Guide to the Identification of

Salix (Willow) in

Illinois, Indiana, Ohio, and Pennsylvania

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The Genus *Salix* in Illinois, Indiana, Ohio, and Pennsylvania

PREFACE

This guide to the identification of willows in Illinois, Indiana, Ohio, and Pennsylvania was written to accompany a workshop in *Salix* identification. It provides a number of resources to aid in the identification of *Salix* in the field and the herbarium; including a dichotomous key, descriptions of the species, information on flowering time, habitat, general distribution, 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, toothing, 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 it importance. First of all, polyploidy is common in *Salix*. It is likely that most of these polypoids are alloploids 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 are left walking an *a priori* tightrope.

Occasionally hybrids can be recognized in the field by their intermediacy. In our area several common hybrids can be recognized in that way. These include *Salix eriocephala* × *S. sericea* and *S. discolor* × *S. humilis*. Many of these hybrids are ephemeral and are either sterile or inviable. 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 is not always present in hybrids it should be sought when hybridization is suspected.

Intraspecific variation poses problems not only in identification, but also in gathering descriptive data. In creating 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 Intkey to enter a value, enter the data as a range rather than as a single measurement. Another was 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 dichotomatous 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.

Descriptions. The descriptions were made using DELTA and the *Salix* database. For the most part descriptions are completely parallel, but in some cases useful characteristics, not included in the database were added to the descriptions. The descriptions are based on the species throughout their entire range, not just in the area covered by the Guide. This applies also to supplementary information such as flowering time, habitat, and elevation.

Illustrations of the taxa included in this Guide can be found in Holmgren (1998), Jones and Fuller (1955) and in Argus (1986a).

Finally, a cautionary footnote 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 (see Bibliography).

> "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)

SALICACEAE Mirbel - Willow Family

Dioecious trees or shrubs, sometimes with root shoots. Branching sympodial Buds with 3-10 imbricate bud scales or a single external bud scale. **Leaves** stipulate, stipules sometimes minute or caducous; blades simple, alternate to subopposite, deciduous, petiolate. **Inflorescence** a unisexual catkin, pendulous or erect. **Flowers** unisexual, simple, perianth absent or vestigial, subtended by a scale-like, toothed, fimbriate, or entire bract; stamens 2-30, rarely 1, filaments distinct or connate; anthers 2-loculed; carpels 2-4, connate, unilocular, ovary superior, sessile or stipitate, placentation parietal, ovules 1-18 per carpel. **Fruits** capsules, dehiscent by valves; seeds surrounded by an arilate coma of long-silky hairs, embryos small, straight, with 2 cotyledons.

Genera 2 (*Populus, Salix*), species ca. 450, worldwide except Oceania; 2 genera in North America.

The Salicaceae is described here in the traditional or strict sense. Recent molecular studies indicate that some genera, formerly included in the Flacourtiaceae, should be included in the Salicaceae s.l. There is strong evidence from many sources, morphologcial, anatomical, biochemical, as well as molecular, 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 imbricate bud scales; floral bracts toothed or fimbriate; flowers with a basal, eglandular, cup-like disk; stamens 5-80; stigmas 2-4, simple. ..... ***Populus***
1. Buds with a single bud scale; floral bracts usually entire, sometimes slightly erose, or irregularly toothed; flowers with 1-2 slender, glandular nectaries, sometimes cup-like; stamens 1-7; stigmas 2, simple or bifid. ..... ***Salix***

1. *Populus* L. Sp. Pl. 2: 1034. 1753 ● Poplar

Trees not colonial or clonal by root shoots or branch fragmentation, anemophilous. **Stems**, branching sympodial or monopodial. **Buds** with 3--10 scales, imbricate, more or less resinous. **Leaves,** stipules caducous, foliaceous; petioles not-glandular at distal ends; blades generally heterophyllous, early (preformed) leaves often differing in shape and toothing from late (neoformed) leaves, subcircular to ovate, sometimes with basilaminar glands; margins subentire to finely or coarsely toothed. **Catkins** pendulous, sessile, leafless, flowering before leaves appear; floral bracts deciduous, one subtending each flower; apices deeply divided (laciniate), glabrous or ciliate. **Flowers** pedicellate; discs cup- or saucer-shaped, entire, not nectariferous; staminate flowers; stamens 5-30, filaments distinct; pistillate flowers ovaries 2-[4] carpellate; styles 2; stigmas 2, plate-like, often rolled or convoluted, bilobed; ovules 4-22 per ovary. **Capsules** narrowly ovoid to spherical.

