$, Russia: (Zhukova 1968).

Flowering mid-to late June. Arctic-alpine; *Dryas* heath tundra, dwarf birch-lichen tundra, sandy lakeshores, snow beds, rock stripes or gravel, wet seepage areas, sedge meadows, willow-dwarf birch-sphagnum bogs; limestone and shale substrates; 2-1524 m; N.T., Yukon; Alaska; Asia: Russia (the Far East, Chukotka, disjunct in Sakhalin). Map 12

Salix chamissonis is characterized by branches and branchlets long-trailing and glabrous; leaf margins distinctly serrulate; ovaries villous with appressed, refractive, ribbon-like hairs.

***Salix commutata* Bebb**

under-green willow

Salix barclayi var. *commutata* (Bebb) Kelso

Low to tall shrubs 0.2-3 m, not colonial. **Stems** erect; **branches** flexible at bases, yellow-, gray-, or red-brown, not glaucous or weakly so, pilose to glabrescent; **branchlets** yellow-green, yellow-, or red-brown,

not glaucous, ***pilose to densely villous or woolly***, hairs appressed or spreading. **Leaves, stipules *foliaceous***, sometimes persistent for 2 or more years, apices rounded or acute; **petioles** shallowly grooved or convex to flat adaxially, 1.5-11 mm, ***not glandular at distal ends, adaxial surfaces pilose or tomentose***; **juvenile leaves** yellowish green, abaxial surfaces sparsely to densely long-silky-tomentose, hairs white; **proximal leaves** entire or shallowly serrulate; **largest medial blades** hypostomatous or amphistomatous, venation pinnate, narrowly oblong, oblong, elliptic, or broadly elliptic, 10-100 × 5-44 mm, length-width ratio 1.5-3.4; bases convex, rounded, subcordate, or cordate, angles < 90°; margins flat or slightly revolute, entire or serrulate all around margins or proximally, glands submarginal; apices acuminate, acute, or convex, angles < or > 90°, ***abaxial surfaces not glaucous***, glabrous, pilose, moderately densely tomentose or villous to glabrescent, hairs spreading, ***white***, wavy or straight; adaxial surfaces dull or shiny, not glaucous, glabrous, pilose or moderately densely villous. **Catkins *flowering as leaves emerge***, lateral; **staminate** stout or subglobose, 15-37 × 9-20 mm, flowering branchlets 2-10(-30) mm; **pistillate *densely flowered***, slender, stout, or subglobose, 17-61 × 7-15 mm, flowering branchlets 3-15(-30) mm; **floral bracts** tawny, brown, or bicolor, 1-3 mm, abaxial surfaces hairy all over, hairs white, straight or wavy; bract apices acute or rounded, entire; ***pistillate bracts persistent***. **Flowers, staminate** adaxial nectaries oblong or square, 0.2-0.8 mm; stamens 2, anthers yellow or purple becoming yellow, ***ellipsoid***, 0.4-1 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong, square, or ovate, 0.3-0.7 mm, shorter than stipes, flat, thick; stipes 0.3-2 mm, ovaries pyriform or obclavate, beaks gradually or abruptly tapering to styles, not glaucous, ***glabrous***; styles connate, 0.5-1.5 mm, ***stigmas two plump lobes or broad-cylindrical***, 0.16-0.34-0.4 mm, 10-28 ovules per ovary. **Capsules** 3.5-8 mm. $2n = 38$, 2× (Dorn 1975a).

Flowering late May to mid-August. Rocky alpine and subalpine slopes, glacial moraine, open spruce woods, stream sides, gravel benches along rivers, and wet fens; 1-2400 m; Alta., B.C., N.T., Yukon; Alaska, Idaho, Mont., Oreg., Wash. Map 13.

Salix commutata is a late-flowering species that is characterized by leaves not glaucous abaxially, often distinctly straggly hairy on both sides with straight and wavy hairs, short petioles (1.5-11 mm); stipules often as long as the petioles, and glabrous, reddish-green ovaries. It hybridizes with *S. barclayi*. For comments on *Salix barrattiana* × *S. commutata*, see *S. barrattiana*.

***Salix drummondiana* Barratt ex Hook.**

Drummond's willow

Salix subcoerulea Piper, *S. drummondiana* var. *subcoerulea* (Piper) C.R. Ball; *S. bella* Piper, *S. drummondiana* var. *bella* (Piper) C.R. Ball

Mid to tall shrubs 1-5 m; not colonial or forming colonies by stem fragmentation. **Stems** erect; **branches *highly to somewhat brittle at bases***, yellow- or red-brown, shiny, strongly to not glaucous, glabrous or glabrescent; **branchlets** red- or mottled yellow-brown, strongly to not glaucous, ***glabrous, puberulent, pilose, or sparsely velvety to glabrescent***, hairy spreading or erect; **buds *with caprea-type or transitional gradation***. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves minute rudiments or absent, sometimes foliaceous, early deciduous or in autumn; **petioles** convex to flat or shallowly grooved adaxially, 2-12 mm, not glandular at distal ends, adaxial surfaces villous or velvety; **juvenile leaves** yellowish green, abaxial surfaces very densely short-silky, adaxially surfaces sparsely so, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, lorate, narrowly elliptic, elliptic, or oblanceolate, 40-85 × 9-26 mm, length-width ratio 3-6.2; bases cuneate, slightly decurrent, or convex, angles < 90°; margins slightly revolute, entire, shallowly crenate to undulate all around margins, glands submarginal; apices acute, acuminate, or convex, angles < 90°, ***abaxial surfaces obscured by hair (but glaucous)***, densely short- to long-silky, hairs appressed or spreading, white or white and ferruginous, straight or wavy; adaxial surfaces shiny or dull, not glaucous, sparsely short-silky to glabrescent, hairs white or white and ferruginous. **Catkins *flowering before leaves***

emerge, lateral; **staminate** stout, 19-40 × 8-20 mm, flowering branchlets 0 mm; **pistillate** densely flowered, slender or stout, 22-87 (to 105 mm in fruit) × 8-18 mm, flowering branchlets 0-3(-6) mm; **floral bracts** brown or black, 1.2-2.8 mm, abaxial surfaces hairy all over, hairs white, straight; bract apices acute or rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, 0.3-0.63 mm; stamens 2, anthers purple becoming yellow, ellipsoid to short-cylindrical, 0.4-0.6 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries narrowly oblong, oblong, or ovate, 0.4-1 mm, shorter to longer than stipes, thin; stipes 0.3-2 mm, ovaries pyriform, beaks gradually tapering to styles, **short-silky**, hairs white, straight, flattened, styles connate, 0.5-1.5 mm, stigmas slender-cylindrical or two plump lobes, 0.32-0.43-0.6 mm, 6-17 ovules per ovary. **Capsules** 2.5-6 mm. $2n = 38$, $2 \times$ (Dorn 1975b), $2n = 57$, $3 \times$ (Suda & Argus 1968), or $2n = 76$, $4 \times$ (Dorn 1975b).

Flowering late April to early July. Subalpine forests and thickets, open spruce forests, stream sides, and gravelly floodplains; 620-3350 m; Alta., B.C., N.T., Sask., Yukon; Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., Utah, Wash., Wyo. Map 14.

Plants with broad leaves very densely woolly abaxially are putative hybrids with *Salix alaxensis*. See Table 5 for a comparison with *S. alaxensis* var. *longistylis*.

Table 5. Comparison of *Salix drummondiana* and *Salix alaxensis* var. *longistylis*.

	<i>S. drummondiana</i>	<i>S. alaxensis</i> var. <i>longistylis</i>
Leaves	silky abaxially	woolly-tomentose abaxially
Stipe length	0.3-2 mm	0-0.4 mm
Style length	0.5-1.5 mm	1.3-2.8 mm
Stigma length	0.32-0.43-0.6 mm	0.4-0.99-1.12 mm

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

Salix lutea Nutt. var. *famelica* C.R. Ball, Bot. Gaz. 71: 426. 1921; *S. lutea* sensu auct. mult.

Mid shrubs to trees 1.5-7 m; not colonial. Stems erect; **branches** flexible at bases, *yellowish, yellow-, or gray-brown*, not glaucous, glabrous (tomentose at nodes) or pubescent to glabrescent; **branchlets** yellow- or red-brown, not glaucous or weakly so with crystals, glabrous, pilose, pubescent or moderately densely villous to glabrescent, hairs spreading or erect; **buds with alba-type gradation.** **Leaves, stipules** deciduous early or in autumn, **on first leaves minute rudiments or absent**, on later leaves foliaceous, apices acute or rounded; **petioles** convex to flat or shallowly grooved adaxially, 3-27 mm, **not glandular at distal ends**, adaxial surfaces puberulent, pubescent, tomentose, velvety, or glabrous; **juvenile leaves** reddish or yellowish green, abaxial surfaces glabrous, pilose, or densely villous; **proximal leaves** entire or shallowly serrulate; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, narrowly oblong, very narrowly elliptic, narrowly elliptic, or lanceolate, 28-116 × 10-30 mm, length-width ratio 2.6-3.5-7; bases subcordate, convex, or rounded, angles < 90°; margins flat or slightly revolute, serrate or shallowly serrulate or crenulate all around margins, **glands marginal**; apices acuminate to acute, angles < 90°; **abaxial surfaces glaucous, glabrous, pilose, or pubescent, midrib hairy**, hairs spreading or appressed, white, straight or wavy, adaxial surfaces dull or shiny, not glaucous, glabrous, pilose, or sparsely long-silky or tomentose to glabrescent, midrib hairy, hairs white. **Catkins**, pistillate flowering as leaves emerge, staminate flowering before or just before leaves emerge, both lateral; **staminate** slender, stout, or subglobose, 15-44 × 8-14 mm, flowering branchlets 0.5-4 mm; **pistillate loosely or moderately densely flowered**, slender or stout, 16-74 (to 115 mm in fruit) × 7-15 mm, flowering branchlets 0.5-9 mm; **floral bracts** dark brown or tawny, 0.8-1.6 mm, abaxial surfaces hairy all over or mainly at proximal ends, hairs straight or wavy; bract apices rounded or convex, entire; **pistillate bracts persistent.** **Flowers, staminate**

adaxial nectaries narrowly oblong, oblong, or flask-shaped, **0.8-1 mm**; stamens 2, anthers yellow or purple becoming yellow, ellipsoid, 0.4-0.68 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong flask-shaped, 0.58-0.75 mm, **shorter than stipes**, flattened; **stipes 0.7-2.4 (-2.75) mm**; ovaries pyriform or obclavate, beaks slightly bulged below styles, not glaucous, **glabrous**; styles connate, 0.2-0.6 mm, stigmas flat with rounded tips or two plump lobes, 0.12-0.22-0.32 mm, 12-18 ovules per ovary. **Capsules** 5-6 mm. $2n = 38$, $2\times$ (Löve & Löve 1982; Suda & Argus 1968).

17. *Salix eriocephala* var. *famelica*

Flowering mid-April to mid-June. Riparian willow thickets on silty, sandy-clay, gravelly, or bouldery banks and floodplains, sand dunes, alluvial fans, wet meadows, rich fens, prairie depressions; 2-2000 m.; Alta., Man., N.T., Ont., Sask.; Colo., Iowa (Dorn), Kans., Minn., Mo., Mont., Nebr., N.Dak., S.Dak., Wyo. Map 15.

See *Salix pseudomonticola* for comment.

***Salix fuscescens* Andersson**

Salix fuscescens var. *reducta* C.R. Ball

Alaska bog willow

Low shrubs 15-55 cm; forming colonies by layering. Stems decumbent or trailing; **branches** flexible at bases, **yellow-brown**, not glaucous, glabrous; **branchlets** red-, gray-, or yellow-brown, not glaucous, glabrous; **buds with arctica-type gradation.** **Leaves, stipules absent or minute rudiments; petioles** deeply grooved adaxially, 2-5.6(-6.4) mm, not glandular at distal ends, adaxial surfaces glabrous; **juvenile leaves** yellowish green, glabrous; **proximal leaves entire; largest medial blades** hypostomatous, venation pinnate, narrowly oblong, oblong, obovate, or broadly obovate, (14-)17-27(-45) \times 7-21 mm, length-width ratio 1.4-2.5; bases cuneate, convex, or slightly decurrent, angles $< 90^\circ$; margins slightly revolute or flat, entire, serrulate, or crenate at proximal ends, glands marginal; apices convex, acuminate, or rounded, **angles $> 90^\circ$** ; abaxial surfaces glaucous, glabrous; **adaxial surfaces shiny or highly glossy**, not glaucous, glabrous.

Catkins flowering as leaves emerge, lateral, **staminate** stout to subglobose, 8-58 \times 5-19 mm, flowering branchlets 0.5-15 mm; **pistillate moderately densely to loosely flowered**, slender, stout, or subglobose, 13.5-64 (to 70 mm in fruit) \times 6.5-15 mm, flowering branchlets 4-18 mm; **floral bracts** brown or bicolor, 0.8-1.6 mm, **abaxial surfaces sparsely hairy all over**, hairs white or white and ferruginous, wavy or straight; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, 0.5-0.83 mm; stamens 2, anthers purple becoming yellow, ellipsoid or short-cylindrical, 0.3-0.4 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong, 0.4-0.88 mm, shorter than stipes, flattened; **stipes 0.8-2.5 mm**; ovaries obclavate, beaks abruptly tapering to styles, not glaucous, pubescent, moderately densely short-silky to glabrescent, hairs white or white and ferruginous, wavy or straight, flattened or ribbon-like; styles connate or slightly distinct, 0.1-0.4(-0.65) mm, stigmas slender- or broad-cylindrical, 0.24-0.3-0.68 mm; 8-12 ovules per ovary. **Capsules** 5.5-8 mm. $2n = 38$, $2\times$ (Johnson & Packer 1968; Suda & Argus 1969). Russia: (Petrovsky & Zhukova 1983; Zhukova 1967; Zhukova & Petrovsky 1976).

Flowering June to late July. Bogs, treed bogs, sedge fens, poorly drained lake shores, wet tundra, substrate silt or fine sandy-gravel; 55-1006 m; Man., N.T., Nunavut, Yukon; Alaska; Asia: Russia (Eastern Siberia, Arctic Siberia, the Far East, Chukotka), North Korea, Japan (Hokkaido). Map 16

Salix fuscescens is characterized by leaves glabrous and obovate, the bases tapering and with a few glandular serrulations, adaxial surfaces glossy and abaxial surfaces glaucous; pistillate catkins loosely flowered, ovaries dark reddish brown with ferruginous hairs.

Salix glauca L.

gray-leaf willow

Low to mid or tall shrubs 0.2-6 m, *not colonial*. **Stems** erect; **branches** flexible, not glaucous, shiny or highly glaucous, hairy to glabrescent; **branchlets** not glaucous; **buds** *with arctica-type gradation*. **Leaves, stipules** early deciduous, deciduous in autumn, or persisting for 2 or more years; **petioles** *deeply to shallowly grooved adaxially, not glandular at distal ends*; **juvenile leaves** yellowish green, hairs white; **largest medial blades** venation pinnate, *abaxial surfaces glaucous*. **Catkins** *flowering as leaves emerge*, lateral; **floral bracts** tawny, bicolor, pale brown or greenish, abaxial surfaces hairy all over, hairs white, wavy; bract apices convex to rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial and adaxial nectaries distinct; **stamens** 2, *anthers purple becoming yellow*, ellipsoid to short-cylindrical; **pistillate** adaxial nectaries narrowly oblong, oblong, ovate, or flask-shaped.

Subspecies 5 (3 in the flora): Greenland; North America; Eurasia: Scandinavia; Russia (Arctic Europe, Novaya Zemlya, East Siberia, Arctic Siberia, Sakhalin, the Far East, Chukotka, disjunct in West Siberia); China (Xinjiang, Altay Shan), N. Mongolia. Map 17

Salix glauca is a highly polymorphic, polyploid species. Its morphological variation seems to have four central tendencies that have been variously treated taxonomically. European treatments have treated it as a single polymorphic species (Skvortsov 1999), as several species (Rechinger 1964) or as subspecies (Elven 2000). In North America, Argus (1965) treated the four central tendencies as widely intergrading “phases” of a single species, later adopting varietal rank, whereas Hultén (1968) used subspecies rank. In view of the fact that the four elements are confluent over wide areas there is some merit in the use of informal phases. Subspecific rank, however, is being used in the Panarctic Flora (Argus et al. 1999) and is followed here.

The major reason for the high variability within *S. glauca* seems to be the presence of high and probably recurrent polyploidy. Tetraploids, pentaploids, hexaploids and octoploids are known in the species and in two of the subspecies three ploidal levels have been reported. It is likely that polyploids have been formed many times in the species and probably involved not only different genomes but also hybrids between different diploid and perhaps even polyploid species.

Reports of *Salix glauca* from Iceland are *S. arctica*, and from the Svalbard, Norway, are *S. lanata*. See Table 4 for a comparison with *S. brachycarpa* and *S. niphoclada*.

The following key will help identify the subspecies but bear in mind that they overlap geographically, intermediates are common, and juvenile material is difficult to identify to subspecies. Because of the uncertainty of identifications the distribution map is given only for *S. glauca* s.l.

- 1 Stipules on later leaves rudimentary or, if foliaceous, small and not prominent, usually deciduous in autumn, mostly elliptic to ovate, 1-8 (-10) mm; branchlets usually less densely hairy; branches usually yellow-brown but also red-brown; proximal leaves serrulate or entire; floral bracts 1-3.4 mm; ovaries pyriform; staminate catkin flowering branchlets 1-3.4 mm; Rocky Mountains, northern Canada east of the Mackenzie River and Greenland. ***Salix glauca* subsp. *glabrescens***
1. Stipules on later leaves foliaceous and prominent, often persistent for more than one year, mostly linear to lanceolate-inequilateral, 2-17 mm; branchlets usually very densely villous but becoming glabrous; branches usually red-brown but sometimes gray- to yellow-brown; proximal leaves entire; floral bracts 1.2-2.5 mm; ovaries usually obclavate, sometimes pyriform; staminate catkins flowering branchlets 1-14 mm; northwestern Canada and Alaska.2.
- 2 Shrubs 0.25-6 m; branchlets soon becoming pilose or glabrous; petioles longer, 4-27 mm; leaf blades acute to sometimes acuminate, adaxial surfaces often sparsely hairy; staminate catkins 19-45 mm; filaments glabrous, distinct; pistillate catkins slender to stout, flowering branchlets 3-37 mm; stipes 0.5-2.8 mm; central Alaska and Yukon east to Great Slave Lake, N.T. ***Salix glauca* subsp. *acutifolia***

2. Shrubs 0.25-1 m; branchlets usually villous; petioles shorter, 1-9 mm; leaf blades acute, adaxial surfaces moderately densely to sparsely hairy; staminate catkins 14-26 mm; filaments glabrous or hairy, distinct to partially connate; pistillate catkins stout to subglobose, flowering branchlets 2-19 mm; stipes 0.4-1.8 mm; arctic Alaska. *Salix glauca* subsp. *stipulifera*

***Salix glauca* L. subsp. *acutifolia* (Hook.) Hultén**

gray-leaf willow

Salix villosa β *acutifolia* Hooker, Fl. Bor.-Am. 2:145. 1838; *S. glauca* var. *acutifolia* (Hook.) C.K. Schneider; *S. glauca* var. *alicea* C.R. Ball; *S. glauca* var. *perstipulata* Raup; *S. glauca* var. *poliophylla* (C.K. Schneider) Raup; *S. glauca* subsp. *desertorum* (Richards.) Hultén

Low to tall shrubs 0.25-6 m. **Stems, branches red-brown or brownish**, shiny to highly glossy, villous or pilose to glabrescent; **branchlets** red-brown or brownish, densely villous to glabrescent, hairs spreading, straight, wavy, or geniculate. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, *generally prominent, 2-17 mm, linear to lanceolate, apices acuminate*; **petioles** 4-27 mm, adaxial surfaces pilose; **juvenile leaves** densely villous or long-silky; **proximal leaves** entire; **largest medial blades** hypostomatous, oblanceolate or obovate to elliptic or narrowly so, 43-82 × 12-39 mm, length-width ratio 2.2-4.8; bases slightly decurrent, cuneate or convex, angles < or > 90°; margins slightly revolute, entire or serrulate, glands submarginal; apices acuminate or convex, angles < or > 90°; abaxial surfaces very densely to sparsely villous-tomentose, long-, or short-silky all over, hairs appressed or spreading, straight, wavy, or curved; adaxial surfaces shiny, not glaucous, sparsely long-silky all over or pilose on midrib, hairs spreading or appressed, white. **Catkins, staminate** slender or stout, 19-45 × 9-17 mm, flowering branchlets 2-9 mm; **pistillate** densely flowered, slender to stout, 24-83 × 8-17 mm, flowering branchlets 3-37 mm; **floral bracts** 1.5-2.5 mm, abaxial surfaces hairy all over. **Flowers, staminate** abaxial nectaries 0.13-0.55 mm, adaxial nectaries narrowly oblong, oblong, or square, 0.6-0.9 mm, anthers 0.5-0.8 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries 0.6-1.4 mm, shorter than to equal to stipes, flat, thick; **stipes 0.5-2.8 mm**, ovaries pyriform to obclavate, **beaks gradually tapering to styles**, densely tomentose, short-silky, or pubescent, styles connate to distinct about half their lengths, 0.3-1.4 mm, stigmas slender-cylindrical, 0.4-0.59-0.8 mm, 12-22 ovules per ovary. **Capsules** 5-9 mm. $2n = 76$, $4\times$ (Suda & Argus 1969), $2n = 95$; $5\times$ (Suda & Argus 1969); or $2n = 114$, $6\times$ (Suda & Argus 1969).

Flowering late May-early July. Wet to mesic thickets, black spruce treed bogs, white spruce woods, river floodplains, fens, swamps, subarctic thickets, alpine tundra; 2-1189 m; B.C., N.T., Nunavut, Yukon; Alaska. Map 17

Salix glauca subsp. *acutifolia* is characterized by leaves that are large, often distinctively villous-tomentose or short-silky abaxially and glabrescent to pilose adaxially; long petioles; and prominent, narrowly elliptic stipules.

***Salix glauca* subsp. *glabrescens* (Andersson) Hultén**

gray-leaf willow

Salix glaucops β *glabrescens* Andersson, DC. Prodr. 16(2): 281. 1868; *S. glauca* var. *glabrescens* (Andersson) C.K. Schneider; *S. glauca* var. *sericea* Hultén; *S. pseudolapponum* Seemen; *S. glauca* var. *villosa* (D. Don ex Hook.) Andersson

Low to tall shrubs 0.3-2 m. **Stems, branches gray-, yellow-, or red-brown**, shiny to highly glossy, villous to glabrescent; **branchlets** red- or yellow-brown, moderately densely or sparsely villous or tomentose, hairs spreading, straight, wavy, curved, crinkled, or geniculate. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, *generally inconspicuous, 4-8(-10) mm, narrowly elliptic to ovate, apices acute*; **petioles** 3-14 mm, adaxial surfaces villous or pilose; **juvenile leaves** sparsely to densely villous; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous, often amphistomatous in southern Rocky Mts., narrowly elliptic, elliptic, oblanceolate, or obovate, 29-80 × 8-24

mm, length-width ratio 2.2-3.9; bases sometimes rounded, angles $<$ or $>$ 90° ; margins slightly revolute or flat, entire or serrulate, glands submarginal; apices acuminate, acute, or convex, angles $<$ or $>$ 90° , abaxial surfaces pilose or moderately densely villous to glabrescent, hairs spreading, wavy; adaxial surfaces shiny, not glaucous, pilose or moderately densely villous to glabrescent, hairs spreading, white. **Catkins, staminate** 19-53 \times 9-14 mm, flowering branchlets 1.5-20 mm; **pistillate** moderately densely to loosely flowered, slender to stout, 19-56 (to 60 mm in fruit) \times 7-18 mm, flowering branchlets 2-27 mm; **floral bracts** 1-3.4 mm, abaxial surfaces sparsely to moderately densely hairy all over, hairs white, wavy. **Flowers, staminate** abaxial nectaries 0.1-0.75 mm, adaxial nectaries oblong or ovate, 0.6-1.3 mm; anthers 0.4-0.8 mm, filaments distinct, glabrous or hairy on lower halves; **pistillate** adaxial nectaries 0.6-1.4 mm, shorter to longer than stipes, flat, thick; **stipes 0.3-1.5 mm**, ovaries pyriform, **beaks gradually tapering or bulged below styles**, very densely villous or tomentose, hairs white, wavy, flattened; styles connate to distinct about half their lengths, 0.4-1.4, stigmas slender- to broad-cylindrical, 0.2-0.4-0.64 mm, 6-15 ovules per ovary. **Capsules** 5-8 mm. $2n = 114$, $6\times$ (Suda & Argus 1968).

Flowering mid-May-late July. Margins of rivers and creeks, openings in spruce woods, thickets on subalpine slopes; 1440-3810 m; Alta., B.C., N.T., Sask., Yukon; Colo., Idaho, Mont., N.Mex., Oreg., Utah, Wash., Wyo. Map 17.

Salix glauca subsp. *glabrescens* is characterized by a tendency toward more glabrescent leaves, less prominent stipules, and smaller leaves and catkins. It intergrades with subsp. *acutifolia* in northern British Columbia and southern Yukon.

***Salix glauca* L. subsp. *stipulifera* (Flod. ex Häyrén) Hiitonen**

gray-leaf willow

Salix stipulifera Flod. ex Häyrén, Mem. Soc. Faun. Fl. Fenn. 5: 133. 1929; *S. glauca* var. *stipulata* Flod.; *S. glauca* var. *glauca sensu* Argus 1973

Low to mid shrubs 0.25-1 m. **Stems, branches gray- to red-brown**, shiny, densely villous; **branchlets** color obscured by hairs, densely villous, hairs spreading, straight or wavy. **Leaves, stipules** foliaceous, sometimes obscured by hairs, **on later leaves very prominent, 2-17 mm, linear to narrowly elliptic, apices acute to caudate**; **petioles** 1-9 mm, adaxial surfaces villous; **juvenile leaves** densely villous or long-silky; **proximal leaves** entire; **largest medial blades** hypostomatous or hemiamphistomatous, narrowly oblong, narrowly elliptic, elliptic, oblanceolate, or obovate, 27-74 \times 8-24 mm, length-width ratio 2.1-3.9; bases slightly decurrent or cuneate, angles $<$ 90° ; margins slightly revolute or flat, entire glands marginal or submarginal; apices acuminate, convex, or acute, angles $<$ 90° ; abaxial surfaces densely villous or villous-long-silky all over, hairs spreading or appressed, straight or wavy; adaxial surfaces shiny, moderately densely villous or long-silky to glabrescent, all over, hairs spreading or appressed, white. **Catkins, staminate** 14-26 \times 8-14, flowering branchlets 1-14 mm; **pistillate** loosely to moderately densely flowered, stout or subglobose, 15-54 \times 7-15 mm, flowering branchlets 2-19 mm; **floral bracts** 1.2-2.2 mm, sparsely hairy all over. **Flowers, staminate** abaxial nectaries 0.33-1 mm, adaxial nectaries narrowly oblong, oblong, square, ovate, or flask-shaped 0.6-1.5 mm; anthers 0.48-0.76, filaments distinct or partly connate, glabrous or hairy on lower halves; **pistillate** adaxial nectaries (0.4-)0.6-1.8 mm, longer to shorter than stipes, flattened; **stipes 0.4-1.8 mm**; ovaries pyriform or obclavate, **beaks abruptly tapering to styles**, very densely villous or tomentose, hairs white, straight or wavy, cylindrical or flattened; styles connate to distinct, 0.4-1 mm; stigmas slender-cylindrical, 0.3-0.54-0.8 mm, 10-20 ovules per ovary. **Capsules** 4.5-7.5 mm. $2n = 76$, $4\times$ (Johnson & Packer 1968; Suda & Argus 1969). Russia: $2n = 76$, $4\times$ (Zhukova & Petrovsky 1975, 1980; Zhukova & Tikhonova 1973) $2n = 114$, $6\times$ (Petrovsky & Zhukova 1983b; Zhukova et al. 1977; Zhukova & Petrovsky 1972; Zhukova & Petrovsky 1980); $2n = 152$, $8\times$ (Zhukova & Petrovsky 1976, 1977).