Species ca. 30, 2 in the flora, widespread in North America, Europe, Asia, North Africa, rare in tropical regions.

Eckenwalder (1996) has written an excellent review of the classification and evolution of *Populus*.

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

Trees or **shrubs**, generally not colonial or colonial by rhizomes, layering, or branch fragmentation, entomophilous or anemophilous. **Stems** branching sympodially; **branches** generally flexible at bases; **buds** with a single scale, margins generally fused into a calyptera, not resinous. **Leaves** indistinctly heterophyllous, early and late often differing in stipule presence, size and position of stomata**;** stipules absent, rudimentary, or foliaceous, generally deciduous in autumn and not persistent for more than one year; **petioles** generally convex to flat or shallowly grooved on adaxial surfaces, generally lacking glandular-dots or lobes at distal ends; **juvenile blades** glabrous or hairy; **proximal blades** generally entire; **largest medial blades** linear to circular, secondary veins generally pinnate, angle of proximal 25% of blade generally < 90°; margins glandular-toothed to entire, glands generally marginal or submarginal, angle of distal 25% of blade generally < 90°, hairs generally white. **Catkins** erect or spreading, sessile or on leafy branchlets, loosely to very densely flowered, flowering as or before leaves emerge, or throughout the year, generally arising from lateral buds, generally unbranched; **floral bracts** one subtending each flower; apices entire, erose or irregularly toothed, generally glabrous or sparsely hairy; pistillate bracts generally persistent in fruit. **Flowers**, **staminate** with an adaxial nectary, rarely also with one abaxially, if both then nectaries distinct or connate into a cup; stamens generally 2, rarely 1 or 3-9; anthers generally purple becoming yellow, long-cylindrical to subglobose, filaments distinct or variously connate; **pistillate** with an adaxial nectary, rarely also with one abaxially; ovaries 2-carpellate, stipitate or sessile, generally with white hairs; styles 2, generally connate or slightly distinct at distal ends, beaks generally gradually tapering or slightly bulged at style; stigmas 2, entire or bifid; ovules [2] 4-24 [44] per ovary. **Capsules** obclavate to ovoid, or ellipsoidal.

Species ca. 450, 22 native species and 10 naturalized introductions in the flora, arctic, boreal and temperate regions worldwide; absent or uncommon in tropical regions; absent from Malasia, Australasia, and Oceania.

Taxonomic treatments of many of the *Salix* in the flora area can be found in the following papers: Midwestern United States (Illinois Jones and Fuller 1955, Indiana Ball 1924, Deam 1940; Michigan Voss 1985; Ohio Braun 1961, Griggs 1905, Sydnor and Cowan 2005; Wisconsin Argus 1964). Northeastern United States (Fernald 1950, Gleason 1952, Gleason and Cronquist 1991; Pennsylvania Argus 2002, Gordon 1960), Southeastern United States (Argus 1968)

CLASSIFICATION OF SALIX
(Based on Argus 1997, introduced taxa in regular boldface.)

I. *Salix* subg. Protitea Kimura

A. *Salix* sect**. *Humboldtianae*** Andersson
Salix amygdaloides
Andersson
Salix caroliniana Michx.
Salix nigra Marshall

II. *Salix* subg. ***Salix***

B. *Salix* sect. ***Salicaster*** Dumort.
Salix lucida Muhl.
Salix* ×*jesupii Fernald
Salix pentandra L.
Salix serissima (L. H. Bailey) Fern.

Salix sect Amygdalinae
Salix triandra L. var. ***triandra***

C. *Salix* sect. ***Salix***
Salix alba L.
Salix fragilis L.
Salix ×rubens Schrank
Salix ×sepulcralis Simonk
Salix ×pendulina Wenderoth