Flowering mid-June-mid-July. Black spruce treed bogs, white spruce woods, river floodplains, subarctic thickets, and alpine tundra; 4-1040 m; Yukon; Alaska; Scandinavia; Russia; China (Xinjiang, Altay Shan), N. Mongolia. Map 17.

Salix glauca subsp. *stipulifera* is characterized by densely villous branchlets with short internodes; leaves villous on both surfaces, relatively short petioles, and stipules barely exceeding the petioles; densely villous ovaries, short stipes, and floral bracts usually brownish rather than tawny.

This taxon in Alaska was treated as *S. glauca* var. *glauca* (Argus 1973).

***Salix hastata* L.**

halberd willow

Salix farriarum C.R. Ball var. *walpolei* Coville & C.R. Ball; *S. walpolei* (Coville & C.R. Ball) C.R. Ball; *S. hastata* subsp. *subintegrifolia* (Flod.) Flod.; *S. hastata* var. *subintegrifolia* Flod.

Low to tall shrubs 0.2-4 m, **not colonial**. **Stems** erect; **branches** flexible at bases, **brownish**, dull or shiny, not glaucous, pilose to glabrescent; **branchlets** red-brown, villous or pilose, hairs straight, wavy, or curved; **buds with alba-type gradation**. **Leaves, stipules** deciduous in autumn, **foliaceous**, apices acute; **petioles** convex to flat or shallowly grooved adaxially, 1.5-7(-9) mm, **not glandular at distal ends**, adaxial surfaces pilose or villous; **juvenile leaves** yellowish green or reddish, abaxial surfaces sparsely pubescent, hairs white or white and ferruginous; **proximal leaves** entire or very finely serrulate; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, broadly elliptic, narrowly ovate, or ovate, 25-68 × 10-32 mm, length-width ratio 1.5-2.6(3.4); bases convex, cuneate, or rounded, angles < or > 90°; margins slightly revolute or flat, shallowly serrulate or entire, all around margins or at distal ends, glands submarginal or marginal; apices acuminate, acute, or convex, angles < 90°; abaxial surfaces glaucous, sparsely pubescent to glabrescent, hairs appressed or spreading, white, wavy; **adaxial surfaces dull**, not glaucous, pilose, sparsely pubescent or glabrous, midrib remaining puberulent, **hairs white and ferruginous**. **Catkins flowering as leaves emerge**, lateral; **staminate** slender, stout, or subglobose, 14.5-34.5 × 8-12 mm, flowering branchlets 1-7 mm; **pistillate moderately densely or loosely flowered**, slender or stout, 21-59 × 6-16 mm, flowering branchlets 1.5-9 mm; **floral bracts** brown or bicolor, 1.2-1.8 mm, abaxial surfaces sparsely hairy all over, hairs white, straight; bract apices acute to rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or square, 0.3-0.7 mm; **stamens 2**, anthers purple becoming yellow, ellipsoid, 0.4-0.6 mm, filaments distinct or connate at bases, glabrous; **pistillate** adaxial nectaries square or obovate, 0.3-0.63 mm, shorter than stipes, flat, thick or thin; stipes 0.4-1.2 mm; ovaries pyriform, beaks gradually tapering to styles, glabrous; styles connate or distinct about half, 0.2-0.4 mm, stigmas two plump lobes, 0.2-0.32-0.44 mm, 12-22 ovules per ovary. **Capsules** 3.2-8 mm. $2n = 38, 2\times$ (Johnson & Packer 1968). Russia $2\times$ (Yurtsev & Zhukova 1982; Zhukova 1967, 1980; Zhukova et al. 1977; Zhukova & Petrovsky 1976); $2n = ca 110, ca 6\times$ (Sokolovskaja & Strelkova 1960).

Flowering early June to late July. Sandy and gravelly river bars and floodplains, lake shores, sand dunes and blowouts, *Dryas* tundra, alpine sedge meadows, openings in upland spruce – willow forests; 2-1182 m; N.T., Yukon; Alaska. Eurasia [Norway, Russia, Siberia]. Map 18.

Salix hastata is characterized by branches pilose with short, curved hairs; juvenile and mature leaves with white or ferruginous hairs adaxially, glaucous or not abaxially; and ovaries often reddish.

Karlsson (2000), in Flora Nordica, recognized *Salix hastata* L. subsp. *subintegrifolia* (Flod.) Flod. in Holmb. as the major northern Eurasian race of *S. hastata*, which he also placed in northwestern North America. It is not recognized, however, by Skvortsov (1999) in Russia or by me in Alaska. This subspecies is distinguished by leaf marginal toothiness and stipule size, both of which are highly variable (Hultén 1967).

Salix hookeriana* Barratt ex Hook.Salix amplifolia* Coville**Hooker's willow**

Low shrubs to small trees (0.6-)2-8 m; not colonial or forming colonies by layering or stem fragmentation. **Stems** erect; **branches** *highly brittle at bases*, yellow-, gray-, red-brown, or violet, weakly glaucous or not, glabrous, tomentose, woolly, or sparsely villous to glabrescent, remaining hairy at nodes; **branchlets** gray-, red-, or yellow-brown, or obscured by hairs, not glaucous or weakly so, glabrous, pilose, moderately densely villous, tomentose, or woolly, hairs spreading, straight, wavy, crinkled, or geniculate; **buds with caprea-type gradation**. **Leaves, stipules** deciduous in autumn, *on first leaves minute rudiments or apparently absent*, on later leaves foliaceous or minute rudiments (sometimes obscured), apices rounded or acute; **petioles** flat to convex or shallowly grooved adaxially, (4-)6-29 mm, not glandular at distal ends; adaxial surfaces very densely to sparsely villous, woolly, pilose, or tomentose, hairs white or white and ferruginous, or yellowish; **juvenile leaves** yellowish green or obscured by hairs, abaxial surfaces pilose or sparsely to very densely long-silky, tomentose, woolly, or villous, hairs white, white and ferruginous, or yellowish; **proximal leaves** entire or shallowly serrulate proximally; **largest medial blades** hypostomatous, venation pinnate, elliptic, obovate, broadly ovate, narrowly elliptic, oblanceolate, broadly elliptic, or broadly obovate, (36-)46-113 × 18-55(-63) mm, length-width ratio 1.5-4.2; bases convex, rounded, subcordate, cordate, cuneate, or slightly decurrent, angles < or > 90°; margins slightly revolute, coarsely and irregularly crenate, remotely or irregularly serrate, shallowly serrulate, undulate, or entire, glands submarginal; apices acuminate or convex, angles < or > 90°; abaxial surfaces glaucous, pilose, moderately densely tomentose, villous, or woolly, midrib remaining hairy, hairs spreading, white or white and ferruginous, wavy or straight; adaxial surfaces highly glossy or shiny, not glaucous, glabrous, pilose, villous, or moderately densely tomentose to glabrescent, midrib and veins remaining hairy, hairs white or white and ferruginous. **Catkins** flowering before, just before, or as leaves emerge, lateral; **staminate** slender or stout, 26-73 × 10-25 mm, flowering branchlets 0-8 mm; **pistillate** densely flowered, slender or stout, 36-117(-140) × 10-22 mm, flowering branchlets 0-10(-35) mm; **floral bracts** dark brown, black, or bicolor, 1.1-3.6 mm, abaxial surfaces densely hairy all over, hairs white, straight or wavy; bract apices convex, rounded, or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, ovate, or narrowly oblong, (0.45-)0.68-1.4 mm; **stamens 2, anthers yellow**, cylindrical or ellipsoid, (0.48-)0.7-1 mm; filaments distinct or slightly connate at bases, glabrous or hairy on lower halves or at bases; **pistillate** adaxial nectaries narrowly oblong, oblong, or square, 0.5-0.9(-1.4) mm, shorter to longer than stipes, flat, thick or thin; **stipes 1-2 mm**; ovaries obclavate or pyriform, beaks gradually or abruptly tapering to styles, not glaucous, *glabrous or uniformly tomentose, villous, or woolly, or hairy in patches and streaks*, hairs white, wavy, flattened; styles 0.6-1.5(-2.3) mm; stigmas broad- to slender-cylindrical or two plump lobes, 0.3-0.58(-0.74) mm, 15-18(-20) ovules per ovary. **Capsules** 5-10 mm. $2n = \text{ca. } 57, 3\times$ (Taylor & Taylor 1977), $2n = \text{ca. } 114, 6\times$ (Taylor & Mulligan 1968).

Flowering mid-April to mid-June. Sand dunes, interdunal depressions, coastal beaches, pine barrens, floodplains, ravines, wet sedge meadows, lake shores, morainal flats, and coastal marshes; sandy or gravelly substrates; 0-100 m; B.C.; Alaska, Calif., Oreg., Wash. Map 19.

Salix hookeriana is characterized by brittle branches; densely woolly branchlets with long, persistent straight hairs at the proximal end; stipules lacking except on vigorous shoots; catkins long and stout; ovaries glabrous or hairy, styles red in life. In Alaska its elevational range is ca. 1-5 m. It hybridizes with *Salix scouleriana* and probably with *S. lasiolepis*. The great morphological variability in this species suggests that hybridization is an important factor in its evolution.

Salix interior* RowleeSalix exigua* Nutt. subsp. *interior* (Rowlee) Cronq.**Sandbar willow**

Mid to tall shrubs or trees to 4-9 m; **forming colonies by root shoots**. **Stems** erect; **branches** flexible at bases, gray-, red- or yellow-brown, not glaucous, glabrous or villous to glabrescent; **Branchlets** yellow- to red-brown, not glaucous, sparsely to very densely tomentose or villous to glabrescent, hairs spreading; **buds** with *alba*-type gradation. **Leaves, stipules** deciduous in autumn, on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous; **petioles** convex to flat adaxially or shallowly grooved adaxially, 1-5(-9) mm, adaxial surfaces glabrous or sparsely villous, **not glandular at distal ends**; **juvenile leaves** reddish or yellowish green, abaxial surface moderately densely to sparsely long-silky hairs white; **proximal leaves** entire; **largest medial blades** amphistomatous, venation pinnate, linear or lorate, 60-160 × 3.5-11 mm, length-width ratio (6.5-)11-19(-31); bases cuneate to slightly decurrent, angles < 90°; margins flat, remotely spinulose-serrulate, all around margins, glands submarginal; apices sharply acute or acuminate and apiculate, angles < 90°; abaxial surfaces very sparsely glaucous, densely villous or long-silky to glabrescent, hairs appressed, white, straight, short; adaxial surfaces shiny, not glaucous, pilose or densely villous to glabrescent, hairs white. **Catkins**, flowering as leaves emerge or throughout season, lateral; **staminate** slender or stout, 20-61 × 4-10 mm, flowering branchlets 3-55 mm; **pistillate loosely flowered**, slender or stout, 20-67 × 5-9 mm, flowering branchlets 3-65 mm; **floral bracts** tawny or greenish, 1.5-3.5 mm, abaxial surfaces sparsely hairy mainly at proximal or at distal ends, hairs white, wavy; bract apex acute or rounded, entire, erose, or toothed; **pistillate bracts deciduous after flowering**. **Flowers, staminate** abaxial nectaries 0.5-1.1 mm, adaxial nectaries ovate or narrowly oblong, 0.6-1.4 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers yellow, ellipsoid to short-cylindrical, 0.4-0.7 mm, filaments distinct, hairy on lower halves; **pistillate** adaxial nectaries narrowly oblong, 0.4-1.1 mm, shorter or longer than stipes even within the same catkin, flattened; stipes 0.5-0.8 mm, ovaries obclavate or pyriform, beaks abruptly tapering to styles, not glaucous, sparsely long-silky to glabrescent, hairs white, flattened; stigmas broad-cylindrical, 0.32-0.38-0.72 mm, styles 0-0.2 mm; 16-36 ovules per ovary. **Capsules** 6-10 mm. $2n = 38$, $2 \times$ (Chmelar 1979; Löve & Löve 1982; Neumann & Polatschek 1972; Suda & Argus 1968; Zsuffa & Raj 1981).

Flowering early April to early July. Sandy to silty floodplains of rivers and creeks; margins of lake, ponds and prairie sloughs, dry prairie sand hills and marshes, disturbed areas, forming large clones; 15-1770 m; Alta., B.C., Man., N.B., N.T., Ont., Que., Sask., Yukon; Alaska, Ark., Colo., Conn., Del., D.C., Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Mich., Minn., Miss., Mo., Mont., Nebr., N.J., N.Dak., N.Y., Ohio, Okla., Pa., S.Dak., Tenn., Tex., Va., W.Va., Wis., Wyo. Mexico (Tamaulipas, Veracruz) (Little 1976). Map 20.

Salix interior is a sand bar species which spreads clonally by root shoots. It is characterized by leaves linear, usually glabrous and distinctly denticulate; catkins often are branched; and floral bracts are deciduous. It is similar in some respects to *S. setchelliana*. See that species for comments.

Sometimes this species is treated as *S. exigua* Nutt. subsp. *interior* (Rowlee) Cronq. *Salix exigua* and *S. interior* hybridize and apparently intergrade in the western Great Plains but because they are distinctive over large areas it is more practical to treat them at the species levels.

***Salix krylovii* E. Wolf**

Mid to tall shrubs 2-2.4 m, not colonial. **Stems** erect; **branches** red-brown, not glaucous, gray-woolly to glabrescent; **branchlets** not glaucous or obscured by hairs, **densely woolly or villous**, hairs spreading. **Leaves, stipules** deciduous in autumn or persisting for 2 or more years, **foliaceous**, apices acute; **petioles** shallowly grooved adaxially, 1.5-5 mm, not glandular or with paired spherical glands at distal ends, adaxial surfaces tomentose; **juvenile leaves** yellowish green, abaxial surfaces very densely tomentose, hairs white; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous, venation pinnate, obovate,

narrowly elliptic, or oblanceolate, 24-98 × 6-24 mm, length-width ratio 2.2-4.5; bases cuneate, slightly decurrent, or convex, angles < 90°; margins slightly to strongly revolute, entire; apices convex or acuminate, angles < 90°; abaxial surfaces obscured by hair, very densely tomentose, hairs spreading or erect, white, wavy or crinkled; adaxial surfaces shiny, not glaucous, sparsely villous to glabrescent, hairs white. **Catkins flowering as leaves emerge**, lateral; **staminate** stout, 18-34 × 10-16 mm, 0-2 mm; **pistillate very densely flowered**, stout, 17-61 × 7-15 mm, **flowering branchlets 0-2 mm**; **floral bracts** tawny or brown, 1.1-2 mm, abaxial surfaces moderately densely hairy all over, hairs white, wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, square, or ovate, 0.63-8.88 mm; stamens 2, anthers purple becoming yellow, ellipsoid or short-cylindrical, 0.5-0.68 mm, filaments distinct or connate less than half, **glabrous or hairy all over**; **pistillate** adaxial nectaries ovate, oblong, or square, 0.38-0.75 mm, shorter than to longer than stipes, flat, thick or swollen; stipes 0.4-0.9 mm; **ovaries ovoid**, beaks slightly bulged or gradually tapering to styles, very densely tomentose, hairs white, wavy or crinkled, flattened, more or less refractive; styles connate to distinct half their lengths, 0.5-0.9 mm, stigmas slender-cylindrical, lobes 0.23-0.38 mm, 18-24 ovules per ovary. **Capsules** 4-6 mm. Russia: 2n = 38, 2× (Zhukova 1967, Zhukova & Tikhonova 1973, Zhukova et al. 1973, Zhukova & Petrovsky 1975, Petrovsky & Zhukova 1983, Zhukova & Petrovsky 1971).

Stony talus and scree slopes, stony tundra, moist depressions, stream banks, larch and poplar woods. Mainly on acidic substrates. Extending into the alpine (Skvortsov 1999). Russian Far East with disjunct populations in Central Asia. Map 19.

Salix krylovii is related to *S. candida*. Both species have short stigmas (*S. candida* 0.4-0.52 mm, *S. krylovii* 0.2-0.5 mm), short styles (*S. candida* 0.3-1 mm, *S. krylovii* 0.36-1 mm), tawny to bicolored floral bracts with short sparse hairs and rounded apices, purple anthers becoming yellow in age, catkins borne on leafy flowering branchlets, and leaves densely woolly abaxially. The main difference between them is ecological; the former is a calciphile, whereas the latter occurs more frequently on acidic rocks (Skvortsov 1969).

Salix lasiandra Benth.

Tall shrubs or trees 1-9(-11) m, not colonial or forming colonies by stem fragmentation. **Stems** erect; **branches** flexible to highly brittle at bases, yellow-, or gray- or red-brown, shiny to highly glossy, not glaucous, glabrous or pilose to glabrescent, remaining pilose at nodes; **branchlets** yellow-, gray- or red-brown, not glaucous, glabrous, pilose, villous, or velvety to glabrescent, hairs spreading; buds with alba-type gradation. **Leaves, stipules** early deciduous or deciduous in autumn, **generally foliaceous**; apices **convex or rounded**; **petioles** deeply grooved adaxially, adaxial surfaces glabrous or pilose; **juvenile leaves** reddish or yellowish green, abaxial surfaces densely villous, long-silky, or glabrous, hairs white and ferruginous; **proximal leaves** entire and glandular dotted or shallowly serrulate; **largest medial blades** venation pinnate, 53-170 × 9-31 mm, length-width ratio 3.1-9.8; margins flat, serrulate all around margins, glands marginal; apices caudate to acuminate, angles < 90°; adaxial surfaces shiny or highly glossy, not glaucous, hairs white and ferruginous. **Catkins** flowering as leaves emerge, lateral; **floral bracts** tawny, abaxial surfaces sparsely hairy all over or mainly at proximal ends, hairs white, wavy; bract apices rounded, entire, toothed or erose; **pistillate bracts deciduous after flowering**. **Flowers, staminate** adaxial nectaries square or ovate; **stamens 4-5**, anthers yellow, 0.6-1 mm, filaments distinct, **hairy on lower halves or at bases**; **pistillate** adaxial nectaries square, 0.2-0.63 mm, shorter than stipes; stipes 0.8-0.4; ovaries pyriform, beaks bulged below or gradually tapering to styles, not glaucous, glabrous, styles connate or slightly distinct, 0.2-0.8 mm, stigmas broad-cylindrical or two plump lobes, 0.16-0.3-0.36 mm. **Capsules** 4-11 mm.

Salix lasiandra is characterized by flowers with stamens 4 or 5 and both abaxial and adaxial nectaries; leaves lanceolate to oblanceolate, apices long-acuminate to caudate; immature leaves with white or ferruginous hairs; and pistillate floral bracts deciduous after flowering.

Variety *lasiandra* is the most common variety in the flora area. At Kootenay Lake, BC, where both varieties occurred, it was observed that *S. lasiandra* var. *lasiandra* was heavily infested with sawfly galls whereas *S. lasiandra* var. *caudata* was not infested. Here the two taxa differed not only in sawfly attraction, leaf glaucescence and the presence of stomata in the adaxial epidermis, but *S. lasiandra* var. *lasiandra* had stiffer leaves than *S. lasiandra* var. *caudata*.

- 1 Leaves hypostomatous and glaucous abaxially; staminate flowers with abaxial nectaries distinct from adaxial nectaries; petioles with clusters of spherical or foliaceous glands at distal ends; largest medial blades convex or rounded at bases. ***Salix lasiandra* var. *lasiandra***
1. Leaves amphistomatous and not glaucous abaxially; staminate flowers with abaxial and adaxial nectaries connate at bases into a cup; petioles with a pair or clusters of foliaceous glands at distal ends; largest medial blades convex or slightly decurrent at bases. ***Salix lasiandra* var. *caudata***

***Salix lasiandra* Benth. var. *caudata* (Nutt.) Sudw. tail-leaf willow**
Salix lucida subsp. *caudata* (Nutt.) E. Murray; *S. pentandra* var. *caudata* Nutt. N. Amer. Sylva 1: 61. 1843

Leaves, petioles (1-)4-15 mm, **with pairs or clusters of spherical glands at distal ends; largest medial leaf blades** amphistomatous, lorate, very narrowly elliptic, narrowly elliptic, or lanceolate to very narrowly so; bases convex or slightly decurrent, angles < 90°, **abaxial surfaces not glaucous**, pilose to glabrescent, hairs white and ferruginous, straight or curved. **Catkins, staminate** stout, 24-50 × 8-15 mm, flowering branchlets 3-27 mm; **pistillate** moderately densely flowered, slender or stout, 30-63 (to 70 mm in fruit) × 9-15 mm, flowering branchlets 10-30 mm; **floral bracts** 2.8-4 mm. **Flowers, staminate** abaxial nectaries (0-)0.4-0.8 mm, adaxial nectaries 0.3-0.63, abaxial and adaxial nectaries connate and shallowly cup-shaped; **pistillate** adaxial nectaries swollen; **28-30 ovules per ovary**. $2n = 76, 4\times$ (Dorn 1975b).

Flowering from late May to late June. Riparian willow and alder thickets or openings in poplar woods on silty, sandy to gravelly alluvium along rivers and streams, wet meadows, lakeshores; 35-3050 m; Alta., B.C., N.T., Yukon; Alaska, Calif., Colo., Idaho, Mont., Nev., Oreg., S.Dak., Utah, Wash., Wyo. Map 21.

***Salix lasiandra* Benth. var. *lasiandra* Pacific willow**
Salix lasiandra var. *lyallii* Sarg.; *S. lasiandra* var. *macrophylla* (Andersson) Little; *S. lasiandra* var. *recomponens* Raup; *S. lucida* Muhl. subsp. *lasiandra* (Benth.) E. Murray

Leaves, stipules on first leaves sometimes also minute rudiments; **petioles** (2-)4-30 mm, **with clusters of spherical or foliaceous glands at distal ends; largest medial blades** hypostomatous or hemiamphistomatous, rarely amphistomatous, narrowly oblong, very narrowly elliptic, narrowly elliptic, lanceolate, very narrowly lanceolate, or oblanceolate; bases convex to rounded, angles < 90°; **abaxial surfaces glaucous** (rarely not glaucous), glabrous or glabrescent, hairs white or white and ferruginous, straight or wavy. **Catkins, staminate** slender or stout, 21-78 × 9-14 mm, flowering branchlets 5-24 mm; **pistillate** densely flowered, slender, stout, or subglobose, 18.5-103 × 6-17 mm, flowering branchlets 6-56 mm; **floral bracts** 1.7-4 mm. **Flowers, staminate** abaxial nectaries 0.35-0.55 mm, adaxial nectaries 0.2-0.5 mm, abaxial and adaxial nectaries distinct; **pistillate** adaxial nectaries flattened; 16-24 ovules per ovary. $2n = 76, 4\times$ (Wilkinson 1944).

Flowering from late March to early June. Thickets, sometimes associated with *Populus*, on silty, sandy to gravelly alluvium along rivers and streams; 0-2715 m; Alta., B.C., N.T., Sask., Yukon; Alaska, Ariz., Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., Utah, Wash. Map 22.

Salix maccalliana Rowlee

MacCalla's willow

Mid to tall shrubs 1-5 m, not colonial or forming colonies by layering. **Stems** erect; **branches** flexible at bases, dark red-brown, highly glossy or shiny, not glaucous, glabrous; **branchlets** red- or yellow-brown, not glaucous, puberulent to glabrescent, hairs appressed or spreading, wavy, curved, straight, or geniculate; **buds** with *alba*-type gradation. **Leaves, stipules early deciduous**, on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous, apices acute; **petioles** convex to flat or shallowly grooved adaxially, 4-15 mm, **not glandular at distal ends**, adaxial surfaces pilose or pubescent; **juvenile leaves reddish**, abaxial surfaces moderately densely short-silky or tomentose, hairs white and ferruginous; **proximal leaves** serrulate; **largest medial blades** hypostomatous or amphistomatous, venation pinnate, lorate or narrowly oblong, 40-85 × 8-25 mm, length-width ratio 2.9-4.8(-5.7); bases convex or cuneate, angles < 90°; margins flat, entire, serrulate, or crenate all around margins, glands marginal; apices acute to sometimes acuminate, angles < 90°; abaxial surfaces not glaucous, but pale, glabrous or sparsely pubescent to glabrescent, hairs white and ferruginous, straight, short and stiff, **adaxial surfaces highly glossy**, not glaucous, glabrous, puberulent, or sparsely tomentose to glabrescent, **hairs white and ferruginous**. **Catkins flowering as leaves emerge**, lateral; **staminate** stout to subglobose, 15.5-42 × 9-16 mm, flowering branchlets 1.5-11 mm; **pistillate very densely flowered**, slender, stout, or subglobose, 25-50 × 10-20 mm, flowering branchlets 3-12 mm; **floral bracts** tawny, 1.6-3.6 mm, abaxial surfaces sparsely hairy all over or mainly at proximal ends, hairs white or white and ferruginous, wavy; bract apices rounded to truncate, entire; **pistillate bracts persistent**. **Flowers, staminate** abaxial nectaries (0-)0.58-0.9 mm, adaxial nectaries oblong or narrowly oblong, 0.5-1 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stamens 2, anthers purple becoming yellow, ellipsoid or short-cylindrical, 0.8-1 mm, filaments distinct, **hairy on lower halves**; **pistillate** abaxial nectaries present, adaxial nectaries oblong, 0.4-1 mm, shorter than stipes, swollen, abaxial and adaxial nectaries distinct; **stipes 0.8-2 mm**, ovaries pyriform, beaks gradually tapering to styles, very densely villous or silky-villous, hairs white and ferruginous, straight or wavy, flattened; styles connate to free about half their lengths, 0.8-1.2 mm; stigmas broad-cylindrical, 0.28-0.47 (-0.56) mm; 12-16 ovules per ovary. **Capsules** 7-11 mm. $2n = ca. 190$, ca. 10x (Löve & Löve 1982; Suda & Argus 1968), $2n = ca. 214$, ca. 11x (Dorn 1975b), $2n = ca. 224$, ca. 12x (Suda & Argus 1968).

Flowering early May to early July. *Carex*-graminoid and shrubby fens, marly or bouldery lake shores, string bogs, treed bogs, and *Calamagrostis* grasslands; 5-1520 m; Alta., B.C., Man., N.T., Ont., Que., Sask., Yukon; Minn., N.Dak., Wash. Endemic. Map 23.

Salix maccalliana is characterized by leaves leathery, glossy and green on both surfaces; juvenile leaves silky with white and ferruginous hairs; ovaries large (6-8 mm) and densely villous, styles long (0.8-1.2 mm); floral bracts tawny or lemon-green; stamens surrounded by a cup-like nectary.

The dodecaploid (12×) chromosome number of *Salix maccalliana*, the highest of any *Salix*, indicates a complex evolutionary origin. It has been suggested (Rowlee 1907, Raup 1959) that it incorporates the characters of two subgenera, *Salix* and *Chamaetia*. The presence of abaxial floral nectaries, particularly in staminate flowers, its tawny and persistent floral bracts, and villous ovaries resemble *S. glauca* in subgenus *Chamaetia*; its leaves, especially the coarse ferruginous hairs and serrate margins, suggest *S. lucida* or *S. serissima* in subgenus *Salix*; and it is phenetically closest to *S. sect. Salicaster* in subgenus *Salix* (Argus 1977). It is likely that it incorporates genomes from more than one subgenus thus making its subgeneric placement arbitrary.

Salix myrtilifolia* Andersson*blueberry willow**

Low to mid shrubs 0.1-0.6(-1) m; **forming colonies by layering**. **Stems** decumbent or erect; **branches** flexible at bases, gray-, red-, or yellow-brown, dull or shiny, not glaucous, pubescent to glabrescent; **branchlets** gray-, red-, or yellow-brown, not glaucous or weakly so, **sparsely pubescent**, hairs spreading or appressed, very short, curved or geniculate. **Leaves, stipules** early deciduous or deciduous in autumn, on first leaves minute rudiments, foliaceous, or apparently absent, on later leaves minute rudiments or foliaceous (to 5 mm), apices acute; **petioles** deeply to shallowly grooved adaxially, 1.5-8 mm, not glandular at distal ends, adaxial surfaces glabrous or pubescent; **juvenile leaves** reddish or yellowish green, glabrous; **proximal leaves** crenate; **largest medial blades** hypostomatous to amphistomatous, venation pinnate, elliptic, narrowly elliptic, obovate, or broadly obovate, 17-74 × 8-30 mm, length-width ratio 1.2-4.5; bases cuneate, convex, or subcordate, angles < 90°; margins flat, **serrulate, crenulate, or undulate all around margins**, glands marginal; apices acute, convex, or acuminate, angles < 90°, **abaxial surfaces not glaucous**, glabrous; adaxial surfaces shiny, not glaucous, glabrous, midrib sometimes pubescent. **Catkins** flowering as leaves emerge, lateral; **staminate** stout, 11.5-39 × 5-14 mm, flowering branchlets 0.5-6 mm; **pistillate** moderately to very densely flowered, slender or stout, 16-46 (to 50 mm in fruit) × 4-15 mm, flowering branchlets 1.5-12 mm; **floral bracts** brown, bicolor, black, or tawny, 0.4-1.1 mm, abaxial surfaces sparsely hairy at proximal ends or all over, hairs white, curly or wavy; bract apices retuse or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or square, 0.2-0.34-0.4 mm; stamens 2, anthers purple becoming yellow, ellipsoid, short-cylindrical, or globose, 0.3-0.6 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries square, oblong, or ovate, 0.2-0.4 mm, shorter than stipes, flat, thick or thin; stipes 0.6-1.7 mm; ovaries pyriform, beaks gradually tapering or slightly bulged below styles, not glaucous, glabrous, styles connate or free about half, 0.3-0.7 mm, stigmas two plump lobes, 0.16-0.23-0.32 mm; 10-14 ovules per ovary. **Capsules** 4-6 mm. $2n = 38$, $2\times$ (Dorn 1975a; Suda & Argus 1968).

Flowering early May to late July. Treed bogs, fens, river banks, subalpine spruce thickets, *Pinus contorta* woods, sand dunes, and coal spoils; 88-2831 m; Alta., B.C., Lab., Man., N.B., N.T., Nunavut (Akimiski Isl.), Ont., Sask., Yukon; Alaska, Colo., Wyo. Map 24.

Salix myrtilifolia is characterized by a low, decumbent growth form (rarely reaching 1-2 m tall), usually in deep moss; mature leaves green on both surfaces, very short styles (0.3-0.5 mm), and sparsely hairy floral bracts.

The complex of species related to *Salix myrtilifolia* includes *S. arizonica* Dorn, *S. ballii* Dorn, *S. boothii* Dorn, and *S. pseudomyrsinites*. Two are diploid (*S. arizonica* and *S. myrtilifolia*), two are tetraploid (*S. boothii* and *S. pseudomyrsinites*), the chromosome number of *S. ballii* is unknown. They have been treated taxonomically in different ways, but they are relatively distinct in their morphology, ecology, and geography and probably deserve species rank. *Salix myrtilifolia* has outlying populations represented by single collections from Wyoming and Colorado. Specimens attributed to this species from the Gaspé Peninsula, Quebec and the Northern Peninsula, Newfoundland, all have evidence of leaf glaucescence and are *S. ballii*. See *S. pseudomyrsinites* for discussion of differences and taxonomy. *Salix myrtilifolia* may hybridize with *S. candida*.

Salix niphoclada* Rydb.*barren-ground willow, snow willow**

Salix brachycarpa subsp. *fullertonensis* (C.K. Schneider) A. & D. Löve; *S. brachycarpa* subsp. *niphoclada* (Rydb.) Argus; *S. brachycarpa* var. *fullertonensis* (C.K. Schneider) Argus; *S. brachycarpa* var. *mexiae* C.R. Ball; *S. fullertonensis* C.K. Schneider; *S. glauca* var. *niphoclada* (Rydb.) Wiggins; *S. muriei* Hultén; *S. niphoclada* var. *fullertonensis* (C.K. Schneider) Raup; *S. niphoclada* var. *mexiae* (C.R. Ball) Hultén; *S. niphoclada* var. *muriei* (Hultén) Raup

Low or mid shrubs 0.3-1.5(-3) m, **not colonial**. **Stems** erect, decumbent, or trailing; **branches** flexible at bases, gray-, yellow-, or red-brown, not glaucous, pilose, villous, or long-silky to glabrescent; **branchlets violet, red-, or yellow-brown**, not glaucous, pilose, densely villous, long-silky, or tomentose, hairs appressed or spreading, wavy, straight, or geniculate; **buds with arctica-type gradation**. **Leaves, stipules** deciduous in autumn or persisting for 2 or more years, **foliaceous**, sometimes obscured by hairs, apices acute; **petioles** shallowly grooved adaxially, 2-5.5 mm, not glandular at distal ends, adaxial surfaces villous; **juvenile leaves** yellowish green, **abaxial surfaces densely long-silky**, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous or amphistomatous, venation pinnate, narrowly oblong, narrowly elliptic, elliptic, broadly elliptic, lanceolate, or obovate, 13-64 × 6-22 mm, length-width ratio 1.6-5.5; bases convex or slightly decurrent, angles < 90°; margins slightly revolute, entire (obscured by hairs); apices acuminate or acute, angles < 90°; abaxial surfaces glaucous, densely villous or woolly to pilose, hairs appressed or spreading, white, straight or wavy; adaxial surfaces shiny, not glaucous, moderately densely to sparsely villous, hairs white. **Catkins flowering as leaves emerge**, lateral, **staminate** 12-42 × 4-14 mm, flowering branchlets 0-20 mm; **pistillate** densely flowered, slender to subglobose, 16-69 × 4-13 mm, flowering branchlets 4-30 mm. **Floral bracts** tawny, brown, or black, 1.2-3.2 mm, abaxial surfaces sparsely to moderately densely hairy all over, hairs white, wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.5-1.2 mm, adaxial nectaries narrowly oblong, oblong, ovate, or flask-shaped, 0.5-1.5 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.3-0.5 mm, filaments distinct, glabrous or sparsely hairy on lower halves; **pistillate adaxial nectaries narrowly oblong, ovate, or flask-shaped**, 0.5-2 mm, **longer than stipes**, swollen or flat; **stipes 0-0.5 mm**; ovaries pyriform, beaks slightly bulged or abruptly tapering to styles, not glaucous, **very densely villous or long-silky**, hairs white, straight or wavy, flattened; styles connate to almost distinct, 0.24-0.8 mm; stigmas slender- or broad-cylindrical, 0.2-0.36-0.6 mm; 8-20 ovules per ovary. **Capsules** 4-6 mm. Chromosome number is unknown. Reports of 2n=38 are either unvouchered (Löve & Löve 1975) or the identification is uncertain (Petrovsky & Zhukova 1983, Yurtsev et al. 1975).

Flowering June and July. Wet to moderately well-drained calcareous, gravelly or sandy floodplains, terraces, eskers, and drumlins, fine, silty loess deposits, dry to mesic stony alpine slopes and saline flats, limestone talus, sand blowouts and plains; 10-2250 m; B.C., N.T., Nunavut, Yukon; Alaska; Eastern Asia (Siberia). Map 25.

Salix niphoclada is characterized by a low growth form, often decumbent or trailing; petioles short (2-5 mm), often narrowly cylindrical catkins; ovaries densely white-villous, stipes short (0-0.5 mm); anthers small (0.3-0.5 mm). See Table 4 for comparison with *S. brachycarpa* and *S. glauca*.

This species were treated as *S. brachycarpa* subsp. *niphoclada* (Argus 1965, 1973) because where the ranges of the two taxa overlap in northern British Columbia they appeared to intergrade. The area of overlap, however, has proved to be small and intergradation uncommon. For those reasons species rank is used here. The putative hybrid, *Salix niphoclada* × *S. setchelliana*, based on a specimen from Sheep Mt., Kluane, YT, 1180 m, has stigmas 0.6 mm, floral bracts oblong, 1.75 mm, and the pistillate catkin shape and length and thin leaves of *S. niphoclada*; but the glabrous, reddish ovaries of *S. setchelliana*.

***Salix nummularia* Andersson**

coin-leaf willow

Salix nummularia subsp. *tundricola* (Schljak.) A. & D. Löve

Dwarf shrubs 1-3 cm, forming colonies by layering. **Stems trailing**, forming mats; **branches** flexible at bases, yellow- or red-brown, not glaucous, glabrous; **branchlets** yellow- or red-brown, pubescent or pilose, hair spreading; **buds** with *arctica*-type gradation. **Leaves, stipules** deciduous in autumn, absent or minute rudiments; **petioles** deeply grooved adaxially, 1.5-2 mm, not glandular at distal ends, adaxial surfaces glabrous or pubescent; **juvenile leaves** yellowish green, abaxial surfaces pilose or puberulent, hairs white;

proximal leaves entire or serrulate; **largest medial blades** amphistomatous, venation two pair of secondary veins arise at or close to base and arc toward apex or pinnate, broadly elliptic, subcircular, or elliptic, broadly ovate, 9-22(-30) × 7.5-14(-19) mm, length-width ratio 1.2-2; bases rounded, subcordate, cordate, or convex, angles < or > 90°; margins flat or slightly revolute, entire or serrulate at proximal ends or all around, glands marginal; apices convex, rounded, or retuse, angles > 90°, abaxial surfaces not glaucous, glabrous; adaxial surfaces highly glossy, glabrous. **Catkins** flowering as leaves emerge, lateral, **staminate** shape **indeterminate, 3-8 flowers**, 3.2-6.6 × 2-5.2 mm, flowering branchlets 0.8-4.6 mm; **pistillate loosely flowered, shape indeterminate, 3-5 flowers**, 7.5-13 × 3-10 mm, flowering branchlets 0.5-10 mm; **floral bracts** tawny, 0.6-1.4 mm, abaxial surfaces sparsely hairy, hairs white, wavy; bract apices rounded or truncate, entire, sometimes toothed; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries (0.3-0.48-0.65 mm, adaxial nectaries narrowly oblong or oblong, 0.65-1.1 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stamens 2, anthers purple becoming yellow, ellipsoid, 0.4-0.5 mm, filaments distinct or connate less than half, glabrous; **pistillate** abaxial nectaries (0-)0.63-0.88 mm, adaxial nectaries narrowly oblong or oblong, 0.6-1.4 mm, longer than stipes, flat, thin, abaxial and adaxial nectaries connate and shallowly cup-shaped; stipes 0-0.7 mm; ovaries pyriform, beaks slightly bulged below styles, not glaucous, glabrous; styles connate or slightly distinct, 0.2-1 mm; stigmas broad-cylindrical, 0.2-0.27-0.32 mm, 8-10 ovules per ovary. **Capsules** 3.5-7.5 mm. $2n = 38$, 2× (Zhukova 1969).

Flowering late June to early August (based on Russian collections). Exposed, relatively dry stony, moss-lichen, and moss tundra, polygonal tundra, outcrops, marine sediments, and sand dunes. Restricted to snow-free areas, usually on acidic substrates (Skvortsov 1999); 2-1850 m; Alaska; Eurasia: Russia (Arctic Europe, Eastern Siberia, Arctic Siberia, disjunct in the Far East and Chukotka), China (Jilin), North Korea, Japan (Hokkaido). Map 25.

See Table 6 for comparison with *Salix rotundifolia* and *S. phlebophylla*.

***Salix ovalifolia* Trautv.**

arctic seashore willow, oval-leaf willow

Dwarf shrubs 2-5 cm, **not colonial or forming colonies by layering**. **Stems long, trailing**; **branches** flexible at bases, yellow-, gray-, or red-brown, not glaucous, glabrous or sparsely hairy; **branchlets** yellow-green, yellow-, or red-brown, not glaucous, **glabrous or pilose**, hairs spreading, straight, or wavy; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments (rarely foliaceous); **petioles** deeply to shallowly grooved adaxially, **not glandular at distal ends**, adaxial surfaces glabrous; **juvenile leaves** reddish or yellowish green, abaxial surfaces pilose, or moderately densely villous or long-silky to glabrescent, hairs white; **adaxial surfaces highly glossy**; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate; margins slightly revolute or flat, entire, sometimes ciliate, **glands submarginal**. **Catkins flowering as leaves emerge**, lateral, **pistillate moderately densely flowered**; **floral bracts** brown, greenish, or bicolor, 1.2-2.5 mm, abaxial surfaces hairy all over, hairs white, straight or wavy; bract apices rounded, entire or bifid; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries present, adaxial nectaries oblong or ovate; stamens 2, anthers purple or red becoming yellow, ellipsoid, short cylindrical, or globose, 0.3-0.5 (-0.6) mm, filaments distinct or connate less than half, glabrous; **pistillate** abaxial nectaries present or absent, adaxial nectaries longer than stipes, flat; ovaries obclavate or pyriform, **beaks abruptly tapering to styles**, glaucous or not; styles connate, 0.2-0.8 mm; stigmas slender-cylindrical, 0.32-0.41-0.64 mm, 10-15 ovules per ovary.

The varieties of *Salix ovalifolia* are relatively minor variants; their ranges overlap and the differences in leaf shape and ovary indumentum intergrade (1969, 1973). The only taxon with a more or less distinctive geographical distribution is var. *cyclophylla* but it overlaps and intergrades with var. *ovalifolia*. The var. *arctolitoralis*, which is characterized by larger leaves and catkins, may be ecotypic. The var. *glacialis* is known definitely only from near Point Barrow, Alaska; it was suggested (Hultén 1968), probably based on

its frequently tomentose ovaries, that it is *Salix arctica* × *S. ovalifolia*. All varieties of the species have some plants with hairy ovaries; the possibility of hybridization, however, needs further study.

1 Ovaries predominantly hairy; leaf blades 8.5-14 mm; endemic at Point Barrow, Alaska.

..... *Salix ovalifolia* var. *glacialis*
1 Ovaries predominantly glabrous; leaf blades 13-46 mm; not endemic at Point Barrow, Alaska. 2

2(1) Leaves subcircular to circular, length-width ratio 1-1.5. *Salix ovalifolia* var. *cyclophylla*

2. Leaves narrowly elliptic to broadly elliptic, obovate, or subcircular, length-width ratio 1-3.4. 3

3(2) Leaves elliptic to subcircular, 13-28 mm. *Salix ovalifolia* var. *ovalifolia*

3. Leaves narrowly elliptic to broadly elliptic or obovate, 25-46 mm.

..... *Salix ovalifolia* var. *arctolitoralis*

***Salix ovalifolia* Trautv. var. *arctolitoralis* (Hultén) Argus**

Salix arctolitoralis Hultén, Sv. Bot. Tidskr. 34: 373. 1940.

Leaves, petioles 2-16 mm; **largest medial blades** narrowly elliptic, elliptic, broadly elliptic, or obovate, 25-46 × 10-20 mm, length-width ratio 1.6-3.4; bases convex or slightly decurrent, angles < 90°; apices convex, acute, acuminate, or rounded, angles < or > 90°; abaxial surfaces glabrous, sparsely pubescent, or pilose, hairs spreading, white, wavy; adaxial surfaces not glaucous, glabrous, pubescent, or pilose to glabrescent, hairs white. **Catkins, staminate stout**, 23-46 × 8-11 mm, flowering branchlets 3-24 mm; **pistillate** stout to subglobose, 28-48 × 10-28 mm, flowering branchlets 5-22 mm. **Flowers, staminate** abaxial nectaries 0.8-1.1 mm, adaxial nectaries 0.7-1.1 mm, abaxial and adaxial nectaries connate and cup-shaped; **pistillate** abaxial nectaries absent, **adaxial nectaries ovate**, 0.5-1.9 mm; stipes 0.2-1.4 mm, **ovaries glabrous**. **Capsules** 5.2-9.6 mm.

Flowering early July to late August. Arctic; coastal beach ridges and sand spits, and tundra meadows; 0-3 m; N.T., Yukon; Alaska. Map 26.

***Salix ovalifolia* Trautv. var. *cyclophylla* (Rydb.) C. R. Ball**

Salix cyclophylla Rydb. Bull. N.Y. Bot. Gard. 1: 274. 1899.

Leaves, petioles 2-7 mm; **largest medial blades** subcircular to circular, 13-28 × 7-18 mm, length-width ratio 1-1.5; bases subcordate, cordate, convex, or slightly decurrent, angles > 90°; apices convex, rounded, or retuse, angles > 90°; abaxial surfaces, glaucous, glabrous, pilose or long-silky to glabrescent, hairs spreading, white; adaxial surfaces not glaucous, glabrous, pilose or sparsely villous to glabrescent, margins sometimes ciliate, hairs white. **Catkins, staminate** subglobose, 12.5-15.5 × 8-10 mm, flowering branchlets 3-12 mm; **pistillate** stout, subglobose, or globose, 10-31 × 6-12 mm, flowering branchlets 3.5-15 mm. **Flowers, staminate** abaxial nectaries 0.8-1.1 mm, adaxial nectaries 0.7-1.1 mm, abaxial and adaxial nectaries connate and cup-shaped; **Pistillate flowers** abaxial nectaries absent, **adaxial nectaries ovate**, 0.5-2.1 mm; stipes 0.2-1.4 mm, ovaries glabrous, pubescent, or villous, hairs flattened. **Capsules** 5.2-6.5 mm.
32. *Salix ovalifolia* var. *arctolitoralis*

Flowering mid-May to late July. Arctic and possibly subarctic; shores of lake and lagoons, *Empetrum* tundra, in moss on rocky pavements, meadows, and beach ridges; 0-22(-610) m; Alaska; Asia: Russia (Chukotka). Map 27.

Salix ovalifolia* Trautv. var. *glacialis* (Andersson) ArgusSalix glacialis* Andersson, Öfvers. Vet. Akad. Forh. 15: 131. 1858.

Leaves, petioles 1.1-3.2 mm; **largest medial blades** elliptic or broadly elliptic to subcircular, **8.5-14** × 4.5-9 mm, length-width ratio 1.1-2.2; bases subcordate, cordate, convex, or slightly decurrent, angles < or > 90°; apices convex, angles > 90°; abaxial surfaces glaucous, glabrous or pilose to glabrescent, hairs spreading, white, wavy; adaxial surfaces not glaucous, pilose to glabrescent, hairs white, long, straight.

Catkins, staminate *subglobose or globose*, 4.75-15 × 5-9 mm, flowering branchlets 1.5-7 mm; **pistillate** stout to globose, 6.25-15 × 5-12 mm, flowering branchlets 2.5-8 mm. **Flowers, staminate** abaxial nectaries 0.5-0.85 mm, adaxial nectaries 0.63-1.1 mm, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped; **pistillate** abaxial nectaries (0-)0.4-0.6 mm; **adaxial nectaries ovate**, 0.5-1.6 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stipes 0.2-0.8 mm, **ovaries glabrous or tomentose**.

Capsules 5.2-6.5 mm.

Flowering July. Arctic; coastal sandy-gravel spits. Elevation 0-12 m; Alaska. Endemic. Map 27.

Salix ovalifolia* Trautv. var. *ovalifolia**arctic seashore willow, oval-leaf willow***Salix ovalifolia* var. *camdensis* C.K. Schneider, *S. flagellaris* Hultén.

Leaves, petioles 2-7 mm; **largest medial blades** elliptic, broadly elliptic, or subcircular, 13-28 × 7-18 mm, length-width ratio 1.1-2.2; bases subcordate, cordate, rounded, or convex, angles < or > 90°; apices convex, rounded, or acute, angles < or > 90°; abaxial surfaces glaucous, glabrous, pilose, or moderately densely villous to glabrescent, **hairs spreading**, white; adaxial surfaces not glaucous, glabrous, pilose, sparsely villous, or long-silky, hairs glabrescent, white. **Catkins, staminate** stout, subglobose, or globose, 9.5-21 × 5-10 mm, flowering branchlets 2-7 mm; **pistillate** stout, subglobose, globose, or slender, 11.5-50 × 6-18 mm, flowering branchlets 3-21 mm. **Flowers, staminate** abaxial nectaries 0.55-1 mm, adaxial nectaries 0.63-1.6 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; **pistillate** abaxial nectaries 0.13-0.63 mm, adaxial nectaries ovate, oblong, or narrowly oblong, 0.5-2 mm, abaxial and adaxial nectaries connate and cup-shaped; stipes 0.2-1.4 mm, ovaries glabrous, pubescent, or villous, hairs flattened.

Capsules 5.2-6.5 mm. $2n = 38$, $2\times$ (Johnson & Packer 1968; Packer & McPherson 1974; Suda & Argus 1969). Russia: $2\times$ (Zhukova & Tikhonova 1973; Zhukova 1980; Petrovsky & Zhukova 1983a). $2n = 56$, $3\times$ (Petrovsky & Zhukova 1983a).

Flowering early June to early August. Arctic and subarctic; coastal sandy-gravel spits, wet sedge meadows, saline marshes, occasionally on upland tundra; 0-10(-616) m; N.T., Yukon; Alaska; Asia: Russia (Chukotka). Map 28.

Salix pedicellaris* Pursh*bog willow***Salix pedicellaris* var. *hypoglauca* Fernald

Low to mid shrubs 0.2-1.5 m, **forming colonies by layering**. **Stems** erect, decumbent or trailing; **branches** flexible at bases, **gray-brown**, shiny or highly glossy, not glaucous, glabrous or glabrescent; **branchlets** yellow-brown or red-yellow, not glaucous, glabrous or puberulent, hairs erect, straight, minute; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments; **petioles** deeply to shallowly grooved adaxially, 3-8 mm, not glandular at distal ends, adaxial surfaces glabrous or puberulent; **juvenile leaves** reddish or yellowish green, translucent, abaxial surfaces, glabrous, puberulent, or sparsely pubescent, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly oblong, oblong, narrowly elliptic, elliptic, broadly elliptic, narrowly oblanceolate or oblanceolate, 19-53(-69) × 5-20 mm, length-width ratio 1.8-4.9; bases convex or rounded, angles < 90°;

margins flat or slightly revolute, entire, glands marginal; apices acute, convex, or rounded, angles $<$ or $>$ 90° ; abaxial surfaces glaucous, glabrous; adaxial surfaces dull, *glaucous*, glabrous (rarely very sparsely short-silky, hairs white or white and ferruginous). **Catkins** flowering as leaves emerge, lateral, **staminate** stout, 11-21 \times 4-8 mm, flowering branchlets 3-12 mm; **pistillate loosely flowered**, stout to subglobose, 14-37 \times 5-14 mm, flowering branchlets 7-25 mm; **floral bracts** tawny or light rose, 0.8-1.6 mm, abaxial surfaces very sparsely hairy at distal ends, hairs white, straight or wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or narrowly oblong, 0.5-1.1 mm; stamens 2, anthers yellow, ellipsoid, 0.4-0.6 mm, filaments distinct or connate less than half, glabrous or hairy on lower halves or at bases; **pistillate** adaxial nectaries oblong, 0.2-1.4 mm, shorter or longer than stipes, flat, thin; **stipes 1-3.2 mm**, ovaries obclavate, beaks abruptly tapering to styles, often glaucous, glabrous; styles connate or free about half their lengths, 0.1-0.24 mm; stigmas flat with rounded tips or broad-cylindrical, 0.2-0.25-0.36 mm, 4-6 ovules per ovary. **Capsules** 4-8 mm. $2n = 38$, $2\times$ (Löve 1954), $2n = 57$, $3\times$ (Suda & Argus), or $2n = 76$, $4\times$ (Löve & Löve 1982; Löve & Ritchie 1966).

Flowering mid-April to mid-July (Argus 1964). *Sphagnum* bogs, fens, and black spruce treed bogs; 5-1440 m; St. Pierre and Miquelon; Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., Que., Sask., Yukon; Conn., Idaho, Ill., Ind., Iowa, Maine, Mass., Mich., Minn., N.H., N.J., N.Dak., N.Y., Ohio, Oreg., Pa., R.I., Vt., Wash., Wis. Map 29.

Salix pedicellaris is characterized by leaves leathery, glabrous, glaucous on both surfaces and reticulate adaxially; catkins loosely flowered; ovaries reddish and glabrous, and stipes long (2.1-3.2 mm). It hybridizes with *S. athabascensis* (Argus 1973); see Table 2 for comparison with *S. athabascensis*.

Chromosome numbers of $2n=38$ (Löve 1954), $2n=76$ (Löve & Ritchie 1966) and $2n=57$ (Suda & Argus 1969) have been reported for *Salix pedicellaris*. Voucher specimens for the Löve counts could not be found. The voucher for the triploid count (Argus & Chunys 5049) has the morphology of typical *S. pedicellaris*. The specimen on which this count was made was collected at Watson Lake, Yukon, in a very wet *Carex lanuginosa* fen with *Salix pedicellaris*, *S. athabascensis*, and hybrids between the two. *Salix planifolia* was growing in the surrounding *Betula glandulosa* thicket. From this population chromosome numbers of $2n=76$ were determined for *Salix athabascensis* (Argus & Chunys 5053) and putative hybrids *S. athabascensis* \times *pedicellaris* (Argus & Chunys 5045). The tetraploid hybrids suggest that both parents are tetraploid. Based, however, on the diploid and tetraploid counts reported for *S. pedicellaris* (Löve 1954, Löve & Ritchie 1966) as well as the triploid report for *S. pedicellaris* (Suda & Argus 1969), it could be postulated that this population of *Salix pedicellaris* consisted of both diploid and autotetraploid individuals along with "hybrids" between them. Partial support for this is provided by a hexaploid count reported for *Salix athabascensis* (Argus 3869) from a wet fen at Candle Lake, Saskatchewan (Suda & Argus 1969). Several *Salix* including *S. pedicellaris*, *S. maccalliana*, *S. candida*, and *S. planifolia* were growing in the area. It is possible that the hexaploid *Salix athabascensis* \times *S. pedicellaris* individual was an allopolyploid derived from hybridization between tetraploid *S. athabascensis* and diploid *S. pedicellaris*. The hypotheses that autopolyploidy occurs within *Salix pedicellaris* and that hybridization with tetraploid *S. athabascensis* has led to complex polyploidization need study.

Salix pentandra L.

bay-leaf willow, bay willow, laurel willow

Tall shrubs or trees 5-15 m, not colonial. **Stems** erect; **branches** flexible at bases, **brownish or yellow-green, highly glossy**, not glaucous, glabrous; **branchlets** yellow-green or red-brown or brownish, glossy, not glaucous, glabrous; **buds** with alba-type gradation. **Leaves, stipules** early deciduous, on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous, apices rounded; **petioles deeply to shallowly grooved adaxially**, 5-15 mm, **with pairs or clusters of spherical glands at distal ends or scattered along petioles**, adaxial surfaces glabrous; **juvenile leaves** reddish, glabrous; **proximal leaves**

entire or serrulate; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, elliptic, or lanceolate, 50-135 × 20-50 mm, length-width ratio 2-4; bases convex or slightly decurrent, angles < 90°; margins slightly revolute or flat, serrulate all around margins, glands marginal or submarginal; apices acuminate, angles < 90°; abaxial surfaces not glaucous (but pale), glabrous; adaxial surfaces highly glossy, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral; **staminate** slender or stout, 27-81 × 9-13 mm, flowering branchlets 9-21 mm; **pistillate** moderately to very densely flowered, slender or stout, 29-68 × 7-15 mm, flowering branchlets 9-42 mm; **floral bracts** tawny or greenish, 2-4 mm, abaxial surfaces sparsely hairy mainly at proximal ends, hairs white or white and ferruginous, wavy or straight; bract apices acute or rounded to truncate, entire or toothed; pistillate bracts deciduous. **Flowers, staminate** abaxial nectaries 0.58-1.68 mm, adaxial nectaries square, ovate, or oblong, 0.5-1.5 mm, abaxial and adaxial nectaries distinct or ±connate and cup-shaped; **stamens 4-10**, anthers yellow, ellipsoid or globose, 0.5-0.6 mm, filaments distinct, hairy on lower halves; **pistillate** adaxial nectaries oblong, square, or ovate, 0.4-0.8 mm, shorter than or equal to stipes, flat, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped; stipes 0.5-1.6 mm; ovaries pyriform, beaks gradually tapering to styles, not glaucous, glabrous; styles connate to distinct, 0.4-0.6 mm; stigmas flat with rounded tips, 0.36-0.5-0.6 mm, 18-22 ovules per ovary. **Capsules** 6-9 mm. $2n = 76, 4\times$ (Zsuffa & Raj 1981 pers. comm.).