III. *Salix* subg. ***Longifoliae*** (Andersson) Argus

D. *Salix* sect. ***Longifoliae*** (Andersson) Andersson
Salix interior Rowlee

IV. *Salix* subg. ***Chamaetia*** (Dumort.) Nasarov

G. *Salix* sect. ***myrtilloides*** (Borrer) Andersson
Salix pedicellaris Pursh

V. *Salix* subg. ***Vetrix***

H. *Salix* sect. ***Hastatae*** (Fries) A. Kerner
Salix myricoides Muhlenberg
Salix cordata Michaux

I. *Salix* sect. ***Cordatae*** J. Barratt ex Hook.
Salix eriocephala Michx.

J. *Salix* sect. ***Fulvae*** J. Barratt
Salix bebbiana Sarg.

K. *Salix* sect. ***Cinerella*** Ser.
Salix atrocinerea Brotero
Salix aurita L.
Salix caprea L.
Salix cinerea L.
Salix discolor Muhl.
Salix humilis Marshall
Salix humilis Marshall var. ***humilis***
Salix humilis Marshall var. ***tristis*** (Aiton) Griggs

M. *Salix* sect. ***Candidae*** C. K. Schneider
Salix candida Flüggé ex Willd.

N. *Salix* sect. ***Viminella*** Ser.
Salix viminalis L.

Q. *Salix* sect. ***Geyerianae*** Argus
Salix petiolaris Sm..

R. *Salix* sect. ***Griseae*** (Borrer) J. Barratt ex Hook.
Salix sericea Marshall

S. *Salix* sect. ***Helix*** Dumortier
Salix purpurea L.

KEY TO SALIX IN ILLINOIS, INDIANA, AND OHIO

1. Bud scale margins distinct and imbricate. 2
1’ Bud scale margins connate. 4

2. (1) Largest medial leaf blades not glaucous on abaxial surface, adaxial surface shiny. **Salix nigra**
2’ Largest medial leaf blades glaucous on abaxial surface, adaxial surface shiny, dull, or highly glossy. 3

3.(2.) Stipule apex on later leaves acute or convex; petioles pilose, or tomentose on adaxial surface; largest medial leaf blades highly glossy on adaxial surface. ..... **Salix caroliniana**
3’ Stipule apex on later leaves rounded; petioles glabrous; or puberulent on adaxial surface; largest medial leaf blades dull on adaxial surface. ..... **Salix amygdaloides**

4.(1’) Largest medial leaf blades greater than 4x as long as wide. 5
4’ Largest medial leaf blades 4x or less as long as wide. 27

5.(4) Stems pendulous; naturalized trees. 6
5’ Stems erect; native or introduced trees or shrubs. 7

6. Petioles short-silky on adaxial surface; branches yellow or yellow-green; leaves finely serrulate; staminate catkins moderately densely flowered, slender 3.1-6 times as long as wide, staminate abaxial and adaxial nectaries distinct. ..... **Salix ×sepulcralis**
6’ Petioles glabrous, glabrescent, pilose, or velvety on adaxial surface; branches yellow-, gray-, or red-brown; leaves generally coarsely serrate; staminate catkins loosely flowered, stout, 2-2.8 times as long as wide, staminate abaxial and adaxial nectaries connate and cup-shaped. ..... **Salix ×pendulina**

7.(5’) Petioles glandular dotted or lobed at distal end. 8
7’ Petioles not glandular at distal end. 16

8. Largest medial leaf blades not glaucous on abaxial surface. 9
8’ Largest medial leaf blades glaucous or obscured by indumentum on abaxial surface. 11

9.(8) Petioles deeply grooved adaxially, margins covering groove; petioles glabrescent, puberulent, or pubescent on adaxial surface; juvenile leaves puberulent or pubescent; largest medial leaf blades crenate. ..... **Salix triandra var. triandra**
9’ Petioles shallowly to deeply grooved adaxially, margins not touching; petioles glabrous, pilose, or villous on adaxial surface; juvenile leaves glabrous, villous, or long-silky; largest medial leaf blades serrulate. 10

10. Stipules on first leaves absent or minute rudiments, on later and vigorous shoots minute rudiments or foliaceous; juvenile leaves glabrous; largest medial leaf blades generally broader, 2-6 times as long as wide; branchlets glabrous; bud scale inner membranaceous layer free but not separating from outer layer; petioles with paired spherical glands at distal end. ..... **Salix serissima**
10’ Stipules on all leaves foliaceous; juvenile leaves with white and ferruginous hair; largest medial leaf blades generally narrower, 3.1-9.8 times as long as wide; branchlets generally hairy, sometimes glabrescent; bud scale inner membranaceous layer free and separating from outer layer; petioles glandular at distal end with clusters of spherical, sometimes stalked glands, or foliaceous glands. ..... **Salix lucida**