Flowering late May to mid-June. Introduced and occasionally naturalized; to 2040 m; Alta., B.C., Man., N.B., Nfld., N.S., Ont., Que., Sask.; Alaska, Colo., Conn., D.C., Ill., Iowa, Ky., Maine, Md., Mass., Minn., Mont., Nebr., N.H., N.J., N.C., N.Y., Pa., R.I., S.Dak., Vt., Va., Wis., Wyo. Eurasia. Map 30.

Only pistillate plants of *Salix pentandra* have been introduced into the flora area.

***Salix petiolaris* Sm.**

meadow willow

Salix gracilis Andersson; *S. gracilis* Andersson var. *textoris* Fernald; *S. petiolaris* Smith var. *gracilis* (Andersson) Andersson; *S. subsericea* (Andersson) C.K. Schneider

Tall shrubs 1-6 m, not colonial. **Stems** erect; **branches** flexible at bases, red-brown or violet, dull or shiny, not glaucous or weakly so, puberulent; **branchlets yellowish**, sometimes not glaucous or weakly so, sparsely pubescent or moderately densely velvety, hairs appressed, spreading, or erect; **buds with transitional-type gradation**. **Leaves, stipules minute rudiments or absent**; **petioles** shallowly grooved adaxially, 3-12 mm, **not glandular at distal ends**, adaxial surfaces pubescent or velvety to glabrescent; **juvenile leaves** yellowish green, abaxial surfaces moderately densely long-silky, hairs white or white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous, venation pinnate, lorate or very narrowly elliptic, 38-110 × 6-19 mm, **length-width ratio 5-9**; bases cuneate or convex, angles < 90°; margins flat to slightly revolute, entire, serrate, serrulate, or spinulose-serrate, glands marginal; apices acute to acuminate, angles < 90°; abaxial surfaces glaucous, densely long-silky to glabrescent, hairs appressed, white or white and ferruginous, straight, long; adaxial surfaces dull or shiny, not glaucous, glabrous or sparsely pubescent, hairs appressed, white or white and ferruginous. **Catkins** flowering as leaves emerge, lateral; **staminate** stout, subglobose, or globose, 12-29 × 6-17 mm, flowering branchlets 0.75-3 mm; **pistillate loosely flowered**, stout, subglobose, or globose, 12-39 × 6-18 mm, flowering branchlets 1-11 mm; **floral bracts** brown, tawny, light rose, or bicolor, 1-2 mm, abaxial surfaces sparsely hairy all over, hairs white, straight; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries square, ovate, or oblong, 0.3-0.7 mm; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.4-0.6 mm; filaments distinct, hairy at bases; **pistillate** adaxial nectaries oblong to ovate, 0.3-0.88 mm, shorter than stipes, flat, thin; **stipes 1.5-4 mm**; ovaries pyriform, beaks abruptly tapering to styles, short-silky, hairs white or white and ferruginous, straight, flattened; styles connate, 0-0.5 mm; stigmas slender-cylindrical, 0.24-0.43-0.6 mm, 6-12 ovules per ovary. **Capsules** 5-9 mm. $2n = 38, 2\times$ (Löve & Löve 1982; Suda & Argus 1968; Zsuffa & Raj 1981).

Flowering mid-April to mid-June. Sedge meadows, openings in moist, low, rich deciduous woods, sandy or peaty wet prairie, lake shores; 10-2740 m.; Alta., B.C., Man., N.B., N.T., Ont., P.E.I., Que., Sask.; Colo., Conn., Ill., Ind., Iowa, Maine, Mass., Mich., Minn., Nebr., N.H., N.J., N.Dak., N.Y., Ohio, Pa., S.Dak., Vt., Wash., Wis. Map 30.

***Salix phlebophylla* Andersson**

skeleton-leaf willow

Dwarf shrubs 1-7 cm, forming colonies by rhizomes. **Stems trailing**, mat forming; **branches** flexible at bases, red- or yellow-brown, not glaucous, glabrous; **branchlets red-brown**, not glaucous, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments; **petioles** deeply grooved to flat adaxially, 1.2-3.2(-4.8) mm, adaxial surfaces sparsely pubescent; **juvenile leaves** green, abaxial surfaces glabrous or ciliate on margins, hairs white; **proximal leaves** entire; **largest medial blades** persistent, becoming skeletonized, amphistomatous, venation two pairs of secondary veins arise at or close to bases and arc toward apices, elliptic, broadly elliptic, obovate, subcircular, or circular, 7-15 × 3-11 mm, length-width ratio 1.1-2.5(-3.5); bases convex, cuneate, or slightly decurrent, angles < or > 90°; margins flat, ciliate, entire; apices convex, rounded, or retuse, angles < or > 90°, **abaxial surfaces not glaucous**, glabrous, midrib sometimes pilose, margins sometimes ciliate, hairs spreading, white, straight, wavy, or crinkled, long; adaxial surfaces highly glossy, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral, **staminate** stout or subglobose, 10-35 × 6-10 mm, flowering branchlets 1-11 mm; **pistillate** moderately densely flowered, stout or subglobose, ca. 25 flowers, 12-38 × 5-11 mm, flowering branchlets 3-14 mm; **floral bracts** brown, black, or bicolor, 1-1.3 mm, abaxial surfaces sparsely hairy all over, hairs white, straight or wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong or oblong, 0.4-1.1 mm; stamens 2, anthers purple becoming yellow, ellipsoid or obovoid, 0.3-0.5 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong or narrowly oblong, 0.4-1.6 mm, *shorter than or equal to stipes*, flat, thick; stipes 0.4-1.4 mm; ovaries pyriform, beaks slightly bulged below styles, not glaucous, sparsely to moderately densely short-silky or villous, at least on beaks, hairs white, wavy or crinkled, ribbon-like; styles connate or slightly distinct, 0.3-1 mm; stigmas slender- or broad-cylindrical, 0.16-0.34-0.52 mm; 12 ovules per ovary. **Capsules** 2.9-4.8 mm. $2n = 38$, 2× (Packer & McPherson 1974; Suda & Argus 1969). Russia: 2× (Zhukova 1967, 1980; Petrovsky & Zhukova 1983b).

Flowering June and July. Arctic-alpine; dry *Dryas*-lichen tundra, polygonal tundra with stone stripes and dry raised centers, scree and colluvial slopes, grass-sedge tussock tundra, sedge meadows in drainage ways, dwarf birch thickets; granitic and sandstone substrates; 2-2134 m; N.T., Yukon; Alaska; Asia: Russia (Arctic Siberia, East Siberia, the Far East, Chukotka). Map 31.

Table 6. Comparison of *Salix rotundifolia*, *Salix phlebophylla*, and *Salix nummularia*.

	<i>S. rotundifolia</i>	<i>S. phlebophylla</i>	<i>S. nummularia</i>
Leaves	often persistent not skeletonized	persistent skeletonized	not persistent
Leaf axis	not arcuate,	arcuate, conduplicate	not arcuate
♀ catkins	4-10 flowers	ca. 25 flowers	3-5 flowers
Ovaries	glabrous	hairy	glabrous
Nectaries	1-3 times stipes	shorter than or equal stipes	about 2 times stipes
Capsule length	4-8.25 mm	2.9-4.8 mm	3.5-7.5 mm

Salix phlebophylla is a dwarf, mat-forming shrub characterized by bearing persistent, skeletonized leaves; catkins with many flowers; ovaries hairy, and nectaries shorter than the stipes. See Tables 6 and 7 for comparisons with related or similar species.

Salix phlebophylla × *S. rotundifolia*. See *S. rotundifolia*..

Salix planifolia Pursh

tea-leaf willow, plane-leaf willow

Salix phylicifolia subsp. *planifolia* (Pursh) Hiitonen.

Low shrubs to trees 0.15-9 m; not colonial or forming colonies by layering. **Stems** erect or decumbent; **branches** flexible at bases, yellow-, red-, or violet, not glaucous to strongly so, glabrous or pubescent to glabrescent; **branchlets** yellow-, red-brown, or violet, not glaucous, glabrous, pilose, pubescent, or moderately densely villous or short-silky, hairs appressed or spreading, curved, wavy, or straight; **buds with caprea-type gradation**. **Leaves, stipules** early deciduous, deciduous in autumn, or persistent for 2 or more years, on first leaves minute rudiments or foliaceous (small and usually brownish), on late leaves minute rudiments, sometimes foliaceous, narrowly ovate to oblong, 1-2.5(-4.5) mm, apices acute; **petioles shallowly grooved adaxially**, 2-5-13 mm, not glandular at distal ends, adaxial surfaces glabrous, pilose, or short-silky; **juvenile leaves** reddish or yellowish green, abaxial surfaces glabrous, puberulent, pubescent or densely long-silky, hairs white or white and ferruginous; **proximal leaves** entire, serrulate, or crenulate; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, narrowly oblong, narrowly elliptic, elliptic, or oblanceolate, 20-35.8-65 × 5-12.3-22 mm, length-width ratio 1.7-2.8-4.7; bases cuneate, convex, or slightly decurrent, angles < or > 90°; margins flat or slightly revolute at bases, entire, sometimes crenulate or serrulate at proximal ends or all around margins, glands marginal or submarginal; apices acute, acuminate, or convex, angles < 90°; *abaxial surfaces glaucous*, glabrous or sparsely silky, *hairs appressed*, white or white and ferruginous, straight or wavy; adaxial surfaces highly glossy, not glaucous, glabrous or sparsely short-silky to glabrescent, hairs white. **Catkins flowering before leaves emerge**, lateral; **staminate** stout, subglobose, or globose, 12-41 × 10-20 mm, flowering branchlets 0-4 mm; **pistillate very densely flowered**, slender, or stout to globose, 15-67 (to 70 mm in fruit) × 8-18 mm, flowering branchlets 0-6 mm; **floral bracts** dark brown or black, 1-3.2 mm, abaxial surfaces densely hairy all over, hairs white, straight; bract apices acute, convex, or rounded, entire or bifid; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong or oblong, 0.4-1.3 mm; stamens 2, anthers purple becoming yellow, short-cylindrical, 0.5-0.7 mm, filaments distinct, glabrous to sparsely hairy at bases; **pistillate** adaxial nectaries oblong, square, or ovate, 0.4-1.3 mm, shorter to longer than stipes, flat, thick or thin; **stipes 0.3-0.8 mm**; ovaries pyriform, beaks slightly bulged below or gradually tapering to styles, densely short- to long-silky, hairs white or white and ferruginous, straight, flattened, refractive; styles connate, 0.5-2 mm; stigmas slender-cylindrical, 0.36-0.52-1.1 mm, 11-16 ovules per ovary. **Capsules** (2.5-)5.5-6 mm. $2n = 57$, $3\times$ (Suda & Argus 1968, 1969). $2n = 76$, $4\times$ (Dorn 1975b; Löve & Löve 1964, 1966, 1982; Suda & Argus 1968).

Flowering early May to late June. Arctic, alpine, subalpine, and boreal meadows and river banks, streams, seeps, snow flush areas, treed bogs, fens; sandy-loam, rocky, igneous, limestone substrates; 1020-4000 m.; 122-3780 m; St. Pierre and Miquelon; Alta., B.C., Lab., Man., Nfld., N.T., Nunavut, Ont., Que., Sask., Yukon; Alaska, Ariz., Calif., Colo., Idaho, Maine, Mich., Minn., Mont., Nev., N.H., N.Mex., Oreg., S.Dak., Utah, Vt., Wash., Wis., Wyo. Map 32.

Salix planifolia is known to occur in Alaska only in the Skagway region. Occasionally specimens of *S. pulchra* resembling *S. planifolia* are known from the Yukon River region (Yukon Flats National Wildlife Refuge, lat. 66° 17', long. 144° 42', Talbot D83-7, 22 August 1982, CAN 471197). See Table 9 for a comparison with *S. pulchra* and that species for discussion.

Salix polaris* Wahl.*polar willow**

Salix pseudopolaris Flod.; *S. polaris* subsp. *pseudopolaris* (Flod.) Hultén; *S. polaris* var. *selwynensis* Raup

Dwarf shrubs 1-9 cm; forming rhizomatous colonies. **Stems** erect; **branches** flexible at bases, red-brown, dull, often glaucous, glabrous; **branchlets brownish**, not glaucous or strongly so, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments; **petioles** deeply grooved adaxially, 2-10 mm, **not glandular at distal ends**, adaxial surfaces glabrous; **juvenile leaves** yellowing green, glabrous; **proximal leaves** entire; **largest medial blades** amphistomatous, venation two pair of secondary veins arise at or close to bases and arc toward apices, elliptic, broadly elliptic, obovate, or subcircular, 5-32 × 8-18 mm, length-width ratio 1.1-2.8; bases convex, rounded, cuneate, or slightly decurrent, angles < or > 90°; margins slightly revolute or flat, entire, ciliate; apices rounded, convex, or sometimes retuse, angles < or > 90°, **abaxial surfaces not glaucous**, glabrous or pilose all over, hairs appressed, white, wavy, **adaxial surfaces shiny**, not glaucous, glabrous or pilose all over, hairs white. **Catkins** flowering as leaves emerge, subterminal or lateral, **staminate** stout 9-34 × 6-12 mm, flowering branchlets 1.5-14 mm; **pistillate** densely flowered, stout to globose, more than 15 flowers, 10-50 × 7-13 mm, flowering branchlets 1-12 mm; **floral bracts** brown, black, or bicolor, 1.5-2.5 mm, abaxial surfaces sparsely hairy all over, hair white, straight or wavy; bract apices rounded or convex, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.3-0.68 mm, adaxial nectaries oblong, narrowly oblong, square, or ovate, 0.5-1.4 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers purple becoming yellow, ellipsoid or ovoid, 0.4-0.6 mm, filaments distinct, sometimes connate proximally, glabrous; **pistillate** adaxial nectaries narrowly oblong, oblong, or ovate, 0.8-1.8 mm, longer than stipes, flat, thick; stipes 0.2-0.7 mm; ovaries obclavate or pyriform, beaks gradually tapering or slightly bulged below styles, not glaucous, villous to pilose, hairs white, straight or wavy, flattened, refractive; styles connate to distinct about half their lengths, 0.7-1.2 mm; stigmas slender-cylindrical, 0.32-0.57-0.72 mm, 12-17 ovules per ovary. **Capsules** 4.8-8.25 mm. $2n = 76$, 4× (Marklund in Floderus 1931, northern Europe); or $2n = ca. 114$, ca. 6× (Engelskjon 1979, Spitzbergen); Russia: $2n = 114$, 6× (Petrovsky & Zhukova 1983b; Yurtsev & Zhukova 1982; Zhukova, et al. 1977; Zhukova & Petrovsky 1971, 1972, 1975, 1976, 1977, 1980; Zhukova et al. 1973; Zhukova & Tikhonova 1973).

Flowering mid-June to early August. Arctic-alpine; moist late snow bed and snow flush areas, talus and scree slopes, sides of depressed center frost polygons, sedge meadows, and mud boils; calcareous tills, and sandy marine silts; 2-1800 m; B.C., N.T., Nunavut, Yukon; Alaska; Eurasia: northern Sweden; Spitzbergen; Russia (Arctic Europe, Novaya Zemlya, Arctic Siberia, the Far East, Chukotka). Map 33.

Salix polaris is characterized by its dwarf habit, hairy ovaries, long styles (0.7-1.2 mm) and leaves not glaucous abaxially. See Table 7 for a comparison with related or similar species and *S. rotundifolia* for discussion of possible hybridization. The sectional placement of *Salix polaris* is uncertain. It was placed in *S. sect. Myrtosalix* (Argus 1997) but in the PanArctic flora (Argus et al. 1999) it is placed in *S. sect. Herbella*.

Salix arctica × *S. polaris*. These putative hybrids resemble *S. polaris*, but have leaves glaucous and often sparsely long-silky abaxially, and catkins and leaves longer than in *S. polaris*.

Salix polaris × *S. rotundifolia*. Apparently this putative hybrid is common in Alaska. Many plants previously identified as *S. rotundifolia* but which have ovaries with hair on the beaks or in patches, are now thought to be this hybrid. Further study is needed.

Table 7. Comparison of *Salix polaris*, *S. rotundifolia*, *S. stolonifera*, *S. phlebophylla*, and *S. arctica*

	<i>S. polaris</i>	<i>S. rotundifolia</i>	<i>S. stolonifera</i>	<i>S. phlebophylla</i>	<i>S. arctica</i>
Leaves					
abaxially surface	not glaucous	not glaucous	glaucous	not glaucous	glaucous
margins	ciliate	ciliate	ciliate	sometimes ciliate	not ciliate
persistence	not	several years	not	several years	not
skeletonized		no		yes	
♀ flowers	more than 15	2-10	more than 25	more than 25	more than 25
ovaries	hairy	glabrous	glabrous	hairy	hairy
nectary length	2-5 × stipe	1-3 × stipe	1.5-3 × stipe	less than or equal	1.5-4 × stipe

Salix prolixa* Andersson*Mackenzie's willow**

Salix eriocephala var. *mackenzieana* (Hook.) Dorn; *S. mackenzieana* Barratt; *S. rigida* Muhl. *sensu* Argus 1973.

Mid to tall shrubs 1-5 m, not colonial. **Stems** erect; **branches** flexible at bases, gray- or red-brown, not glaucous or weakly so with sparkling crystals, glabrous or moderately villous to glabrescent; **branchlets** yellow- or red-brown, not glaucous or weakly so, **glabrous or sparsely to moderately densely velvety to glabrescent**, hairs erect or spreading. **Leaves, stipules** deciduous in autumn, foliaceous, apices rounded or convex; **petioles convex to flat adaxially**, 6-12 mm, **not glandular at distal ends**, adaxial surfaces glabrous or pilose; **juvenile leaves** reddish or yellowish green, abaxial surfaces glabrous, pilose or sparsely long-silky, hairs white; **proximal leaves** entire; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, narrowly oblong, narrowly elliptic, lanceolate, or obovate, 50-150 × 10-53 mm, length-width ratio 2.4-4.5; bases convex, rounded, subcordate, cordate, or slightly decurrent, angles < or > 90°; margins flat, serrate, serrulate, or spinulose-serrulate all around margins, **glands submarginal**; apices acuminate to acute, angles < or > 90°; abaxial surfaces glaucous, glabrous; **adaxial surfaces dull**, not glaucous, glabrous, pilose, or sparsely pubescent; hairs white. **Catkins generally flowering as leaves emerge**, lateral; **staminate** slender or stout, 16-41 × 8-12 mm, flowering branchlets 0.5-2 mm; **pistillate moderately densely to loosely flowered**, slender or stout, 19-66 × 8-18 mm, **flowering branchlets 0.5-6 mm**; **floral bracts** brown, sometimes tawny, 0.8-1.6 mm, **abaxial surfaces sparsely hairy mainly at proximal ends**, hair white, wavy; bract apices acute or rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong to narrowly oblong, 0.8-1 mm; stamens 2, anthers purple becoming yellow, ellipsoid, 0.5-0.6 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong, square, or flask-shaped, 0.38-0.78 mm, shorter than stipes, flat, thick; **stipes 1.3-4.2 mm**; ovaries pyriform, beaks gradually tapering or slightly bulged below styles, not glaucous, glabrous; styles connate or slightly distinct, 0.3-0.7 mm; stigmas flat with rounded tips, two plump lobes, or slender-cylindrical, 0.16-0.28-0.4 mm, 12-22 ovules per ovary. **Capsules** 4-6 mm.

Flowering late March to late June. Along rivers, streams, lakes, springs, marsh margins; sandy-gravel, sandy, or silty substrates; 110-2255 m.; Alta., B.C., N.T., Yukon; Alaska, Calif., Idaho, Mont., Nev., Oreg., Utah, Wash., Wyo. Map 34.

See Table 8 for a comparison with *S. pseudomonticola* and *S. barclayi*.

Salix pseudomonticola* C.R. Ball*false mountain willow***Salix padophylla* Rydb.; *S. monticola* auct. non Bebb

Mid to tall shrubs 1-6 m, not colonial. **Stems** erect; **branches** flexible at bases, red- or yellow-brown, shiny or highly glossy, not glaucous or weakly so, glabrous to glabrescent; **branchlets** **yellow-green, red-brown, or brownish**, not or strongly glaucous, glabrous, pilose or densely villous to glabrescent, hairs spreading, curved or wavy. **Leaves, stipules** **deciduous in autumn, foliaceous**, apices rounded to acute or acuminate; **petioles** shallowly grooved or convex to flat adaxially, 6-20 mm, not glandular at distal ends, adaxial surfaces short-silky or velvety; **juvenile leaves** **reddish**, abaxial surfaces glabrous or pubescent, hairs white or white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous, venation pinnate, broadly elliptic to narrowly elliptic, or ovate to broadly obovate, (25-)30-86(-100) × 12-49 mm, length-width ratio 1.4-3; bases convex, rounded, cuneate, subcordate, or cordate, angles < or > 90°; margins flat, serrulate or crenate all around margins, glands marginal or submarginal; apices acute, acuminate, or convex, angles < or > 90°; abaxial surfaces sparsely glaucous, glabrous, pubescent, or pilose to glabrescent, **hairs spreading**, white, wavy; adaxial surfaces shiny or dull, glabrous, puberulent, pubescent, or pilose, midrib hairy, hairs white. **Catkins** **flowering before leaves emerge**, lateral; **staminate** 16-39 × 10-12 mm, **flowering branchlets 0 mm**; **pistillate** densely flowered, slender, stout, subglobose, or globose, 17-73 × 8-20 mm, **flowering branchlets 0-5 mm**; **floral bracts** brown or black, 1-2.4 mm, abaxial surfaces **sparsely hairy all over**, hairs white, straight; bract apices rounded or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, 0.3-1 mm; stamens 2, anthers purple becoming yellow, short-cylindrical or globose, 0.4-0.5 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong or flask-shaped, 0.3-0.8 mm, shorter than stipes, flat, thin; **stipes 0.5-0.8-3 mm**; ovaries pyriform or obclavate, beaks gradually tapering to styles, not glaucous, glabrous; styles connate or slightly distinct, (0.5-)0.7-1.8 mm; stigmas flat with pointed tips or two plump lobes, 0.1-0.21-0.29 mm, 18 ovules per ovary. **Capsules** 4-7 mm. $2n = 38$, $2\times$ (Dorn 1975a, Löve & Löve 1982, Suda & Argus 1968).

Flowering late April to early June. Moist fens in drainage ways in white spruce forests, treed bogs, balsam poplar forests, and river floodplains; 3-2490 m.; Alta., B.C., Lab. (?), N.T., Ont., Que., Sask., Yukon; Alaska, Idaho, Minn., Mont., S.Dak., Wash., Wyo. Map 35.

Salix pseudomonticola is characterized by flowering before leaves emerge; catkins sessile; juvenile leaves, petioles, and lower midribs reddish; stipules small and rounded; and leaves and branchlets sparsely hairy. Branches older than 2 years have a distinctive pattern, which consists of a series of longitudinal splits in epidermis produced as the branch expands. The edge of the 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. See Table 8 for a comparison with *S. barclayi* and *S. prolixa*.

Vegetative specimens of *Salix pseudomonticola* with yellow-brown branches can be confused with *S. eriocephala* var. *famelica*. They can be separated by having juvenile leaves with margins prominently and closely gland-dotted; stipules usually prominent (although sometimes early deciduous); broader leaves (1.4-3 times longer than wide vs. 2.6-7 times longer than wide in *S. eriocephala* var. *famelica*), and petioles slender and often longer in relation to leaf length.

Table 8. Comparison of *Salix prolixa*, *Salix pseudomonticola*, and *Salix barclayi*

	<i>S. prolixa</i>	<i>S. pseudomonticola</i>	<i>S. barclayi</i>
Juvenile leaves	reddish or green	reddish	green
Petioles	reddish	reddish	green
Catkins flowering	as leaves emerge	before leaves emerge	as leaves emerge
♂ Flowering branchlet	0.5-2 mm	0 mm	0-17 mm
♀ Flowering branchlet	0.5-6 mm	0-5 mm	4-24 mm

Salix pseudomyrsinities* Andersson*tall blueberry willow**

Salix myrtillofolia var. *cordata* (Andersson) Dorn; *S. myrtillofolia* var. *pseudomyrsinities* (Andersson) C. R. Ball ex Hultén; *S. novae-angliae sensu* Argus 1973.

Mid to tall shrubs 1-7 m, **not colonial**. **Stems** erect; **branches** flexible at bases, gray-, red-, or yellow-brown, shiny to highly glossy, not glaucous, villous to glabrescent; **branchlets gray-, red-, yellow-brown, or yellow-green**, not glaucous or weakly so, pilose or densely villous or tomentose, **hairs spreading, geniculate**. **Leaves, stipules deciduous in autumn**, on first leaves minute rudiments or foliaceous, on later leaves foliaceous, apices acute or convex; **petioles** shallowly to deeply grooved adaxially, 2.5-8 mm, **not glandular**, adaxial surfaces glabrous or villous; **juvenile leaves** reddish or yellowish green, abaxial surfaces moderately densely villous to glabrescent, hairs white or white and ferruginous; **proximal leaves serrulate or entire**; **largest medial blades** hypostomatous or amphistomatous, venation pinnate, narrowly elliptic to broadly elliptic, oblong, to oblanceolate or obovate, 32-109 × 10-47 mm, length-width ratio 1.8-4.8; bases convex, cuneate, or subcordate, sometimes cordate, angles < 90°; margins flat, entire, crenate, crenulate, or serrulate all around, glands marginal; apices acute, convex, or acuminate, angles < or > 90°; abaxial surfaces **not glaucous**, glabrous, glabrescent, or pilose, hairs spreading, white or white and ferruginous, wavy; adaxial surfaces shiny, glabrous or glabrescent, the midribs moderately densely pubescent, short- or long-silky to glabrescent, with straight, wavy, or curved, white or white and ferruginous hairs. **Catkins flowering as leaves emerge**, lateral; **staminate** stout, 16.5-35.5 × 7-15 mm, flowering branchlets 0.5-12 mm; **pistillate densely flowered**, slender or stout, 10.5-68 × 5-20 mm, flowering branchlets 0.5-10 mm; **floral bracts** brown, black, tawny, or bicolor, **0.56-1.1 mm**, abaxial surfaces hairy all over, hairs white, long-wavy or curly; bract apices retuse, entire; **pistillate bracts persistent**. **Flowers, staminate** adaxial nectaries oblong or square, 0.2-0.4-0.6 mm; stamens 2, anthers purple becoming yellow, **short-cylindrical, obovoid, or globose**, 0.4-0.7 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries square or oblong, **0.2-0.4 mm**, shorter than stipes, flat, thick or thin; **stipes 0.8-1.4 mm**; ovaries pyriform, **beaks slightly bulged below styles**, not glaucous, glabrous; styles connate or slightly distinct, 0.4-1.6 mm; stigmas two plump lobes or broad-cylindrical, 0.16-0.24-0.32 mm, 11-18 ovules per ovary. **Capsules** 4.4-6.4 mm. $2n = 76, 4\times$ (Dorn 1975a).

Flowering early May to early July. Shores of lakes and rivers, dwarf birch thickets, fens, marl bogs, and rarely treed bogs; 45-1000 m.; Alta., B.C., Man., N.T., Nunavut (Akimiski Isl.), Ont., Sask., Yukon; Alaska. Map 36.

Salix pseudomyrsinities and *S. myrtillofolia*, although sometimes treated as conspecific (Dorn 1975), deserve species rank. They are distinct in their habit, habitat, and general appearance, including the glossiness of leaves, as well as a number of technical characteristics (Viereck and Little 1972 and Argus 1973, 1997). *S. pseudomyrsinities* is a tall, erect shrub (1-7 m) of riparian habitats; its juvenile leaves are pubescent with hairs persisting on mature leaves, at least on the adaxial midribs, stipules are usually prominent and leaf-like, and styles tend to be longer (0.4-1.6 mm). *S. myrtillofolia* is a low, decumbent shrub (0.1-0.6 (-1) m) of treed bogs and fens; its juvenile and mature leaves are typically glabrous, stipules usually are rudimentary, and styles tend to be shorter (0.3-0.5 mm). There is no field evidence of hybridization but, infrequently, herbarium specimens appear to be intermediate inasmuch as they may have the habit or habitat of one species and the leaf hairiness of the other. The species also differ in their chromosome number. *S. myrtillofolia* is diploid, based on two counts from Saskatchewan (Suda and Argus 1968) and *S. pseudomyrsinities* is tetraploid, based on three counts from Alberta (Dorn 1975).

The nomenclature of these species is confusing (Dorn 1975). When treating them as varieties Hultén (1968) used the name *S. myrtillofolia* var. *pseudomyrsinities* (Andersson) Ball ex Hultén and Dorn (1975a) used the name *S. myrtillofolia* var. *cordata* (Andersson) Dorn. At the species level the name *S. novae-angliae* Andersson was used by Argus (1973) and Viereck and Little (1972). The latter name, however, is illegitimate (Dorn 1975) and has been replaced by *S. pseudomyrsinities* Andersson (Argus 1997).

Salix pulchra* Cham.*diamond-leaf willow**

Salix planifolia subsp. *pulchra* (Cham.) Argus; *S. pulchra* var. *looffiae* C.R. Ball; *S. pulchra* var. *palmeri* C.R. Ball; *S. pulchra* var. *yukonensis* C.K. Schneider.

Low to tall shrubs 0.1-3(-4.5) m, not colonial. **Stems** erect; **branches** flexible at bases, yellow- or red-brown, shiny or highly glossy, not glaucous or weakly so, villous in patches to glabrescent; **branchlets** **yellow-green or brownish**, not glaucous, glabrous, puberulent, or densely villous. **Leaves, stipules** **generally persistent for 2 or more years**, foliaceous, linear or lanceolate, apices acuminate; **petioles** **convex to flat adaxially**, 2.8-10(-15) mm, not glandular at distal ends, adaxial surfaces glabrous or puberulent; **juvenile leaves** yellowish green, abaxial surfaces glabrous or pubescent, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, elliptic, obovate, 22-75 × 8-26 mm, length-width ratio 1.7-4.7; bases cuneate or slightly decurrent, angles < 90°; margins flat to slightly revolute, entire, crenate, or serrulate all around margins or at proximal ends, glands submarginal or marginal; apices acuminate, acute, or convex, angles < or > 90°; **abaxial surfaces** **glaucous**, glabrous or pubescent, midrib pilose, hairs spreading, white or white and ferruginous, straight; adaxial surfaces highly glossy to shiny, not glaucous, glabrous, hairy along midrib. **Catkins** **flowering before leaves emerge**, lateral; **staminate** stout or subglobose, 21-53 × 12-19 mm, flowering branchlets 0-3 mm; **pistillate** densely flowered, slender to stout, 27-82 × 8-20 mm, flowering branchlets 0-3(-8) mm; **floral bracts** brown or black, 1.6-2.8 mm, abaxial surfaces **moderately densely hairy at distal ends**, hairs white, straight; bract apices acute or rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.6-1 mm; stamens 2; anthers purple becoming yellow, ellipsoid to short-cylindrical, 0.4-0.8 mm; filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries narrowly oblong to oblong, 0.4-1.6 mm, longer than stipes, flat, thin; stipes 0.2-0.8 mm; ovaries pyriform, beaks slightly bulged below styles, long-silky; styles connate or slightly distinct, 1-1.8 mm; stigmas slender-cylindrical, lobes 0.44-0.63-0.96 mm; 12-16 ovules per ovary. **Capsules** 3.2-5.6 mm. $2n = 76$, $4\times$ (Johnson & Packer 1968; Suda & Argus 1969). Russia: $4\times$ (Petrovsky & Zhukova 1983b; Zhukova 1967, 1968, 1969; Zhukova et al. 1977).

Flowering mid-April to late July. Arctic to subalpine thickets, river, stream and lake margins, tundra, black spruce-lichen woodlands, and open white spruce-dwarf birch woodlands. 0-2133 m; B.C., N.T., Yukon; Alaska. Asia (Russia: Siberia, Chukotka, Anadyr, Lena-Kolyma, and Okhotia. Subspecies *parallelinervis* (Floderus) A. K. Skvortsov extends into Kamchatka, Skvortsov 1999). Map 37.

Salix pulchra var. *yukonensis* C. K. Schneider (1919) has branchlets densely villous with white, gray, or sometimes ferruginous hairs. The branches frequently are moderately densely hairy to patchy hairy or even glabrescent. Such forms occur through the range of the species in North America and Russia and similar variants occur in the related *Salix planifolia*. They are not worthy of taxonomic recognition.

The taxonomic rank of *Salix planifolia* and *S. pulchra* is uncertain. Their ranges overlap in northwestern Canada, from northern British Columbia across the southern quarter of the Yukon and northeastward into the Great Bear Lake area. Evidence of hybridization and introgression was described in a population along the Haines Road in northwestern British Columbia (Argus 1969, 1973). Based on that evidence, along with their tetraploid chromosome number, and their similar leaf flavenoid chromatographic patterns, subspecies rank was proposed. The primary differences between the two taxa are stipule size, shape, and the persistence and pubescence of juvenile leaves (Table 9). The occurrence of rhombic mature leaves in *S. pulchra*, sometimes is distinctive but leaf shape is highly variability in both species. In other areas where their ranges overlap, such as Whitehorse, YT and Nahanni National Park, NWT, the two seem to be separated by elevation; *S. pulchra* occurs at high elevations and *S. planifolia* at low elevations. Within those areas there is no clear evidence of intergradation although *Salix planifolia* does tend to have stipules that are more persistent (40% are persistent) and sometimes longer (2-3.5 mm) than outside the area of overlap; but there are few vegetative characters that separate the two. The relationship of these two taxa still need to be resolved. In the meantime, it is best to treat them as species.

Table 9. Comparison of *Salix planifolia* and *Salix pulchra*.

	<i>S. planifolia</i>	<i>S. pulchra</i>
Stipules	narrowly ovate to oblong, 0.8-3 mm, shorter than petioles	linear or lanceolate, 3-32 mm, often equal to or longer than petioles
Juvenile leaves	often densely long-silky	glabrous or sparsely pubescent

Salix pyrifolia* Andersson*balsam willow**

Salix. balsamifera Barratt ex Andersson; *S. pyrifolia* var. *lanceolata* (Bebb) Fernald

Low to tall shrubs 0.4-4 m, not colonial. **Stems** erect; **branches** flexible at bases, **red-brown, highly glossy**, not glaucous, glabrous; **branchlets** red-, yellow-brown, or yellowish, not glaucous or weakly so, glabrous or sparsely velvety. **Leaves, stipules early deciduous, on first leaves foliaceous or minute rudiments, on later leaves foliaceous**, apices acute to rounded; **petioles** convex to flat or shallowly grooved adaxially, 7-20 mm, not glandular or rarely with spherical glands at distal ends, adaxial surfaces glabrous or sparsely velvety; **juvenile leaves** yellowish green, translucent, abaxial surfaces glabrous or pilose, hairs white; **proximal leaves** serrulate or entire; **largest medial blades** hypostomatous, venation pinnate, narrowly oblong, oblong, elliptic, or broadly elliptic, 30-103 × 19-40 mm, length-width ratio 1.5-3.4; bases rounded, convex, subcordate, or cordate, angles < or > 90°; margins flat or slightly revolute, serrulate, crenate, or undulate all around margins, **glands marginal**; apices acute or acuminate, angles < or > 90°, abaxial surfaces glaucous, glabrous, adaxial surfaces shiny or highly glossy, not glaucous, glabrous. **Catkins**, pistillate flowering as leaves emerge, staminate flowering just before leaves emerge, both lateral; **staminate** stout or slender, 18.5-63 × 7-15 mm, flowering branchlets 1-5 mm; **pistillate loosely flowered**, stout or slender, 25-85 × 8-20 mm, flowering branchlets 2-22 mm; **floral bracts** tawny, 1-2.4 mm, abaxial surfaces hairy all over, hairs white, straight or wavy; bract apices acute or convex, entire; pistillate bracts persistent. **Flowers, staminate adaxial nectaries square or ovate**, 0.3-0.45 mm; stamens 2, anthers yellow, ellipsoid or short-cylindrical, 0.5-0.8 mm, filaments distinct, glabrous or sparsely hairy at bases; **pistillate** adaxial nectaries narrowly ovate or square, 0.3-0.7 mm, shorter than stipes, flat, thick; **stipes 1.8-3.5 mm**, ovaries obclavate, beaks slightly bulged below styles, not glaucous, glabrous; styles 0.4-0.5 mm; stigmas broad-cylindrical or two plump lobes, 0.2-0.23-0.32 mm, 10-19 ovules per ovary. **Capsules** 7-8 mm. $2n = 38$, $2\times$ (Dorn 1976; Löve & Löve 1982).

Flowering May to mid-June (to mid-July in subalpine). Fens, wet lake and slough margins, and treed bogs; 0-320 m (to 1600 m in subalpine), Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., P.E.I., Que., Sask., Yukon; Maine, Mich., Minn., N.H., N.Y., Vt., Wis. Map 38.

Salix pyrifolia is characterized by juvenile leaves membranaceous and translucent; mature leaves subcoriaceous, reticulate abaxial surfaces, and often cordate bases. The buds and foliage are reported to have a balsam-like fragrance.

Salix raupii* Argus*Raup's willow**

Mid shrubs 1.2-1.8 m, not colonial. **Stems** erect; **branches** flexible at bases, **gray-brown**, glaucous, glabrous; **branchlets** yellow-brown, not glaucous, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** deciduous early or in autumn, **foliaceous**; apices acute or acuminate; **petioles deeply grooved adaxially**, 5-9 mm, **not glandular at distal ends**; **juvenile leaves** yellowish green, glabrous; **proximal leaves shallowly serrulate**; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, 32-58

× 12-19 mm, length-width ratio 2-3.3; bases cuneate, slightly decurrent, or convex, angles < 90°; margins slightly revolute, ciliate, entire; apices acute to acuminate, angles < 90°; **abaxial surfaces glaucous**, glabrous, adaxial surfaces shiny, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral, **staminate** stout, 17.5-42 × 5-13 mm, flowering branchlets 6-7 mm; **pistillate moderately densely flowered**, stout, 20-40 × 6-12 mm, flowering branchlets 4-7 mm; **floral bracts** tawny or bicolor. 1.3-2.5 mm; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.3-0.75 mm, **adaxial nectaries narrowly oblong**, 0.6-1 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers purple becoming yellow, ellipsoid, short-cylindrical, or globose, 0.4-0.7 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries narrowly oblong or oblong, 0.5-1.1 mm, equal to or longer than stipes, flat; stipes 0.4-1.2 mm; ovaries pyriform, beaks slightly bulged below styles, not glaucous, **glabrous, rarely puberulent**; styles 0.6-0.8 mm; stigmas broad-cylindrical, 0.32-0.52 mm, 12 ovules per ovary. **Capsules** 4.4-8 mm. .

Flowering late June. Thickets in moist, open forests and on gravel floodplains; 800-1500 m; Alta., B.C., N.T., Yukon. Endemic. Map 39.

Salix raupii resembles glabrous *Salix glauca* subsp. *glabrescens*. Thin layer chromatography of leaf phenolics revealed a pattern similar to *S. glauca* subsp. *glabrescens* and *acutifolia* and *S. athabascensis* (Argus 1974). Phenetic study showed it to be nearest to *S. glauca* s.l. and *S. athabascensis* (Argus 1997). It is likely a species of hybrid origin.

***Salix reptans* Rupr.**

Dwarf or low shrubs 10-40 cm, **forming colonies by layering**. **Stems erect or decumbent**, branches flexible at bases (?), red-brown, not glaucous, pilose, tomentose, or villous to glabrescent; **branchlets** red- or yellow-brown, not glaucous or sometimes sparsely so at proximal end, densely pilose or villous, hairs spreading; **buds with arctica-type gradation**. **Leaves, stipules** deciduous early or in autumn, or persisting for 2 or more years, minute rudiments or foliaceous, apices acute; **petioles** deeply to shallowly grooved adaxially, 0.5-2.4-6 mm, not glandular at distal ends, adaxial surfaces villous; **juvenile leaves** yellowish green, abaxial surfaces sparsely or moderately densely villous or long-silky, hairs white or yellowish; **proximal leaves** entire; **largest medial blades** amphistomatous or hemiamphistomatous, venation pinnate, narrowly oblong, elliptic, subcircular, oblanceolate, obovate, or broadly obovate, 15-28.6-47 × 8-18.5-55 mm, length-width ratio 1.2-2.2-3.2; bases slightly decurrent, cuneate, or convex, angles < 90°; margins flat, **entire or serrulate at proximal ends, glands marginal**; apices acute, convex, or rounded, angles < or > 90°, abaxial surfaces glaucous, pilose or moderately densely villous or long-silky, hairs appressed or spreading, white, straight or wavy, adaxial surfaces dull or shiny, not glaucous, pilose or moderately densely villous or long-silky to glabrescent, white. **Catkins flowering as leaves emerge**, lateral; **staminate** stout or subglobose, 8-28 × 5-12 mm, flowering branchlets 3.5-18 mm; **pistillate** densely flowered, slender, stout, or subglobose, 15-63 × 4-15 mm, flowering branchlets 3-21 mm; **floral bracts** brown, black, or bicolor, 1-2.5 mm, abaxial surfaces sparsely to moderately densely hairy all over or at proximal ends, hairs white, straight or wavy; bract apices rounded, entire or irregularly toothed; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.5-1.2 mm, adaxial nectaries narrowly oblong or oblong, 0.6-1.9 mm, **abaxial and adaxial nectaries connate and cup-shaped**; stamens 2, anthers purple or purple becoming yellow, ellipsoid or short-cylindrical, 0.3-0.6 mm, filaments distinct, glabrous; **pistillate** abaxial nectaries 0.25-1.3 mm, **adaxial nectaries each lobe narrowly oblong**, 0.95-2.1 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped, longer than stipes, flat; **stipes 0.2-0.4-0.76** mm; ovaries pyriform or obclavate, beaks abruptly tapering to styles, **densely tomentose or woolly**, hairs white, crinkled, flattened (twisted), not glaucous; styles connate to distinct, 0.3-1 mm; stigmas slender-cylindrical, 0.34-0.6-0.8 mm, 12-24 ovules per ovary.

Capsules 6-8 mm. Russia: $2n = 38, 2\times$ (Zhukova 1967, Zhukova & Petrovsky 1972, 1975, 1980, 1981, Zhukova et al. 1973, Petrovsky & Zhukova 1983, Yurtsev et. al. 1975).

Moist to wet tundra on coastal plains and river floodplains, grassy tundra, or tussock tundra (Skvortsov 1999). Eurasia. Map 39.

Salix reptans is very similar to *S. niphoclada*. Some plants in a sand dune population of *S. niphoclada* at Meade River, Alaska, were so close to *S. reptans* that they were even tentatively named that species. The relationship of these two species deserves study.

***Salix reticulata* L.**

net-vein willow, net-leaf willow

Salix orbicularis Andersson, *S. reticulata* subsp. *orbicularis* (Andersson) Flod.; *S. reticulata* var. *gigantifolia* C.R. Ball; *S. reticulata* subsp. *glabellcarpa* Argus

Dwarf shrubs 3-15 cm; forming colonies by layering. **Stems trailing; branches and branchlets** flexible at bases, yellow- or red-brown, not or weakly glaucous, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules absent or minute rudiments; petioles** deeply grooved adaxially, 3-46 mm, not glandular or with spherical glands at distal ends, adaxial surfaces glabrous; **juvenile leaves** yellowish green, glabrous; **proximal leaves** entire; **largest medial blades** amphistomatous or hemiamphistomatous, venation two pair of secondary veins arise at or close to bases and arc toward apices, oblong, broadly oblong, broadly elliptic, subcircular, or circular, (8-)12-66 × 8-50 mm, length-width ratio 1-1.5; bases convex, rounded, subcordate, cordate, or slightly decurrent, angles < or > 90°; margins slightly revolute, entire or crenulate all around margins or at proximal ends, glands submarginal, apices rounded, convex, or retuse, angles < or > 90°, abaxial surfaces glaucous, sparsely long-silky to glabrescent, hairs appressed, white, straight, adaxial surfaces shiny or highly glossy, not glaucous, glabrous or pilose, hairs white. **Catkins** flowering as leaves emerge, subterminal; **staminate slender, stout, or subglobose**, 11-54 × 4-9 mm, flowering branchlets 2-28 mm; **pistillate very densely flowered**, slender or stout, more than 6 flowers, 11-79 × 3-8 mm, flowering branchlets 2-37 mm; **floral bracts tawny** (brown in subsp. *glabellcarpa*), 0.8-1.8 mm, abaxial surfaces glabrous; bract apices rounded to retuse, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.5-0.88 mm, adaxial nectaries oblong or ovate, 0.5-1 mm, abaxial and adaxial nectaries connate and cup-shaped; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.3-0.4 mm, filaments distinct, hairy all over or on lower halves; **pistillate** abaxial nectaries (0-)0.25-0.5 mm, adaxial nectaries narrowly oblong, 0.5-1 mm, equal to or longer than stipes, flat, abaxial and adaxial nectaries distinct or connate and cup-shaped; stipes 0-0.8 mm; ovaries obclavate or pyriform, beaks abruptly tapering to or slightly bulged below styles, **densely short-silky** (glabrous in subsp. *glabellcarpa*), hairs white or white and ferruginous, straight or wavy, flattened; styles connate to distinct about half their lengths, 0.2-0.3 mm; stigmas broad-cylindrical, 0.2-0.26-0.32 mm, 12-18 ovules per ovary. **Capsules** 4.5-5 mm. $2n = 38$ (Engelskjøn 1979; Engelskjøn & Knaben 1971; Hedberg, 1967; Löve 1954; Löve & Löve 1982; Mrrklund in Floderus 1931; Packer & McPherson 1974; Suda & Argus 1969). Russia: (Sokolovskaya & Strelkova 1941 Zhukova 1967, 1980; Zhukova et al. 1977; Zhukova & Petrovsky 1976, 1977; Petrovsky & Zhukova 1983b).

Flowering early June to mid-August. Arctic-alpine; polygonal tundra, dry tussock tundra, partially stabilized sand dunes, sedge meadows, *Dryas* tundra on alpine cliffs and ledges, snow beds, stabilized talus slopes, and in moss in white spruce woods and treed bogs; 1-3505 m. Canada: Alta., B.C., Lab., Man., Nfld., N.T., Nunavut, Ont., Que., Sask., Yukon; Alaska; Eurasia: northern Scotland; northern Scandinavia; the Alps and other European mountains, Spitzbergen; Russia (Arctic Europe, Arctic Siberia, East Siberia, the Far East, Chukotka). Map 40.

Salix reticulata is a dwarf, trailing shrub characterized by prominently reticulate leaves, catkins borne on flowering branchlets that are not differentiated from normal vegetative branchlets. A population on the

Queen Charlotte Islands, BC. (Map 40), with glabrous ovaries, was named *Salix reticulata* subsp. *glabelllicarpa* because of its uniform population. There are some Southeastern Alaska plants with glabrous, partially hairy, and completely short-silky ovaries growing together. This suggests that subsp. *glabelllicarpa* may be a hybrid or a simple mutation. The problem requires further study.

***Salix richardsonii* Hook.**

Richardson's willow

Salix lanata L. subsp. *richardsonii* (Hook.) A. K. Skvortsov

Low to tall shrubs 0.3-6.5 m, not colonial. **Stems** erect; **branches** flexible at bases, red-, yellow-brown, or violet, shiny or highly glossy, not or strongly glaucous, villous or glabrescent with persistent patches of hair; **branchlets** red- or yellow-brown, pilose to densely villous; **buds** with *caprea*-type gradation, transitional to *arctica*-type. **Leaves, stipules** *sometimes persistent for 2 or more years*, foliaceous, 3-11.9-35 mm, apices acuminate or acute; **petioles** convex to flat or shallowly grooved adaxially, 2-7.3-27 mm, adaxial surfaces villous to glabrescent; **juvenile leaves** yellowish green, abaxial surfaces densely villous or pilose, sometimes glabrous, hairs white or white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** hypostomatous, venation pinnate, broadly elliptic, elliptic, narrowly elliptic, or obovate, 20-45.3-100 × 7-22.5-55 mm, length-width ratio 1.2-2.2-4.2; bases cuneate, slightly decurrent, convex, or concave, angles < or > 90°; margins slightly revolute or flat, entire, serrulate, serrate all around margins, glands submarginal; apices acute, acuminate, or convex, angles < or > 90°; abaxial surfaces glaucous, glabrous or pilose to glabrescent, hairs spreading, white or white and ferruginous, **curved**; adaxial surfaces shiny, not glaucous, moderately densely villous or pilose to glabrescent, hairs white or white and ferruginous. **Catkins flowering before leaves emerge**, lateral; **staminate** stout or subglobose, 22-53 × 16-24 mm, flowering branchlets 0 mm; **pistillate** densely flowered, slender or stout, 25-69 (to 85 mm in fruit) × 13-20 mm, **flowering branchlets 0-2 mm**; **floral bracts** brown or black, 2.4-3.2 mm, abaxial surfaces hairy all over, hairs white, straight; bract apices acute, rounded, or retuse, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.73-1.75 mm; stamens 2, anthers purple becoming yellow, ellipsoid to short-cylindrical, 0.5-0.8 mm; filaments distinct to about half connate, glabrous; **pistillate** adaxial nectaries narrowly oblong, oblong, or flask-shaped, 0.6-1.4 mm, longer than stipes, flat; stipes 0.4-1 mm; ovaries pyriform, beaks tapering to styles, not glaucous, **glabrous**; styles connate or slightly distinct, 0.96-2.8 mm; stigmas slender- or broad-cylindrical, 0.32-0.63-0.86 mm; 22-37 ovules per ovary. **Capsules** 4.5-6.8 mm. $2n = 38$, 2× Russia: (Zhukova 1969, 1980; Zhukova & Petrovsky 1972; Petrovsky & Zhukova 1983b).

Flowering late May to early July. Arctic, subarctic, subalpine and boreal, river terraces and floodplains, open forests, wet sedge meadows, fens, drumlin fields, gravel ridges, bogs, cliff ledges, and snow beds; Silt, sand and gravel, calcareous or sometimes igneous substrates; 8-1829 m; B.C., Man., N.T., Nunavut, Yukon; Alaska. Eastern Asia (Russia: eastern Siberia, Chukotka, Anadyr, and Kamchatka). Map 41.

Salix richardsonii is characterized by stipules persistent, broad, with inequilateral bases and attenuate apices; catkins flowering before leaves emerge, ovaries glabrous, and nectaries 2-3 times as long as the stipes.

This taxon is sometimes treated as a subspecies of the European *S. lanata* L. (Skvortsov 1968, 1999, Argus 1973). It is more practical, however, to treat it as a full species because the area of overlap between *S. lanata* and *S. richardsonii* is very narrow and clear evidence of intergradation has not been demonstrated. Vegetative specimens of *Salix richardsonii* are sometimes difficult to distinguish from *S. barclayi* (see Table 3) and the two sometimes hybridize (see *S. barclayi*).

Salix rotundifolia* Trautv.*round-leaf willow, least willow**

Salix dodgeana Rydberg; *Salix leirolepis* (Cham.) Coville; *S. rotundifolia* Trautv. subsp. *dodgeana* (Rydberg) Argus; *S. rotundifolia* var. *dodgeana* (Rydberg) E. Murray

Dwarf shrubs 0.5-5 cm, **forming rhizomatous colonies**. **Stems erect**; **branches** flexible at bases, **yellow-green, yellow-, or gray-brown**, not glaucous or weakly so, glabrous; **branchlets** yellow- or red-brown, weakly to strongly glaucous, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** absent or minute rudiments; **petioles** *shallowly grooved or convex to flat adaxially*, 0.8-3 mm, not glandular at distal ends, adaxial surfaces glabrous; **juvenile leaves** yellowish green, glabrous or puberulent; **proximal leaves** entire; **largest medial blades** often persistent, amphistomatous, venation two pair of secondary veins arise at or close to bases and arc toward apices, broadly elliptic, subcircular, or circular, 4-14 × (1.7-)4.2-9(-11.2) mm, length-width ratio (0.9-)1.2-1.3(-2.7); bases slightly decurrent, rounded, or convex, angles > 90°; margins flat, ciliate, entire; apices retuse, convex, or rounded, angles > 90°, abaxial surfaces not glaucous, glabrous (pilose ciliate at edges), adaxial surfaces highly glossy, not glaucous, glabrous. **Catkins** flowering as leaves emerge, **subterminal, staminate** subglobose, stout to indeterminate, 9.5-18.5 × 2.5-12 mm, flowering branchlets 0.5-9 mm; **pistillate** moderately densely to loosely flowered, 2-10 flowers, stout to globose or indeterminate, (4.5-)13-35 × (2.5-)6-17 mm, flowering branchlets (0.5-)2-22 mm; **floral bracts** brown, 1.6-2.8 mm, abaxial surfaces sparsely hairy all over or ciliate, hairs white, straight, wavy, or crinkled; bract apices rounded or retuse, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.5-0.68 (-1) mm, adaxial nectaries narrowly oblong or oblong, 0.8-1.63 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers purple becoming yellow, ellipsoid or globose, 0.4-0.6 mm, filaments distinct or connate less than half, glabrous; **pistillate** abaxial nectaries 0.5-0.63 mm, adaxial nectaries narrowly oblong, oblong, or flask-shaped, 0.75-2 mm, longer than stipes, flat, thick, abaxial and adaxial nectaries distinct; stipes 0.4-0.8 mm; ovaries pyriform, beaks slightly bulged below styles, not glaucous, glabrous; styles connate to distinct, 0.5-1 mm; stigmas slender-cylindrical, 0.28-0.6 mm, 7-17 ovules per ovary. **Capsules** 4-8.25 mm. $2n = 114$, $6\times$ (Packer & McPherson 1974) $2n = \text{ca. } 38$, $2\times$ (Buechler, unpubl.), Russia: $2n = 38$, $2\times$ (Yurtsev & Zhukova 1982) $2n=114$, $6\times$ (Zhukova 1968; Petrovsky & Zhukova 1983b; Zhukova & Petrovsky 1987).

Flowering July to early August. Arctic-alpine; *Dryas* tundra and willow thickets along streams, sedge-grass tundra, sandy, saline coastal flats, beach cobbles, *Empetrum*-lichen heath on wet slopes, upland shrubby tundra, polygonal tundra and raised center polygons, snow beds, scree and colluvial slopes, dry to windswept ridges to moist scree and talus slopes; substrates from clay to coarse rubble, both calcareous limestone and acidic; 2-3415 m; Eastern Asia; N.T., Yukon; Alaska, Mont. Wyo.; Asia: Russia (Chukotka). Map 42.

Salix rotundifolia is a dwarf, largely subterranean shrub characterized by leaves circular to elliptic with 3-4 prominent veins that originate at or near the bases, blades green on both surfaces and glossy adaxially; catkins few-flowered (4-15), ovaries glabrous, and nectaries longer than the stipes. Attempts to separate *S. rotundifolia*, which typically has three main veins arising from the leaf base and often only one pair of secondary veins arising from the midrib, from *S. polaris*, which has leaves distinctly pinnate with several secondary veins arising from the midrib, and more pronounced tertiary veins, are not completely successful.

Previously, two variants of the species, subsp. *dodgeana* (described from northwestern Wyoming) and subsp. *rotundifolia* (described from Chukotka, Russia), were recognized (Argus 1973). The type specimen of *S. rotundifolia*, however, has proved to be identical to the small-leaved and few-flowered "*dodgeana*." The large-leaved and many-flowered "*rotundifolia*" appears to include a number of hybrids. Also, there are two chromosome numbers, in Russia several hexaploid counts a single diploid count have been reported. In North America there is one hexaploid and one putatively diploid count. This taxon is more complex than previously suspected. Until it can be carefully studied it is best to treat it in a broad sense. See Table 6 for comparisons with *S. rotundifolia* and *S. nummularia*.

Salix phlebophylla × *S. rotundifolia* has hairy ovaries, a few skeletonized leaves, a compact growth form lacking rhizomes, and catkins with more than 15 flowers. This hybrid occurs on the Alaska Arctic Slope, where *S. polaris* does not occur. In regions, such as the Alaska Range, where all three species occur, *S. polaris* frequently seems to hybridize with *S. rotundifolia*. These plants typically have hairy beaks but the general appearance of *S. rotundifolia*. The hybrid *Salix arctica* × *S. rotundifolia* resemble *S. rotundifolia* except for the partially hairy ovaries and glaucous leaves.