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11.(8') Pistillate floral bracts persistent in fruit; bud gradation of caprea-type; floral bracts bicolor, brown, or black, staminate abaxial nectaries absent. 12
11' Pistillate floral bracts deciduous in fruit; bud gradation of alba-type; floral bracts tawny or greenish; staminate abaxial nectaries present. 13

12.(11) Largest medial leaf blades moderately to very densely short-silky on abaxial surface; branchlets velvety; petioles velvety on adaxial surface; proximal leaves glandular-dotted; largest medial leaf blades dull on adaxial surface; ovaries ovoid, beak abruptly tapering to style, short-silky, stigmas 0.12-0.2 mm. ..... **Salix sericea**
12' Largest medial leaf blades glabrous, glabrescent, or sparsely pilose on abaxial surface; branchlets glabrous, pubescent, pilose, or villous; petioles pubescent, pilose, villous, or tomentose on adaxial surface; proximal leaves not glandular-dotted; largest medial leaf blades shiny on adaxial surface; ovaries obclavate or pyriform, beak slightly bulged below style, glabrous, stigmas 0.28-0.56 mm. ..... **Salix myricoides**

13.(11') Mid to tall shrubs; native; branchlets glabrous; floral bracts toothed; capsules 7-12 mm. ..... **Salix serissima**
13' Trees; naturalized; branchlets variously hairy to glabrescent; floral bracts entire or erose; capsules 3.5-6 mm. 14

14.(13') Largest medial leaf blades persistently silky on both surfaces, adaxial surface dull, petioles long-silky; styles 0.16-0.44 mm; branches flexible to somewhat brittle at proximal end; branchlets straight at proximal end. ..... **Salix alba**
14' Largest medial leaf blades glabrescent to glabrous on both surfaces, adaxial surface shiny to highly glossy, petioles glabrous or puberulent; styles 0.4-1 mm; branches highly brittle at proximal end; branchlets curved at proximal end. 15

15.(14') Largest medial leaf blades glabrous from the start or almost so, margins generally irregularly serrate, blades shiny to glossy and glabrous adaxially, amphistomatous or hypostomatous, buds glabrous; petioles glabrous or puberulent; stipe 0.5-1.5 mm; ovaries obclavate. ……... **Salix fragilis**
15' Largest medial leaf blades at first long-silky but soon glabrous, margins uniformly serrulate or serrate, blades dull to shiny and glabrous to long-silky adaxially, amphistomatous, buds hairy; petioles pilose or villous; stipe 0.3-0.5 mm; ovaries pyriform. ..... **Salix ×rubens**

16.(7') Stipules on later leaves and vigorous shoots absent or minute rudiments. 56
16' Stipules on later leaves and vigorous shoots foliaceous. 17

17.(16') Largest medial leaf blades entire or undulate. 18
17' Largest medial leaf blades toothed. 21

18.(17) Branchlets densely woolly; ovaries tomentose, or woolly; largest medial leaf blades hair on abaxial surface crinkled, adaxial surface tomentose, often floccose. ..... **Salix candida**
18' Branchlets glabrous, glabrescent, puberulent, pilose, villous, tomentose, or velvety; ovaries villous or silky; largest medial leaf blade hairs on abaxial surface straight, wavy, or curved, adaxial surface glabrous, glabrescent, pubescent, or pilose. 19

19.(18') Stipules acuminate; largest medial leaf blades hair on adaxial surface gray; catkins flowering just before or as leaves emerge; pistillate adaxial nectars longer than stipes, stipes 0.1-0.5 mm. ..... **Salix viminalis**

19’ Stipules acute; largest medial leaf blades hair on adaxial surface white, or white and ferruginous; catkins flowering before leaves emerge; pistillate adaxial nectaries shorter than stipes, stipes 1-2.7 mm. 20

20.(19’) Native; mid-shrubs; stipules on first leaves absent or rudimentary; largest medial leaf blade margins usually strongly revolute; anthers purple becoming yellow in age; ovaries sparsely to moderately densely hairy, hairs wavy and crinkled. ..... **Salix humilis var. humilis**
20’ Introduced and naturalized; tall shrubs, 3-12 m; stipules on first leaves foliaceous; largest medial leaf blade margins slightly revolute; anthers yellow; ovaries very densely hairy, hairs straight. ..... **Salix atrocinerea**