***Salix saxatilis* Trucz.**

Prostrate shrub 0.15-0.50 m; trailing and layering. **Stems** upright or ascending; **branches** dark purple or chestnut; **branchlets** hairy to glabrescent. **Leaves, stipules** foliaceous, well-developed, lanceolate; **petioles** 2-5 mm; **largest medial blades** broadly ovate, broadly elliptic, or obovate; margins serrulate to entire, abaxial surfaces glaucous, adaxial surfaces green. **Catkins** up to 70 mm; **floral bracts** lanceolate or ovate, dark brown, with long straight hairs, broadest distally; bract apices rounded; pistillate bracts persistent. **Flowers, pistillate**: ovaries dark purple, white villous, styles ca. 0.5 mm, stipes up to 1 mm, capsules 4 mm, glaucous. (Description based on Hultén 1968, Korapachinsky 1983, and Skvortsov 1999.)

Well-drained stony or gravelly substrates, open pine and larch woods, along mountain streams, spring fens, or places with ample flowing water, also in fairly dry stony slopes, especially on calcareous substrates. Ranging from forests to tundra (Skvortsov 1999). Eastern Asia. Map 43.

***Salix scouleriana* Barratt ex Hook.**

Scouler's willow, mountain willow

Salix scouleriana var. *coetanea* C.R. Ball; *S. scouleriana* f. *poikila* (C.K. Schneider) C.K. Schneider.

Tall shrubs or trees 3-10(-20) m, not colonial. **Stems** erect; **branches** *flexible at bases*, gray-, yellow-, or red-brown, *dull*, not glaucous or weakly so, glabrous or tomentose to glabrescent; **branchlets** yellow-green or yellow-brown, not glaucous or weakly so, sparsely to densely villous, tomentose, or velvety, hairs erect, spreading or appressed, straight, curved, or wavy; **buds** *with caprea-type gradation*. **Leaves, stipules** deciduous in autumn, on first leaves absent, minute rudiments or foliaceous, on later leaves foliaceous, apices acute or acuminate; **petioles** *convex to flat adaxially*, 2-13 mm, not glandular at distal ends, adaxial surfaces velvety or villous; **juvenile leaves** reddish or yellowish green, abaxial surfaces sparsely to densely villous, short- or long-silky, hairs white or white and ferruginous; **proximal leaves** entire, serrulate, or crenulate. **Largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, elliptic, oblanceolate, or obovate, 29-100 × 9-37 mm, length-width ratio 1.7-3.9; bases cuneate, convex, or slightly decurrent, angles < or > 90°; margins strongly to slightly revolute or flat, entire, remotely serrate, crenate, or undulate all around margins or at proximal ends, glands submarginal or epilaminal; apices acuminate, convex, or rounded, angles < or > 90°; abaxial surfaces glaucous, sparsely to densely short-, long-silky, or woolly, hairs erect or appressed, white or white and ferruginous, wavy or straight; adaxial surfaces shiny, not glaucous, pilose or moderately densely short-silky, midrib remaining velutinous or villous, hairs white or white and ferruginous. **Catkins** *flowering before leaves emerge*, lateral; **staminate** stout or subglobose, 18-40.5 × 8-22 mm, flowering branchlets 0-4 mm; **pistillate** *very densely flowered*, slender or stout, 18-60 (to 90 mm in fruit) × 10-22 mm, flowering branchlets 0-8 mm; **floral bracts** brown, black, or bicolor, 1.5-4.5 mm, abaxial surfaces densely hairy all over, hairs white, straight; bract apices rounded or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong or square, 0.35-0.93 mm; stamens 2; anthers purple becoming yellow, ellipsoid to short-cylindrical, 0.68-1.2 mm; filaments distinct, glabrous or hairy on lower halves; **pistillate** adaxial nectaries oblong or square, 0.2-0.75 mm, shorter than stipes, flat; **stipes** **0.8-2.3 mm**; ovaries pyriform or obclavate, beaks slightly bulged below styles, *densely long-silky*, hairs white,

straight, flattened; styles connate, 0.2-0.6 mm; stigmas slender-cylindrical, 0.4-0.82-1.04 mm; 10-18 ovules per ovary. **Capsules** 4.5-11 mm. $2n = 76$, $4\times$ (Suda & Argus 1968).

Flowering late February to mid-June. Dry conifer forests, mature woods on the edges of rivers and lakes, treed bogs, meadows, subalpine slopes, springs, pine barrens, openings in old burns, arroyos and disturbed sites; sandy, silty-clay, or gravelly, igneous substrates; 1-3500 m.; Alta., B.C., N.T., Sask., Yukon; Alaska, Ariz., Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., S.Dak., Utah, Wash., Wyo. Mexico (Chihuahua, Sonora). Map 43.

Salix scouleriana is characterized by flowering before the leaves emerge, branchlets and petioles velvety; leaves often obovate and with appressed white or ferruginous hairs abaxially; and pistils with long beaks and stigmas. It displays two forms of pubescence on the abaxial leaf surfaces, most are sparsely pubescent with short, appressed, white or ferruginous hairs, but some are densely woolly with long, wavy, erect, white hairs (*S. scouleriana* f. *poikila*). See *S. sitchensis* and Table 10.

Table 10. Comparison of *Salix scouleriana* and *Salix sitchensis*

	<i>S. scouleriana</i>	<i>S. sitchensis</i>
Branchlets	flexible at bases	flexible to highly brittle at bases
Stipule length	0.8-3.5(-10) mm	0.4-1.5 mm
Leaf blades	glaucous abaxially	not glaucous or obscured by hairs
Catkins flowering	before leaves emerge	as or just before leaves emerge
Stamen number	2	1
stigma length	0.4-0.82-1 mm	0.16-0.28-0.4 mm

***Salix ×sepulcralis* Simonk.**

hybrid weeping willow

Salix alba L. var. *vitellina* (L.) Stokes \times *S. babylonica* L.; *S. babylonica* auct. non L.; *S. ×sepulcralis* nothovar. *chrysocoma* (Dode) Meikle

Trees up to 12 m, not colonial or forming colonies by stem fragmentation. **Stems pendulous**; **branches** somewhat to highly brittle at bases, yellowish, not glaucous, pubescent, tomentose, or velvety, especially at nodes, to glabrescent; **branchlets** yellowish, golden, or yellow-brown, pilose, moderately densely short-silky to glabrescent; **buds** with *alba*-type gradation. **Leaves, stipules** early deciduous, on first leaves minute rudiments, on later leaves minute rudiments or foliaceous, apices acute; **petioles** shallowly grooved adaxially, 4-8 mm, not glandular or with pairs or clusters of spherical glands at distal ends or scattered along petioles, adaxial surfaces short-silky; **juvenile leaves** reddish or yellowish green, abaxial surfaces sparsely to very densely long-silky, hairs white; **proximal leaves** entire; **largest medial blades** amphistomatous or hemiamphistomatous, venation pinnate, narrowly elliptic to very narrowly so, $55-120 \times 7-18$ mm, length-width ratio 4.2-7.2; bases slightly decurrent, cuneate, or convex, angles $< 90^\circ$; margins flat, serrulate or spinulose-serrulate all around margins, glands marginal; apices acuminate, caudate, or acute, angles $< 90^\circ$; abaxial surfaces glaucous, sparsely long-silky to glabrescent, hairs appressed or spreading, white or white and ferruginous, straight; adaxial surfaces shiny, not glaucous, pubescent or sparsely long-silky to glabrescent, hairs appressed, white. **Catkins flowering as leaves emerge**, lateral; **staminate** slender, $23-53 \times 3-9$ mm, flowering branchlets 3-14 mm; **pistillate** moderately densely to loosely flowered, slender to stout, $18-30 \times 3-8$ mm, flowering branchlets 3-14 mm; **floral bracts** tawny, 1-2 mm, abaxial surfaces sparsely hairy all over or mainly at proximal ends, hairs straight; bract apices acute, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.38-0.83 mm, adaxial nectaries oblong to ovate, 0.4-1.1 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers yellow, ellipsoid, 0.53-0.8 mm, filaments distinct, hairy on lower halves or at bases; **pistillate** adaxial nectaries oblong, square, or ovate, 0.3-0.9 mm, longer than stipes,

flat, thick; **stipes** 0-0.2 mm, ovaries pyriform, beaks gradually tapering to styles, glabrous, not glaucous; styles connate, 0.15-2 mm, stigmas flat with rounded tips, 0.2-0.36 mm, 2-4 ovules per ovary. **Capsules** 1-2 mm. $2n=76$, $4\times$ (Vachova & Chmelar 1976, Vachova in Majovsky et al. 1978, Chmelar 1979).

Introduced and naturalized; B.C., Ont., Que.; Alaska, Ariz., Ark., Calif., Conn., D.C., Ill., Iowa, Ky., La., Maine, Md., Mass., Mich., Mo., Nev., N.H., N.Mex., N.C., N.Y., Ohio, Oreg., Pa., Tenn., Utah, Va., W.Va. Eurasia. Map 44.

This hybrid is cultivated in Southeastern Alaska. It is the basis of the report of *S. babylonica* L. from Alaska (Argus 1973). The commonly cultivated and sometimes escaped weeping willow with golden or yellowing-green branchlets is *Salix* \times *sepulcralis* nothovar. *chrysocoma* (Dode) Meikle. It originated as *Salix alba* var. *vitellina* \times *S. babylonica* (R. D. Meikle 1984).

***Salix serissima* (L. H. Bailey) Fernald**

autumn willow

Salix lucida var. *serissima* L.H. Bailey, Geol. & Nat. Hist. Surv. Minn. Bull. 3: 19. 1887

Mid to tall shrubs 1-5 m, not colonial or forming colonies by stem fragmentation. **Stems** erect; **branches** usually flexible or sometimes brittle at bases, **yellow-, red-, or gray-brown**, shiny or dull, not glaucous, glabrous; **branchlets** yellow- or red-brown, glossy or shiny, not glaucous, glabrous; **buds** with *alba*-type gradation. **Leaves, stipules absent or minute rudiments**; **petioles** shallowly to deeply grooved adaxially, 3-13 mm, with pairs of spherical glands at distal ends or scattered along petioles, adaxial surfaces glabrous; **juvenile leaves** reddish or yellowish green, glabrous; **proximal leaves** serrulate or entire; **largest medial blades** hypostomatous or hemiamphistomatous, venation pinnate, narrowly oblong, very narrowly elliptic, elliptic, lanceolate, or narrowly ovate, 43-103 \times 9-33 mm, length-width ratio 2.4-6; bases convex or cuneate, angles $< 90^\circ$; margins flat, serrulate all around margins, glands marginal; apices acuminate, caudate, or acute, angles $< 90^\circ$; abaxial surfaces not glaucous (but pale), not or rarely thinly glaucous, glabrous, shiny; adaxial surfaces highly glossy, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral; **staminate** stout, 25-53 \times 12-16 mm, flowering branchlets 5-14 mm; **pistillate** moderately densely to loosely flowered, stout to globose, 17-42 (to 65 mm in fruit) \times 11-22 mm, flowering branchlets 5-32 mm; **floral bracts** sometimes greenish-tawny, 1.2-4 mm, **abaxial surfaces moderately densely hairy all over**, hairs white, straight or wavy; bract apices acute, rounded, or truncate, glandular toothed; **pistillate bracts deciduous**. **Flowers, staminate** abaxial nectaries 0.5-1.1 mm, adaxial nectaries oblong or ovate, 0.4-1.1 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; **stamens** 3-9, anthers yellow, ellipsoid or short-cylindrical, 0.5-0.7 mm, filaments distinct or connate at bases, hairy on lower halves or at bases; **pistillate** adaxial nectaries ovate or oblong, 0.3-1.1 mm, shorter than stipes, swollen or flattened; stipes 1.2-2.4 mm, ovaries pyriform to obclavate, beaks bulged below styles or abruptly tapering to styles, not glaucous; styles connate or slightly distinct, 0.3-1 mm, stigmas broad-cylindrical or flat with rounded tips, 0.4-0.54-0.68 mm, 12-16 ovules per ovary. **Capsules** 7-12 mm. $2n = 76$, $4\times$ (Dorn 1994; Löve & Löve 1982; Zsuffa & Raj 1981).

Flowering from early June to early July. Wet thickets in fens and brackish marshy strands, marly lake shores, treed bogs, gravelly riverbanks and lake shores; 9-2960 m. Alta., B.C., Lab., Man., N.B., Nfld., N.T., P.E.I., Que., Sask., Yukon; Colo., Conn., Ill., Ind., Mass., Mich., Minn., Mont., N.J., N.Dak., N.Y., Ohio, Pa., S.Dak., Vt., Wis., Wyo. Endemic. Map 44.

The catkins in *Salix serissima* emerge as the leaves are emerging. They are not serotinous (i.e. flowering long after the leaves emerge); but they do flower somewhat later than related species and set fruit in late summer. The fruiting catkins sometimes persist for more than one year.

Salix setchelliana* C.R. Ball*Setchell's willow**

Low shrubs 8-30 cm; *forming colonies by root shoots*. **Stems** decumbent, erect, or semi-prostrate; **branches** flexible at bases, gray- or red-brown, bit glaucous, glabrous or gray-woolly to glabrescent; **branchlets** reddish, not glaucous, *very densely woolly*, hairs spreading; **buds** with *arctica*-type gradation. **Leaves, stipules absent or minute rudiments**; **petioles** shallowly grooved adaxially, enclosing bud, 0-3 mm, not glandular at distal ends; **juvenile leaves** yellowish green, glabrous; **proximal leaves** entire or serrulate; **largest medial blades** amphistomatous, venation pinnate, narrowly oblong, narrowly elliptic, elliptic, oblanceolate, or obovate, 25-87 × 10-30 mm, length-width ratio 2-3.9; bases slightly decurrent, cuneate, or convex, angles < 90°; margins flat, not ciliate, entire or serrulate all around margins; apices rounded to convex, angles < or > 90°; abaxial surfaces glaucescent, glabrous; adaxial surfaces dull, not glaucous, glabrous. **Catkins** flowering as leaves emerge, lateral, **staminate** stout, 12-27 × 6-10 mm, flowering branchlets 3-8 mm; **pistillate very densely flowered**, stout to subglobose, 20-34 × 6-13 mm, flowering branchlets 5-19 mm; **floral bracts** tawny or greenish, 2-3.6 mm, glabrous; bract apices rounded or truncate, erose, undulate, irregularly toothed, or entire, translucent; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries 0.4-0.8 mm, adaxial nectaries narrowly oblong, oblong, or ovate, 0.6-1 mm, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped; stamens 2, anthers purple becoming yellow, *long-cylindrical*, 0.6-0.8 mm, filaments distinct, glabrous or hairy at bases or on lower halves; **pistillate** adaxial nectaries oblong, 0.8-1.3 mm, equal to or longer than stipes, flattened; stipes 0-0.6 mm, ovaries obclavate or ovoid, beaks abruptly tapering to styles, glabrous, not glaucous; styles distinct, 0.3-0.4 mm, stigmas broad-cylindrical, 0.32-0.47-0.6 mm, 16-23 ovules per ovary. **Capsules** 3.6-10 mm. $2n = 38$, $2 \times$ (Buechler 2001).

Flowering late May to late June. Pioneer on sandy to gravelly beaches and bars along glacial rivers and on glacial moraine; 6-1097 m. B.C., Yukon; Alaska. Map 45.

Salix setchelliana is characterized by branches with reddish, loose, leathery bark; branchlets usually woolly; leaves lemon green, leathery, and borne on very short petioles; ovaries brick-red and almost completely surrounded by golden-tawny floral bracts.

This species shares three unique characters with members of *S. sect. Longifoliae*: it produce shoots from roots (soboliferous), catkins are sometimes branched, and its leaves are isolateral, in that the palisade tissue is present on both sides of the leaf (Buechler, pers. comm.). Occasionally there are spinulose teeth on leaf margins. Although these shared characters may have evolved independently it is possible that they indicate a common ancestry. Further study of this unique species is indicated.

Salix niphoclada × *S. setchelliana*. See *S. niphoclada*.

Salix sitchensis* Sanson ex Bong.*Sitka willow**

Salix coulteri Andersson, *S. sitchensis* var. *coulteri* (Andersson) Jeps.

Tall shrubs to trees 1-8 m; not colonial or sometimes forming colonies by stem fragmentation. **Stems** erect; **branches** highly brittle or flexible at bases, yellow- or red-brown, *dull*, not glaucous, sometimes weakly so, glabrous or pilose to glabrescent; **branchlets** yellow-, gray-, or red-brown, not glaucous or weakly so, densely short-silky, velvety, or villous, hairs straight, wavy or curved. **Leaves, stipules** deciduous in autumn, *on first leaves absent or minute rudiments*, on later leaves minute rudiments or foliaceous, *apices acute*; **petioles** convex to flat or shallowly grooved adaxially, 3-13(-16) mm, *not glandular at distal ends*, adaxial surfaces tomentose or velvety; **juvenile leaves** yellowish green, abaxial surfaces very densely long-silky or woolly, adaxial surfaces sparsely silky-tomentose; **proximal leaves** entire or shallowly serrulate; **largest medial blades** hypostomatous, venation pinnate, elliptic, narrowly oblanceolate, oblanceolate, or obovate, 31-70-120 × 17-48 mm, length-width ratio 2.1-3.1-4; bases slightly

decurrent, cuneate, or convex, angles $< 90^\circ$; margins strongly revolute at bases, entire, irregularly serrate or undulate all around margins, **glands submarginal or epilaminar**; apices acuminate or convex, angles $<$ or $> 90^\circ$; abaxial surfaces obscured by hair or glaucous (rarely evident), **very densely long- to short-silky, tomentose, woolly, or silky-woolly**, hairs appressed or spreading, straight, wavy, or curved; adaxial surfaces shiny (sometimes dull and glaucous), not glaucous, pilose or moderately densely short-silky to glabrescent, hairs white. **Catkins** flowering just before or as leaves emerge, lateral; **staminate** slender or stout, 22-54 \times 8-15 mm, flowering branchlets 1-9 mm; **pistillate moderately densely flowered**, slender to stout, 25-73 (to 115 mm in fruit) \times 5-15 mm, flowering branchlets 1-20 mm; **floral bracts** tawny or brown, 1.4-2.4 mm, abaxial surfaces hairy all over, hairs white, straight or wavy; bract apices rounded or acute, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries narrowly oblong, oblong, or ovate, 0.4-1.3 mm; **stamens 1**, anthers purple becoming yellow, short-cylindrical, 0.5-0.7 mm; filaments glabrous; **pistillate** adaxial nectaries square, ovate, or flask-shaped, 0.5-0.88 mm, shorter to longer than stipes, flattened; stipes 0.4-1.4 mm; ovaries pyriform, beaks bulged below or gradually tapering to styles, very densely long- or short-silky or villous, hairs white, straight, flattened; styles connate to slightly distinct, 0.4-0.8 mm; stigmas broad-cylindrical or two plump lobes, 0.16-0.28-0.4 mm; 14-20 ovules per ovary. **Capsules** 3.5-5.6 mm. $2n = 38, 2\times$ (Chmelar 1979; Taylor & Mulligan 1968; Vachova & Chmelar 1976).

Flowering early April to mid-June, March in California. Tidal swamps and marshes, coastal fog belts and headlands, sand dunes, springs, gravelly river and creek beds and deltas, glacial moraines, avalanche tracks, dry canyons, clearings and edges of forests; shade tolerant; 0-1840 m; Alta., B.C.; Alaska, Calif., Idaho, Mont., Oreg., Wash. Map 46.

Salix sitchensis is characterized by leaves obovate, satiny-hairy abaxially, margins revolute; pistillate catkins slender, ovaries densely silky, and staminate flowers with a single stamen. For comparison with *S. scouleriana* see Table 10. Ovary hairiness varies from glabrous to uniformly hairy, or with patchy or streaky hairiness. All three variations may occur in the same populations. There is no evidence that this is an indication of hybridization but further study is needed. Both *S. sitchensis* and *S. scouleriana* have conspicuous leaf indumentum variants, in which there are densely, curly hairs on the abaxial surfaces (*S. sitchensis* f. *coulteri* and *S. scouleriana* f. *poikila*).

***Salix sphenophylla* A. K. Skvortsov**

wedge-leaf willow

Salix sphenophylla subsp. *pseudotorulosa* A.K. Skvortsov.

Dwarf shrubs 3-12 cm, not colonial or forming colonies by layering. **Stems trailing; branches** flexible at bases, **yellow-brown or brownish**, shiny, not glaucous, glabrous; **branchlets** yellow-brown, not glaucous, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** deciduous in autumn, absent or minute rudiments; **petioles** deeply grooved adaxially, 4-25 mm, not glandular at distal ends, adaxial surfaces glabrous or pilose; **juvenile leaves reddish, abaxial surfaces very sparsely long-silky; proximal leaves** entire; **largest medial blades** hypostomatous, venation pinnate, narrowly elliptic, broadly elliptic, obovate, or very broadly so, 19-52 \times 10-28 mm, length-width ratio 1-3; bases slightly decurrent, cuneate, or convex, angles $< 90^\circ$; margins flat or slightly revolute, ciliate, entire; apices convex, retuse, or rounded, angles $> 90^\circ$; abaxial surfaces glabrous, pilose or sparsely long-silky to glabrescent, hairs spreading or appressed, white, straight or wavy; **adaxial surfaces shiny**, not glaucous, glabrous or pilose, hairs white. **Catkins** flowering as leaves emerge, lateral, **staminate slender or stout**, 21-53 \times 7-13 mm, flowering branchlets 8-20 mm; **pistillate** loosely to densely flowered, slender or stout, 32-79 \times 7-18 mm, flowering branchlets 4-27 mm; **floral bracts** brown or black, 1.1-2 mm, abaxial surfaces sparsely hairy all over or ciliate, hairs white, straight; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** adaxial nectaries oblong, 0.6-1 mm; stamens 2, anthers purple becoming yellow, ellipsoid or short cylindrical, 0.4-0.6 mm, filaments distinct, **glabrous**; **pistillate** adaxial nectaries oblong or ovate, 0.7-1.6 mm, equal to or longer than

stipes, flattened; stipes 0.5-1.4 mm; ovaries obclavate or pyriform, **beaks gradually tapering or slightly bulged below styles**, glabrous or patchy or streaky pilose or villous, especially on beaks, glaucous or not, hairs white, straight or wavy, flattened; styles connate or slightly distinct, 0.6-1.8 mm, stigmas slender- or broad-cylindrical, 0.32-0.5-0.68 mm, 10-18 ovules per ovary. **Capsules** 4-12 mm. $2n = 38$, $2\times$ Russia (Zhukova 1969, 1980; Zhukova & Petrovsky 1976, 1980; Zhukova & Tikhonova 1973; Zhukova et al. 1977), or $2n = \text{ca. } 57$, $\text{ca } 3\times$ (Zhukova 1968).

Flowering mid-June to late July (early August). Stony or gravelly substrates on talus, rocky outcrops, and dry stony tundra, occasionally on sandy and moss tundra; 6-850 m; N.T.; Alaska; Asia: Russia (East Siberia, the Far East, Chukotka). Map 47.

The occurrence of patchy or streaky hairiness on the ovaries often indicates hybridization, but in this species plants with that character are not evidently hybrids. Further study is needed.

Salix stolonifera Coville

creeping willow

Dwarf shrubs 2-10 cm, not colonial or forming colonies by layering or rhizomes. **Stems** trailing or erect; **branches** flexible at base, red-brown, not glaucous or weakly so, glabrous; **branchlets** yellow-brown or greenish brown, not glaucous or weakly so, glabrous; **buds** with *arctica*-type gradation. **Leaves, stipules** deciduous in autumn or persisting for 2 or more years, on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous, 0.5-4 mm, apices acute; **petioles** deeply to shallowly grooved adaxially, 3-9-20 mm, adaxial surfaces glabrous, margins ciliate; **juvenile leaves** yellowish green, abaxial surfaces pilose to glabrescent; **proximal leaves** entire or irregularly serrulate; **largest medial blades amphistomatous or hemiamphistomatous**, venation pinnate or with two pairs of secondary veins arising at or close to base and arcing toward apex, elliptic, broadly elliptic, or subcircular, $16-42 \times 12-30(-38)$ mm, length-width ratio 1-2; bases convex, cuneate, slightly decurrent, or rounded, angles $<$ or $> 90^\circ$; margins flat or slightly revolute, entire or serrulate at proximal ends, **glands marginal**, ciliate, hairs white, wavy; apices convex, acuminate, rounded, or retuse, angles $<$ or $> 90^\circ$; **abaxial surfaces glaucous**, glabrous; **adaxial surfaces highly glossy**, glabrous. **Catkins** flowering as leaves emerge, lateral; **staminate stout or subglobose**, $13-31 \times 7-11$ mm, flowering branchlets 1-15 mm; **pistillate moderately densely to loosely flowered**, stout to globose, $15-54$ (to 105 mm in fruit) $\times 6-15$ mm, flowering branchlets 2-42 mm; **floral bracts** brown, 1.6-2 mm, **abaxial surfaces sparsely hairy all over or at distal ends**, hairs white, straight or wavy; bract apices rounded, entire; pistillate bracts persistent. **Flowers, staminate** abaxial nectaries (0-)0.2-0.7 mm, adaxial nectaries oblong, narrowly oblong, or ovate, 0.6-1.3 mm, abaxial and adaxial nectaries distinct; stamens 2, anthers purple becoming yellow, ellipsoid, 0.4-0.6 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong, 0.5-1.4 mm, longer than stipes, flattened; stipes 0.2-0.8 mm; ovaries pyriform, beaks gradually tapering to styles, glabrous, sometimes glaucous, styles connate to free about half their lengths, (0.6-)0.8-2 mm, stigmas slender-cylindrical or flat with pointed tips, 0.32-0.5-0.88 mm, 12-13 ovules pr ovary. **Capsules** 4-10 mm.

Flowering early June to early July. Arctic, subarctic, and alpine; wet sedge meadows, hummocky tundra, raised center polygons, *Dryas*-willow-sedge tundra, *Dryas* mats on dry ridge tops; 1-975 m; Alta., B.C., Yukon; Alaska. Map 48.

Wherever *Salix stolonifera* and *S. arctica* occur together the hybridize. See *S. arctica*. The report of this species from Russia, with a chromosome number of $2n = 90-114$, needs verification. See Table 7 for a comparison with similar species.

***Salix tschuktschorum* A. K. Skvortsov**

Dwarf shrubs up to 40 cm, rhizomes lacking. **Leaves, stipules** present, at least on later leaves; **largest medial blades** persistent for several years, broadly elliptic, abaxial surfaces not glaucous; adaxial surfaces shiny; bases abruptly cuneate, rounded, or subcordate; margins serrulate to spinulose. **Catkins** up to 40 mm., on long flowering branchlets; **floral bracts** brown, long white hairy; pistillate bracts persistent. **Flowers, staminate**: anthers 0.5-0.7 mm; **pistillate**: ovaries glabrous or sometimes hairy, styles 0.5-1 mm, stigmas 0.3-0.7 mm, capsules 5-8 mm. (Description based on Hultén 1968, Korapachinsky 1983, and Skvortsov 1999).

Wet mossy and stony tundra near streams, dwarf-shrub and cryptogram tundra (Skvortsov 1999). Eastern Siberia. Map 48.

GLOSSARY

4 March 2005

References: Flora of Australia 1998; Hickey, 1973, 1979; Jackson 1928; Kiger and Porter 2001; Lawrence 1951; Leaf Architecture Working Group 1999; Skvortsov 1999; Stearn 1966. Other terms are described in the Intkey character notes (cnotes).

Abaxial. The side away from the axis. Dorsal.

Abaxial floral nectaries. Nectaries located between the stamens or ovary and the floral bract.

Acuminate. Margin between apex and 0.75 blade length distinctly concave basally and gradually tapering to tip apically.

Acute. Margin between apex and 0.75 blade length forming an angle less than 90° and essentially straight. Straight.

Adaxial. The side of a structure toward the axis. Ventral.

Adaxial floral nectaries. Nectaries located between the stamens or ovary and the axis.

Adnate. Fusion of dissimilar structures.

Alba-type bud gradation. Buds are similar in size and shape along the entire branchlet length. Floral and vegetative buds cannot be distinguished by size or shape (Skvortsov 1999).

Amphistomatous. Stomata uniformly distributed on both leaf surfaces.

Arctica-type bud gradation. There are usually few buds. The distal two or three are the largest abruptly changing to smaller buds at proximal end. The large distal buds, which open in spring, may be floral or vegetative (Skvortsov 1999).

Branch. A shoot in at least its second year of growth.

Branchlet. The current year's shoot; bearing leaves.

Broadly elliptic. A plane shape, L:W 1.5:1, widest at middle.

Broadly oblong. A plane shape, L:W 1.5:1, widest in the mid-zone.

Broadly obovate. A plane shape, L:W 1.2:1, widest toward apex.

Broadly ovate. A plane shape, L:W 1.2:1, widest toward base.

Caprea-type bud gradation. The floral buds are strikingly different in size and shape from vegetative buds. The large floral buds are sometimes intermixed with smaller vegetative buds (Skvortsov 1999).

Carinal. Applied to stigmas in which the lobes are associated with a single carpel; not jointed across the suture or commissure.

Catkin. Inflorescence a spike of unisexual flowers without conspicuous perianth.

Caudate. Margin between apex and 0.75 blade length distinctly concave basally and gradually tapering to a long tail-like tip apically. Subtype of acuminate.

Circular. A plane shape, L:W 1:1, widest at middle.

Concave. Margin between base and 0.25 blade length curves toward center of blade.

Connate. Fusion of like structures.

Convex. Margin between base and 0.25 blade length or apex and 0.75 blade length curves away from center of blade. Obtuse.

Commissural. Applied to stigmas when the lobes of one carpel are connate to those of the other carpel. Joined across the suture or commissure.

Cordate. Margin between base and 0.25 blade length with rounded projections with the sides toward petioles straight or convex. Subtype of convex.

Crenate. Teeth of shallow, rounded notches.

Cuneate. Margin between base and 0.25 blade length essentially straight.

Decurrent. Margin between base and 0.25 blade length concave basally and straight distally, extending along petiole. Subtype of concave.

Depressed-ovate. A plane shape, egg-shaped but broader than long.

Distal. Toward the tip of a structure, away from point of attachment.

Distinct. Not connate.

Dwarf shrubs. Plants 0.1 m or less, e.g. *S. reticulata*.

- Elliptic.** A plane shape, L:W 2:1, widest at middle.
- Emarginate.** Apex deeply notched, 5-25% leaf length.
- Entire.** Margin forming a smooth line, lacking teeth or undulations.
- Ferruginous.** Rust-colored.
- Flask-shaped.** With a more or less abruptly tapering neck.
- Floccose.** Covered with tufts of soft woolly hairs that tend to rub off.
- Flowering branchlet.** A short, vegetative shoot which terminates in a catkin.
- Free.** Not adnate.
- Glabrous.** Without hairs.
- Glabrate.** Becoming glabrous in age.
- Glabrescent.** The process of becoming glabrous in age but a few hairs remaining.
- Glaucous.** With a whitish waxy coating which may be polished by rubbing or scratching.
- Globose.** Solid shape in which length and width are equal; spherical.
- Gourd-shaped.** Lageniform.
- Hairs.** Filamentous epidermal outgrowths. Trichomes.
- Hemiamphistomatous.** Stomata on leaf adaxial surface only at apex and scattered along veins, but uniformly distributed on abaxial surface.
- Hypostomatous.** Stomata uniformly distributed on abaxial leaf surface.
- Indumentum.** General hairiness.
- Juvenile leaves.** Young still unfolding leaves at distal end of branchlets.
- Lanceolate.** A plane shape, L:W 3:1 or more, widest toward proximal end.
- Largest mature leaves.** The normal well developed leaves, usual medial on the branchlet.
- Linear.** A plane shape, L:W 10:1, widest in the mid-zone.
- Lobate.** Margin between base and 0.25 blade length with rounded projections with the sides toward petioles concave. Subtype of concave.
- Long-silky.** Densely covered with fine, long (0.5 mm or more long), straight, appressed, shiny hairs.
- Lorate.** A plane shape, L:W 6:1, widest in the mid-zone. Ligulate.
- Low shrubs.** Plants 0.15-0.5 m, e.g. *S. myrtillifolia*.
- Marcrescent.** Persisting for more than one year in a brown, withered condition.
- Mid shrubs.** Plants 0.6-2.0 m, e.g. *S. humilis*.
- Moderately dense.** Surface 50% visible.
- Narrowly elliptic.** A plane shape, L:W 3:1, widest at middle.
- Narrowly oblanceolate.** A plane shape, L:W 6:1 or more, widest toward apex.
- Narrowly oblong.** A plane shape, L:W 3:1, widest in the mid-zone.
- Narrowly oblong nectary.** A slender-rod, 4 or more times longer than wide.
- Narrowly ovate.** A plane shape, L:W 2:1, widest toward base.
- Non-glaucous.** Lacking a waxy coating.
- Oblanceolate.** A plane shape, L:W 3:1, widest toward distal end.
- Oblong.** A plane shape, L:W 2:1, widest in the mid-zone.
- Oblong nectary.** A broad-rod, 2-3 times longer than wide.
- Obovate.** A plane shape, L:W 2:1, widest toward distal end. Inverse egg-shaped.
- Obclavate.** Broadest at proximal end. Inverse club-shaped
- Obnapiform.** Broadest at proximal end. Inverse turnip-shaped.
- Obtriangular.** A plane shape. Inverted triangle narrowest at the proximal end.
- Obturbinate.** broadest at proximal end. Inverse top-shaped.
- Obtuse.** Forming an angle of greater than 90°.
- Ovate.** A plane shape, L:W 1.5:1, widest toward proximal end. Egg-shaped.
- Ovoid.** A solid shape widest toward proximal end. Egg-shaped.
- Pear-shaped.** Pyriform.
- Peduncle.** The naked stalk Between the flower-bearing axis and the flowering branchlet or the branch.
- Pilose.** Very sparsely covered with long, soft, wavy or straight, spreading hairs. Shaggy.

- Proximal.** Toward the base of a structure, near point of attachment.
- Proximal leaves.** The first 2-4 leaves at the base (proximal end) of a branchlet or all leaves on a flowering branchlet.
- Puberulent.** Covered with very sparse, minute, soft, straight or wavy, erect or spreading hairs, scarcely visible to the unaided eye.
- Pubescent.** Densely covered with short, soft, spreading hairs. Not used for general hairiness.
- Remotely denticulate.** Widely spaced, small, slender teeth extending more or less at right angle to axis.
- Remotely or irregularly serrate.** Widely separated, uniform teeth with an inclined axis.
- Retuse.** Apex slightly notched, less than 5% leaf length.
- Rounded.** Margin between base and 0.25 blade length or apex and 0.75 blade length forming a smooth arc.
Subtype of convex.
- Rudimentary.** Used to describe stipules that appear as minute brownish lobes.
- Serrate.** Uniform large teeth with their axes inclined toward the distal end.
- Serrulate.** Uniform small teeth with their axes inclined toward the distal end.
- Short-silky.** Densely covered with short (less than 0.5 mm), soft, straight, appressed, shiny hairs.
- Silky.** Densely covered with short or long, soft, straight, appressed, shiny hairs.
- Slender.** More than 4× longer than wide.
- Sparse.** Surface little obscured.
- Spindle-shaped.** Ellipsoidal.
- Square.** About as long as wide.
- Squat flask-shaped.** Ampulliform.
- Stipe.** The stalk of an ovary.
- Stout.** Structure less than 4× longer than wide.
- Strongly glaucous.** Conspicuous bluish or whitish waxy coating.
- Subcircular** L:W 1.2:1, widest at middle.
- Subcordate.** Margin between base and 0.25 blade length slightly lobed, grading from convex to rounded apically to concave as it meets petiole. Similar to concavo convex.
- Subglobose.** Slightly longer than wide (1.3-1.1×). Subspherical.
- Tall shrubs.** Plants greater than 2.0 m, e.g. *S. discolor*.
- Tomentose.** Densely covered with short, rather firm, more or less matted or intertwined, hairs erect or spreading.
- Transverse-oblong.** A plane shape, L:W 2:1, widest in the mid-zone but broader than long.
- Trees.** Plants of "tree" stature, sometimes with several boles.
- Triangular.** Broadest at proximal end.
- Undulate.** Wavy, up and down, in and out.
- Velvety.** Densely covered with short, soft, straight, erect hairs of relatively uniform length.
- Very broadly oblong.** A plane shape, L:W 1.2:1 or less, widest in the mid-zone.
- Very broadly obovate.** A plane shape, L:W 1:1 or less, widest toward apex.
- Very broadly ovate.** A plane shape, L:W 1:1 or less, widest toward base.
- Very densely.** Surface obscured.
- Very narrowly elliptic.** A plane shape, L:W 6:1 or more, widest at middle.
- Villous.** Somewhat densely covered with long, soft, straight or wavy, spreading hairs.
- Weakly glaucous.** Wax visible only when scratched or as isolated crystals.
- Woolly.** Very densely covered with long, soft, spreading, wavy, more or less matted or intertwined hairs.

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Biology and Ecology

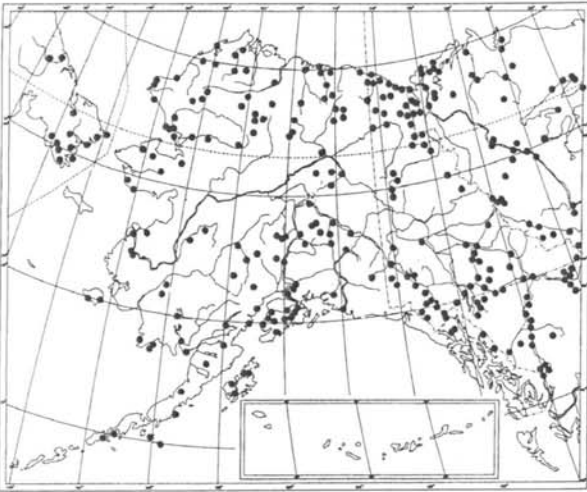
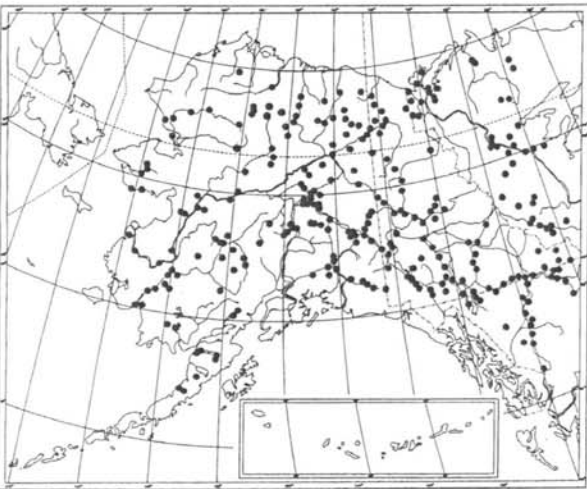
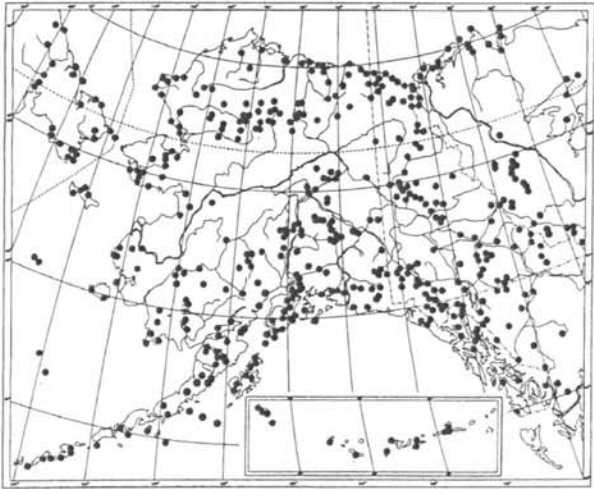
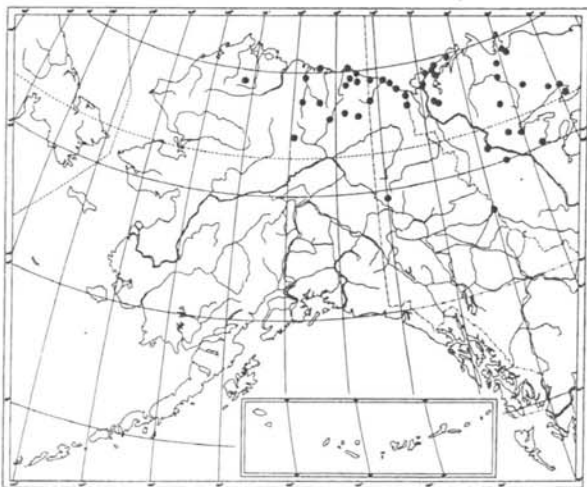
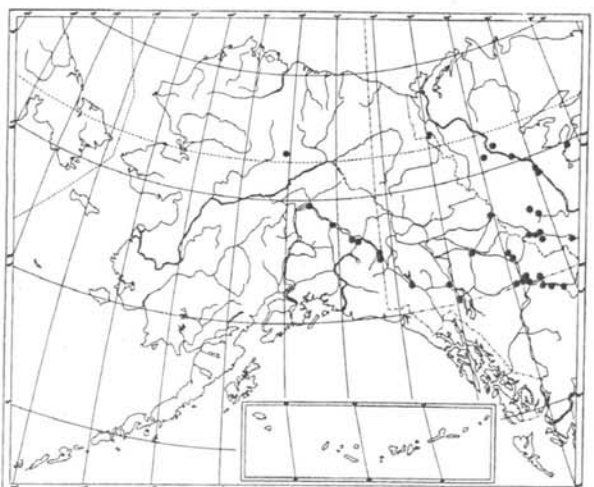
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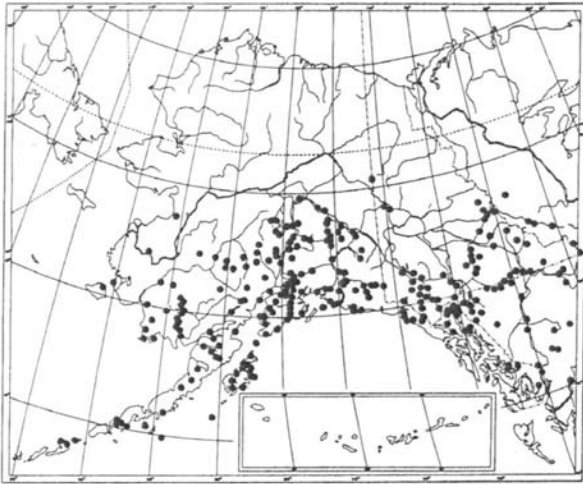
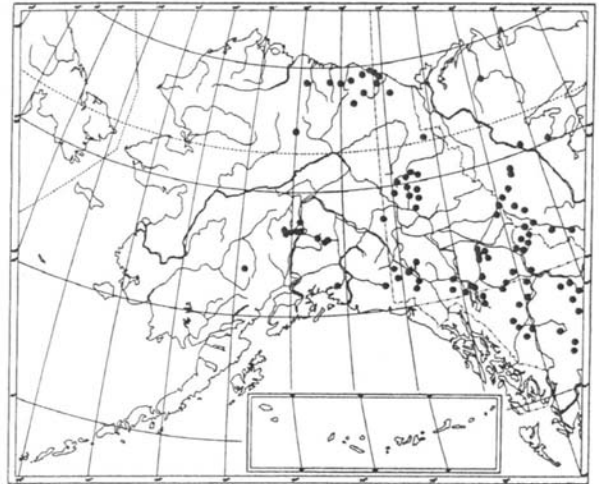
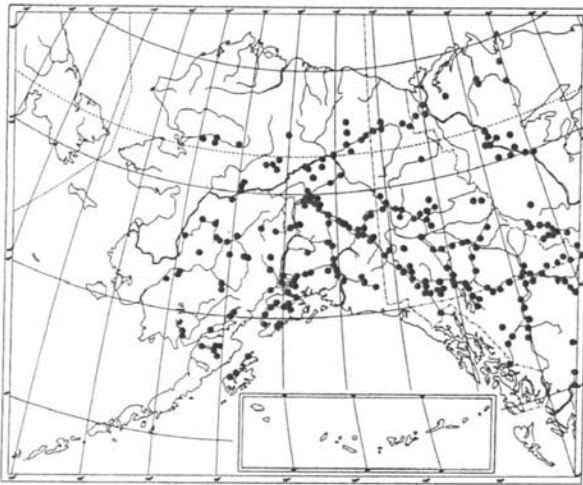
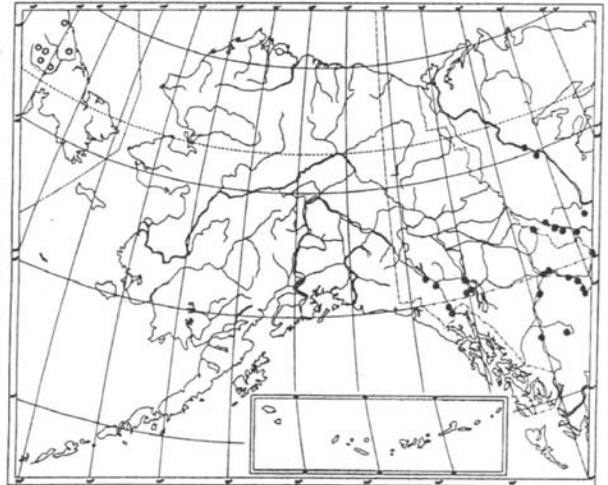
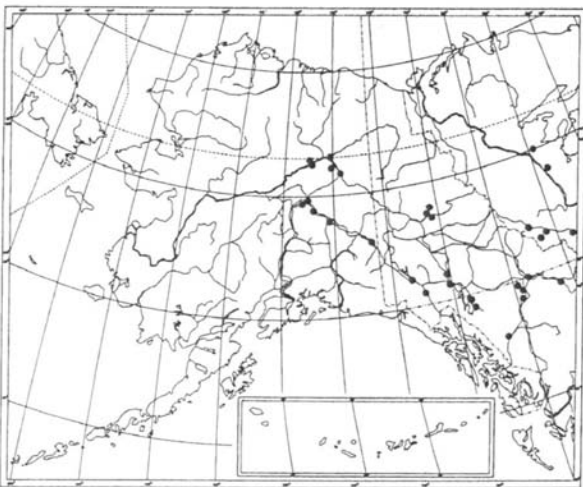
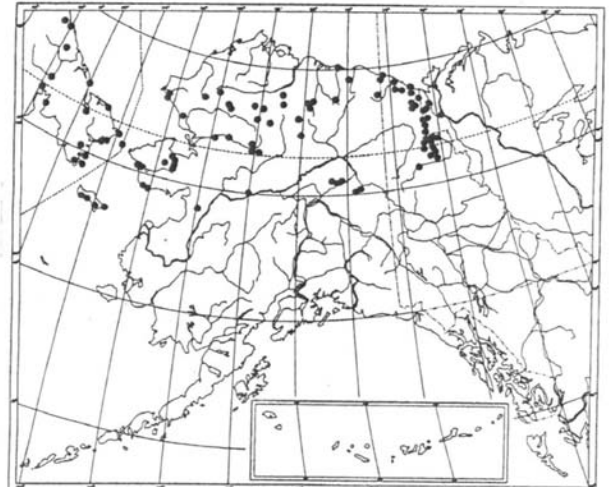
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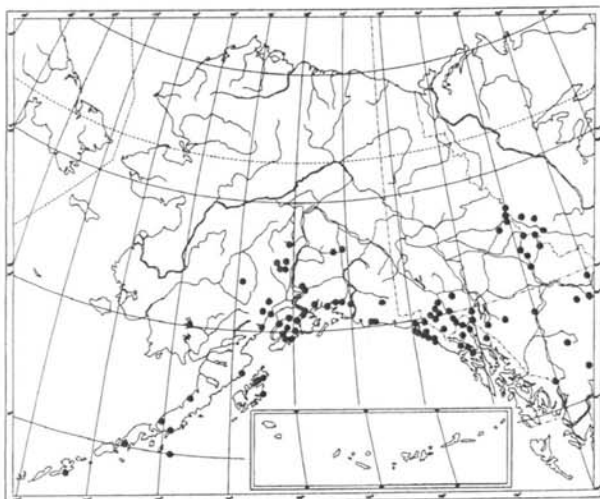
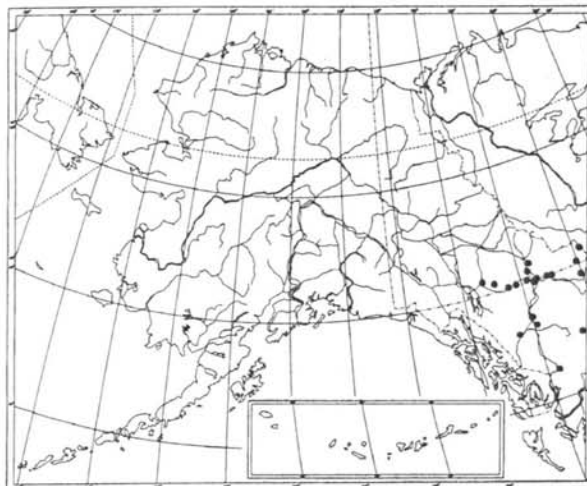
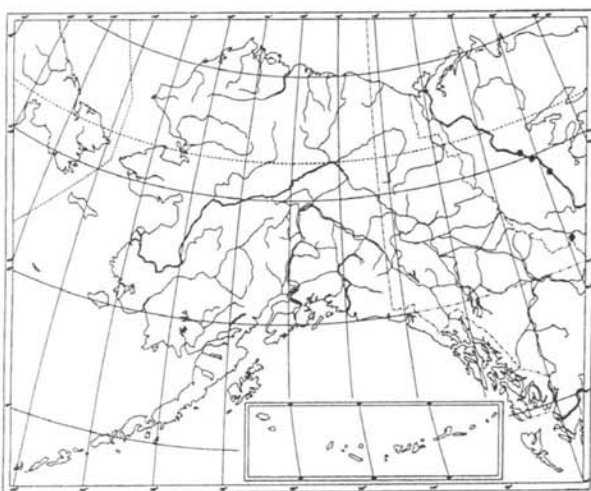
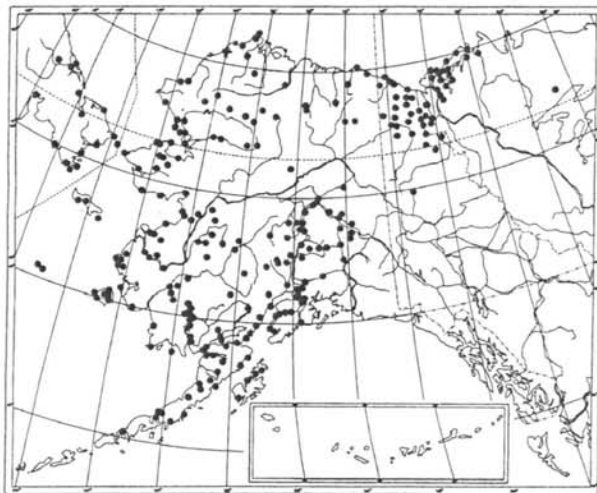
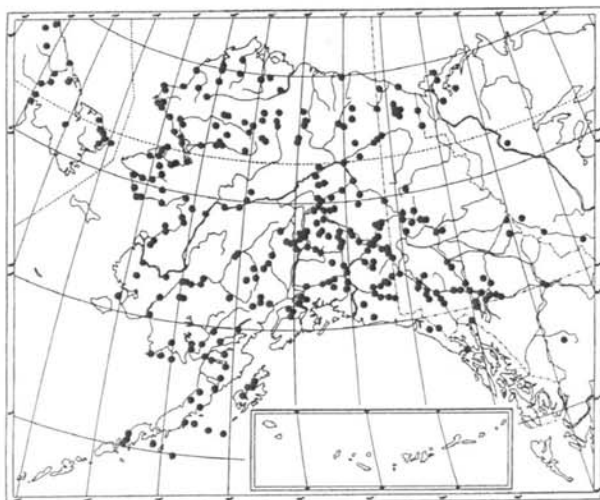
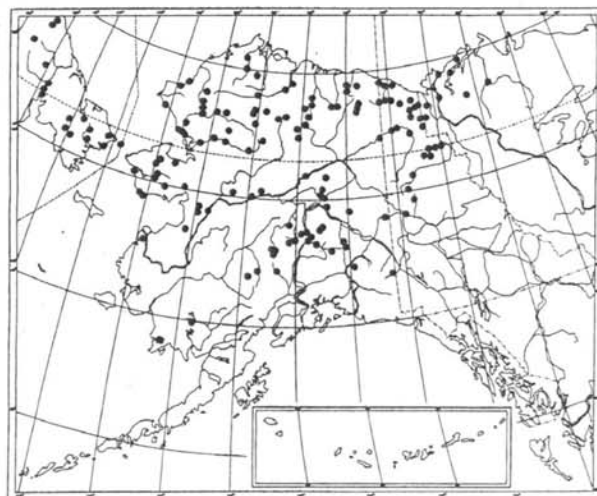
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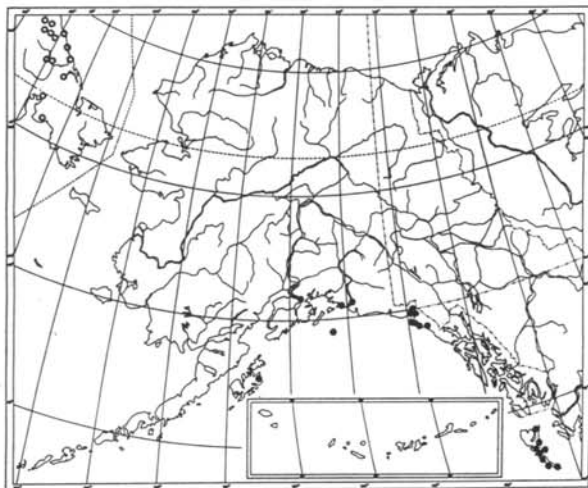
Salix Web Sites

- <http://aknhp.uaa.alaska.edu/willow/index.html>. An interactive key to New World *Salix* based on the Argus DELTA databases. The files, including Intkey, *Salix* databases, and text instruction on its use, must be downloaded to your computer. There are links to other *Salix* books and papers.
- <http://www.mun.ca/biology/delta/arcticf/sal>. Treatment of *Salix* for the Flora of the Canadian Arctic Archipelago. It includes descriptions, illustrations, maps, and the interactive identification of *Salix*.
- <http://flora.huh.harvard.edu:8080/actkey/actkey.jsp?setId=3001>. An online interactive key to New World *Salix* based on the Argus DELTA *Salix* databases.
- http://www.colostate.edu/depts/entomology/courses/en570/papers_1994/seidl.html. This site contains a paper on Chrysomelid beetle herbivores and *Salix* phenoglycosides. *Chemical Ecology Review Paper EN 570*.

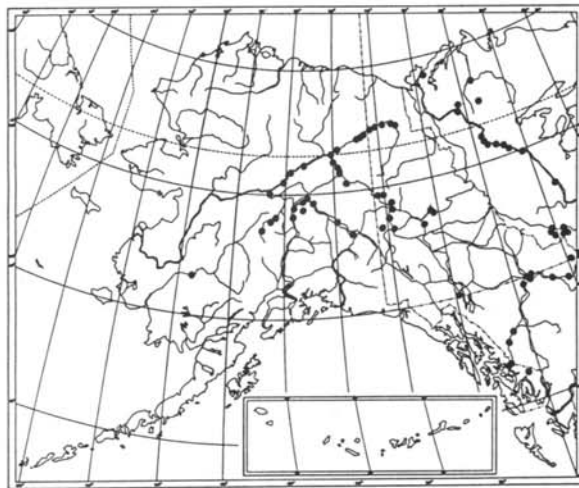
Map 1. *S. alaxensis* var. *alaxensis*Map 2. *S. alaxensis* var. *longistylis*Map 3. *S. arbusculoides*Map 4. *S. arctica*Map 5. *S. arctophila*Map 6. *S. athabascensis*

Map 7. *S. barclayi*Map 8. *S. barrattiana*Map 9. *S. bebbiana*Map 10. ○ *S. boganidensis*, ● *S. brachycarpa*Map 11. *S. candida*Map 12. *S. chamissonis*

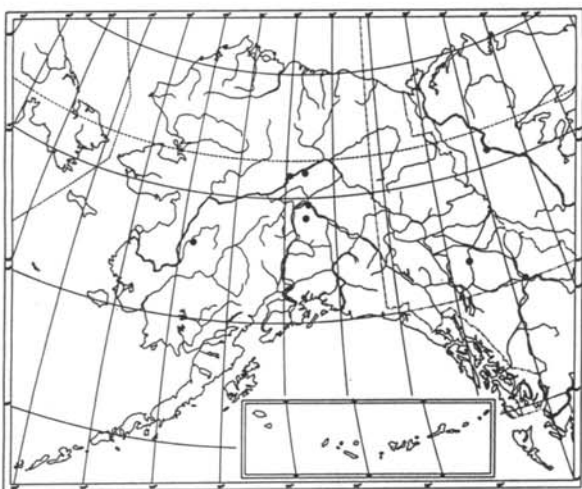
Map 13. *S. commutata*Map 14. *S. drummondiana*Map 15. *S. eriocephala* var. *famelica*Map 16. *S. fuscescens*Map 17. *S. glauca* s.l.Map 18. *S. hastata*



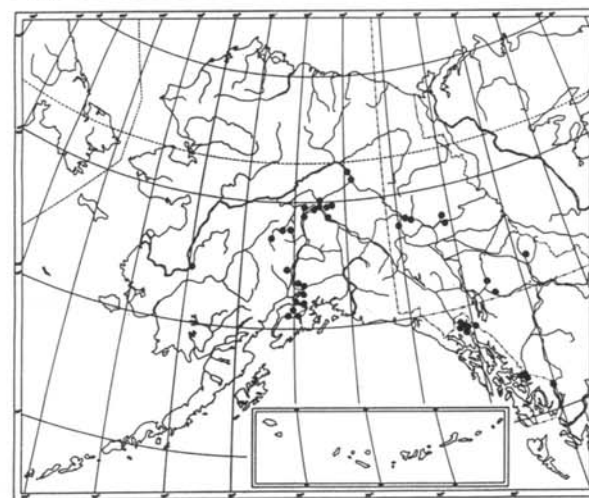
Map 19. ● *S. hookeriana*, ○ *S. krylovii*



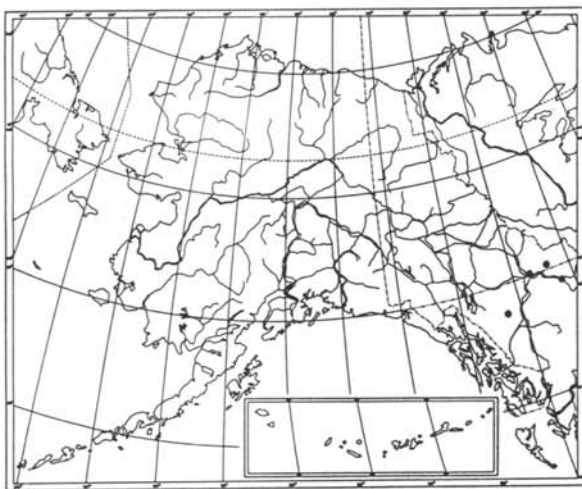
Map 20. *S. interior*



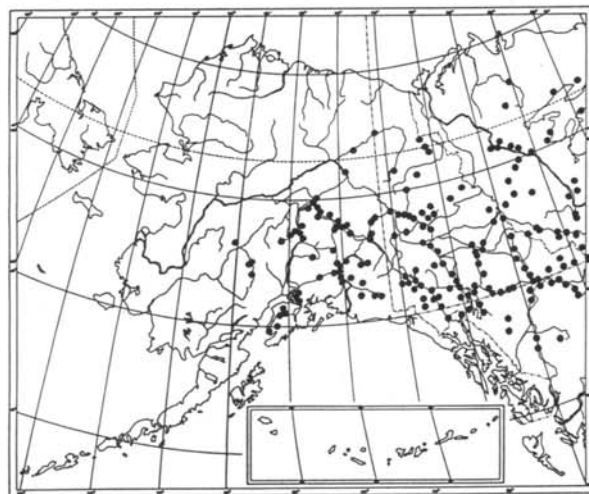
Map 21. *S. lasiandra* var. *caudata*



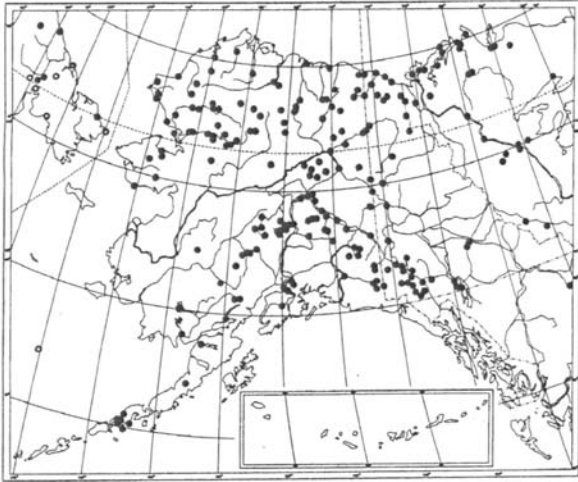
Map 22. *S. lasiandra* var. *lasiandra*



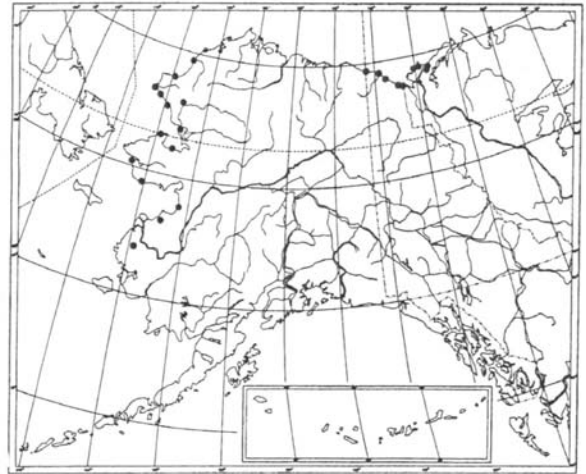
Map 23. *S. maccalliana*



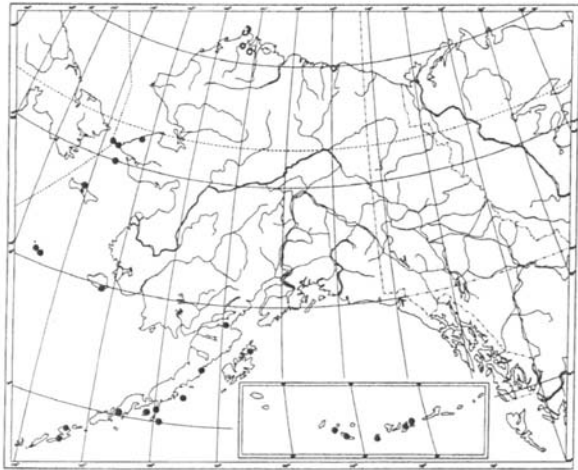
Map 24. *S. myrtillifolia*



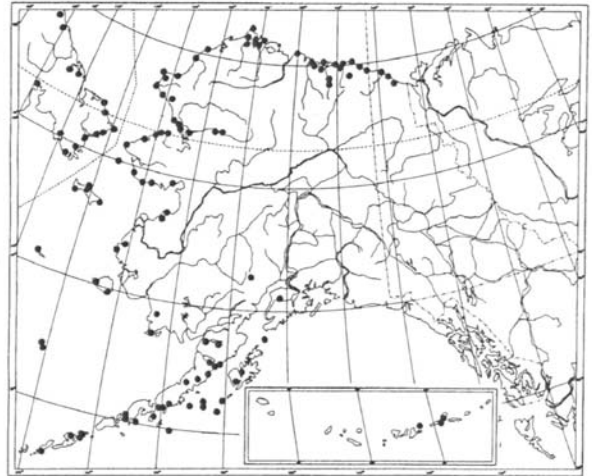
Map 25. ● *S. niphoclada*, ○ *S. nummularia*



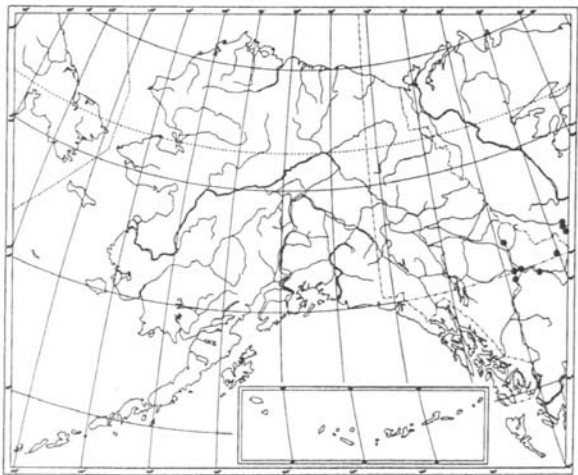
Map 26. *S. ovalifolia* var. *arctolitoralis*



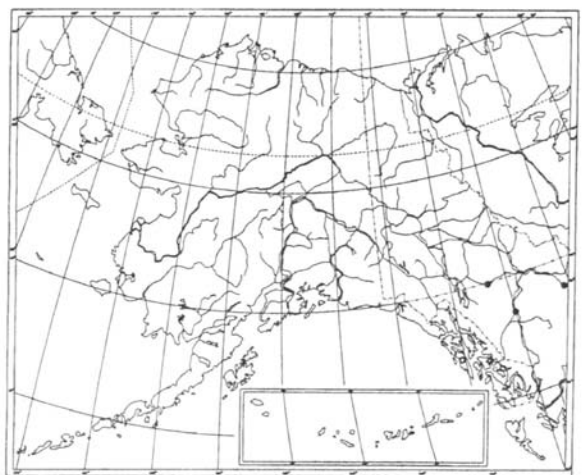
Map 27. ● *S. ovalifolia* var. *cyclophylla*, ○ var. *glacialis*



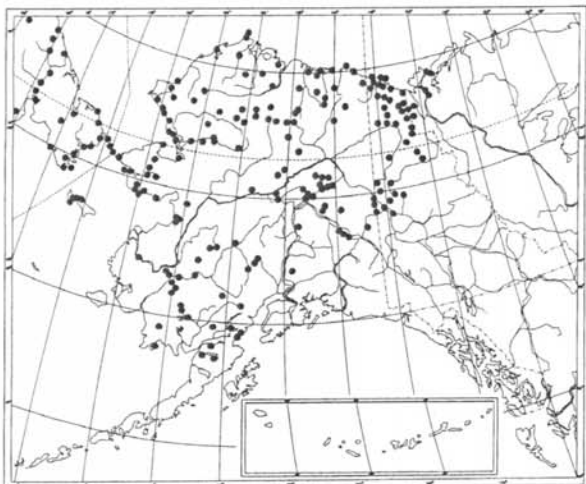
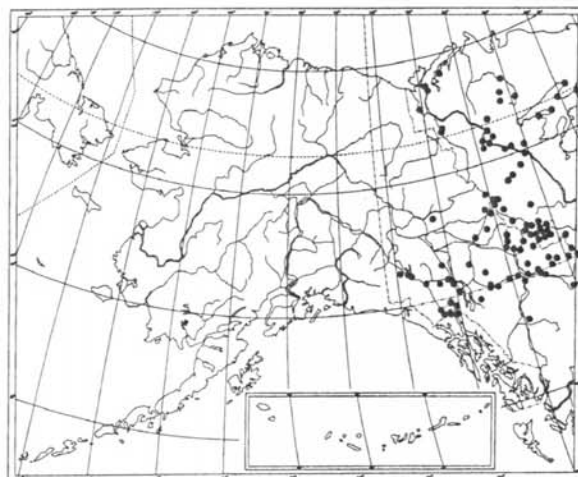
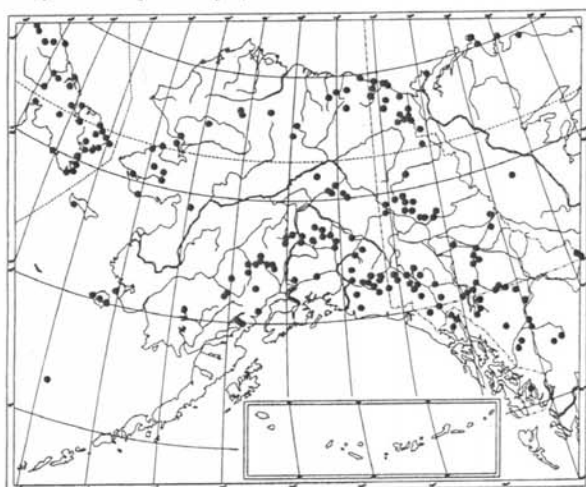
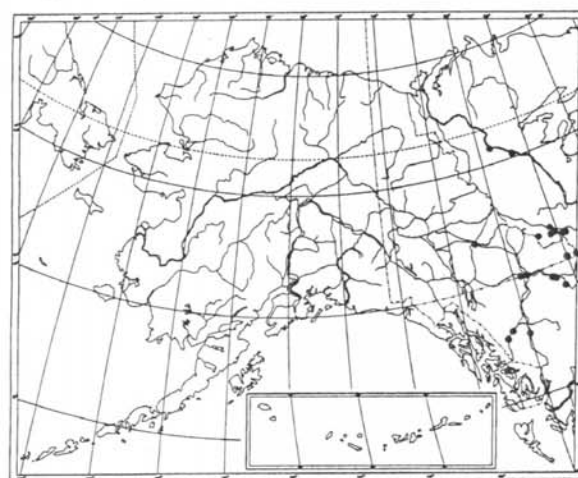
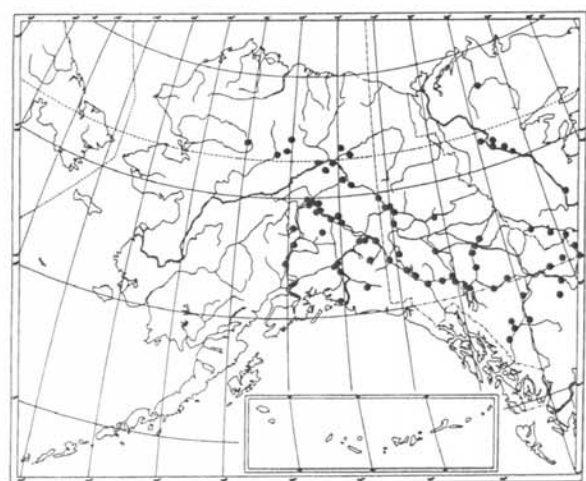
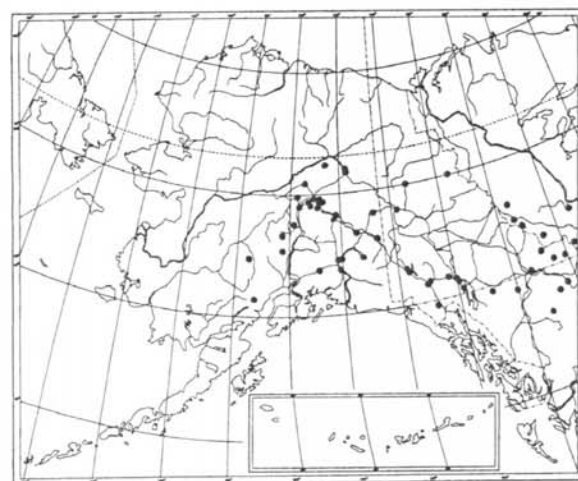
Map 28. *S. ovalifolia* var. *ovalifolia*

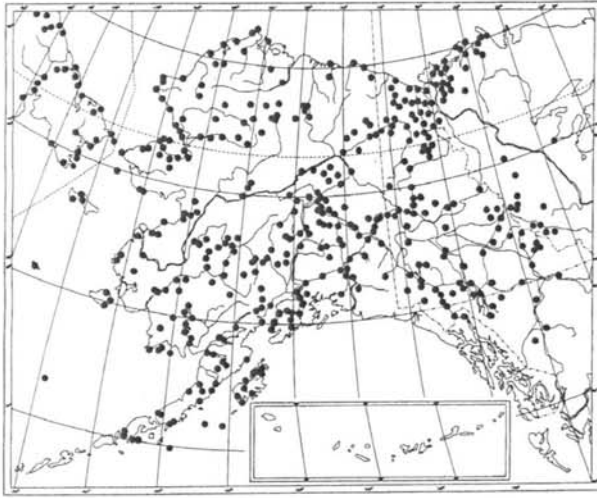
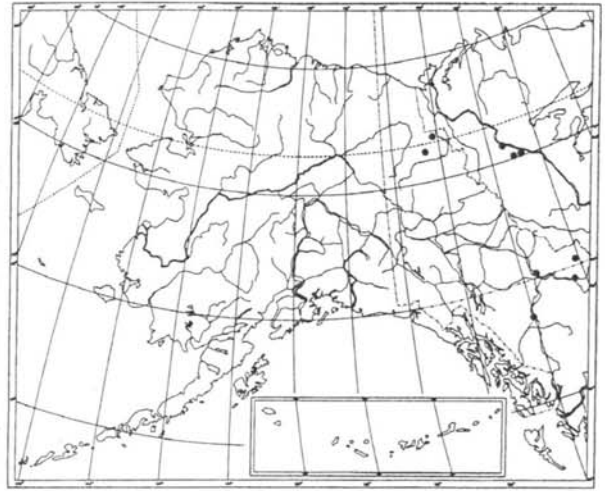
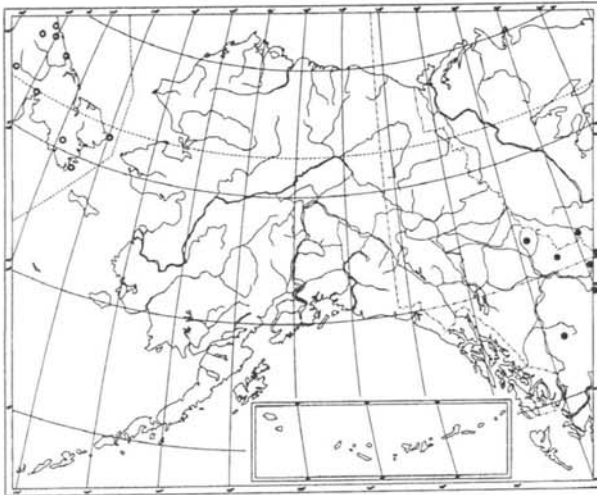
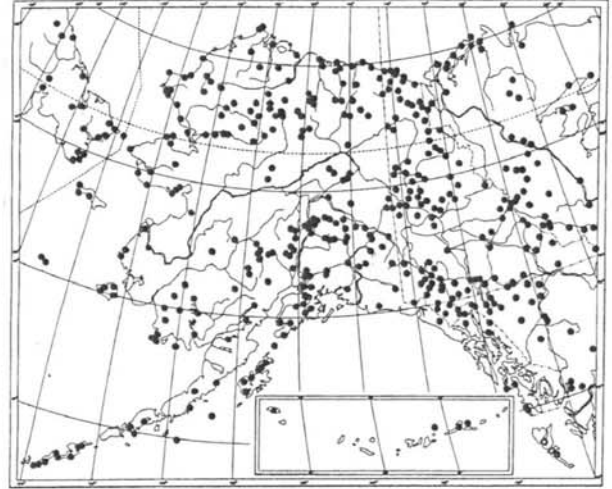
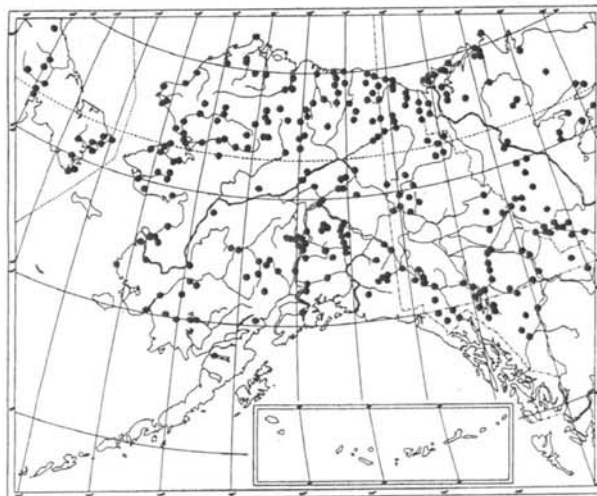
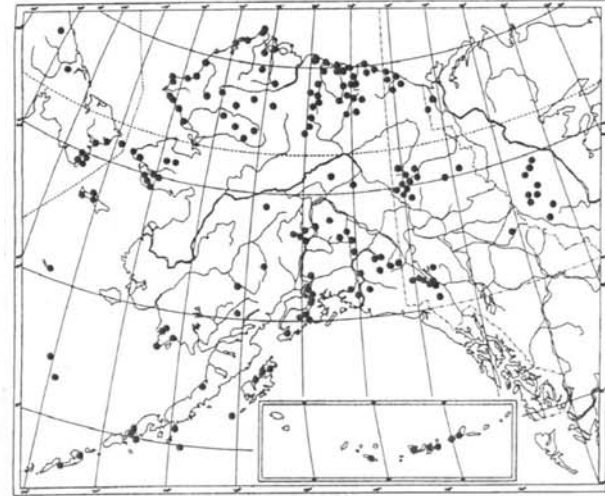


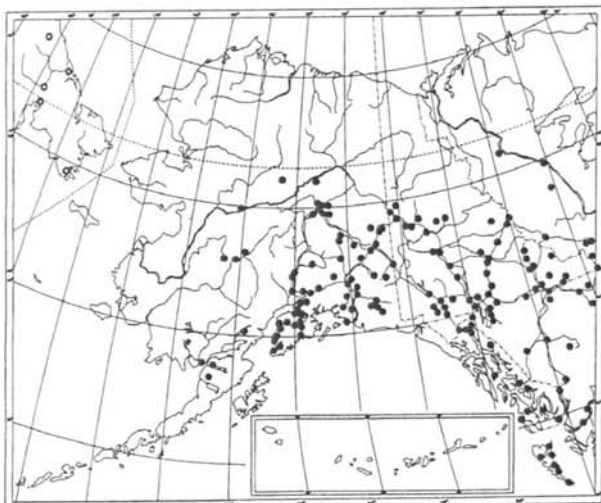
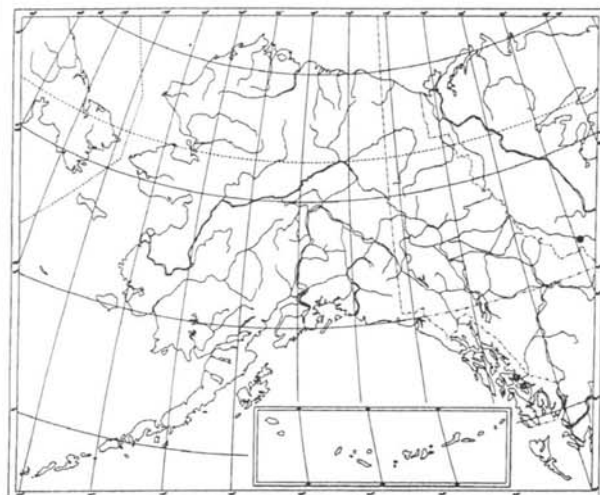
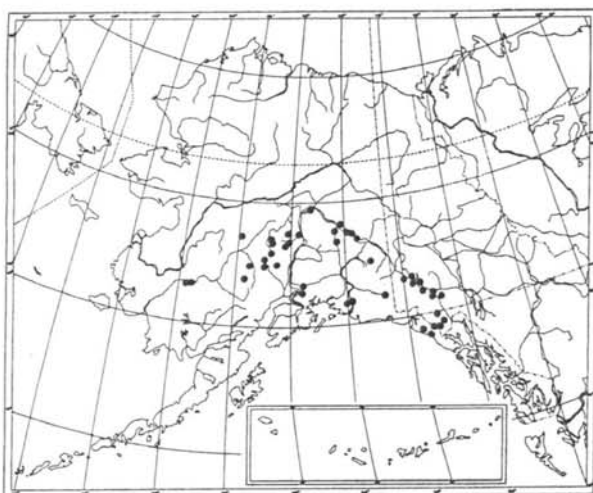
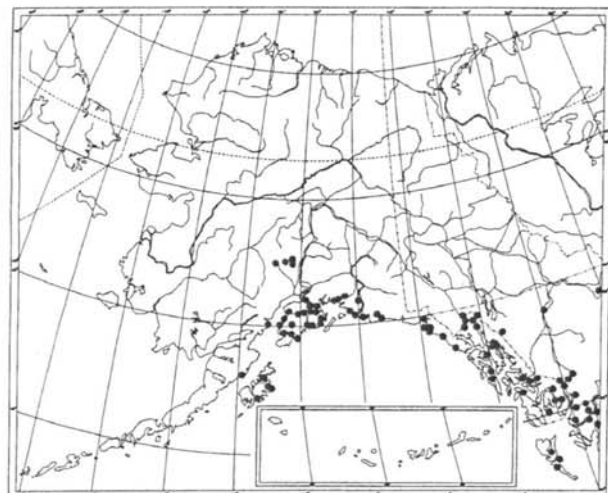
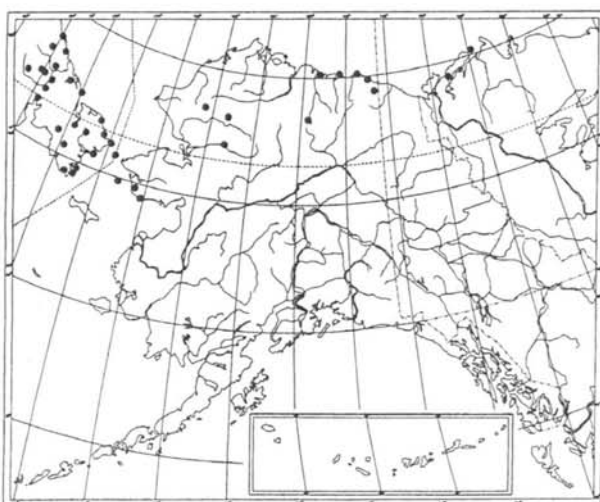
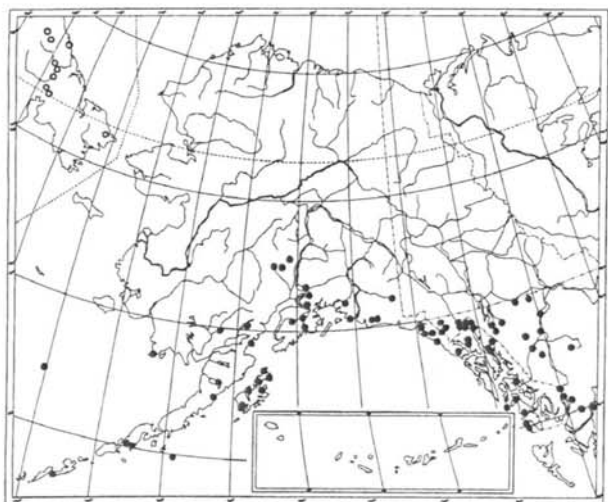
Map 29. *S. pedicellaris*



Map 30. ○ *S. pentandra*, ● *S. petiolaris*

Map 31. *S. phlebophylla*Map 32. *S. planifolia*Map 33. *S. polaris*Map 34. *S. proluxa*Map 35. *S. pseudomonticola*Map 36. *S. pseudomyrsinites*

Map 37. *S. pulchra*Map 38. *S. pyrifolia*Map 39. ● *S. raupii* ○ *S. reptans*Map 40. ● *S. reticulata* ○ subsp. *glabellcarpa*Map 41. *S. richardsonii*Map 42. *S. rotundifolia* s.l.

Map 43. ○ *S. saxatilis*, ● *S. scouleriana*Map 44. ○ *S. xsepulcralis*, ● *S. serissima*Map 45. *S. setchelliana*Map 46. *S. sitchensis*Map 47. *S. sphenophylla*Map 48. ● *S. stolonifera*, ○ *S. tshuktschorum*