21.(17’) Pistillate floral bracts deciduous in fruit; plants forming colonies by root shoots; largest medial leaf blades amphistomatous, blade margins remotely spinulose-serrulate; floral bracts tawny or greenish, staminate flowers with an abaxial nectary. ..... **Salix interior**
21’ Pistillate floral bracts persistent in fruit; plants not colonial, or forming colonies by layering or stem fragmentation; largest medial leaf blades hypostomatous, blade margins serrate, serrulate, crenate, or crenulate; floral bracts bicolor, brown, or black; staminate flowers lacking an abaxial. 22

22.(21’) Stipules on first leaves foliaceous. 23
22’ Stipules on first leaves absent or minute rudiments. 25

23.(22) Ovaries hairy; largest medial leaf blade margins crenate; introduced, naturalized. ..... **Salix atrocinerea**
23’ Ovaries glabrous; largest medial leaf blade margins serrate, serrulate, or crenulate; native. 24

24 (23’) Largest medial leaf blades only with white hairs, margins toothed; stigmas two plump lobes, 0.16-0.28 mm; pistillate catkins densely or moderately densely flowered; anthers 0.4-0.64 mm. ..... **Salix eriocephala**
24’ Largest medial leaf blades often with ferruginous hairs, margins entire or toothed; stigmas flat or slender-cylindrical lobes, 0.24-0.56 mm; pistillate catkins loosely flowered; anthers 0.6-0.8 mm. ..... **Salix myricoides**

25.(22’)Largest medial leaf blades short-silky on abaxial surface; branches gray-brown or violet; juvenile leaves short-silky; largest medial leaf blades dull on adaxial surface; ovaries ovoid, beak abruptly tapering to style, stigma lobes 0.12-0.2 mm, capsules 2.5-4 mm. ..... **Salix sericea**
25’ Largest medial leaf blades glabrous, glabrescent, pilose, tomentose, or woolly on abaxial surface; branches yellow-, or red-brown; juvenile leaves glabrous, glabrescent, puberulent, pubescent, tomentose, or long-silky; largest medial leaf blades shiny or highly glossy on adaxial surface; ovaries obclavate or pyriform, beak slightly bulged below style, stigma lobes length: 0.24-0.56 mm, capsules 5-12 mm. 26

26.(25’) Largest medial leaf blade margins serrulate or crenulate, 5-10 per cm, blades glabrous, glabrescent, or pilose on abaxial surface; ovaries glabrous. ..... **Salix myricoides**
26’ Largest medial leaf blade margins crenate, 1-4 per cm, blades moderately to very dense tomentose, or woolly on abaxial surface; ovaries villous or short-silky. ..... **Salix humilis var. humilis**

27.(4’) Stipules on first leaves foliaceous. 28
27’ Stipules on first leaves absent or minute rudiments. 37

28.(28) Ovaries hairy. 29
28’ Ovaries glabrous. 32

29.(28) Branchlets densely woolly, petioles shallowly grooved adaxially, deeply grooved adaxially; catkins: flowering: as leaves emerge; ovaries tomentose or woolly. ..... **Salix candida**
29’ Branchlets puberulent, pilose, villous, tomentose, or velvety; petioles flat to convex adaxially, catkins flowering before leaves emerge; ovaries silky. 30

30.(29’) Shrubs 1-3 m; largest medial leaf blades with veins strongly impressed on adaxial and raised on abaxial surfaces, tomentose, villous, or sometimes glabrescent on abaxial surface; ovaries short-silky with wavy or crinkled hairs. ..... **Salix aurita**
30’ Shrubs 3-12 m; largest medial leaf blades with veins raised on both adaxial and abaxial surfaces, sparsely pubescent or pilose on abaxial surface; ovaries long- or short-silky with straight hairs. 31

31.(30’) Tall shrubs 3-7 (-10) m; branches grayish brown to brown; striae on peeled 3-4-year old stems (10-) 20-40 (-62) mm; largest medial leaves tomentose with white hairs. ..... **Salix cinerea**
31’ Tall shrubs or small trees 3-12 m; branches sometimes yellow-brown but variable; striae on peeled 3-4-year old stems (5-) 10-20 (-45) mm; largest medial leaves tomentose to glabrescent with white or white and ferruginous hairs. ..... **Salix atrocinerea**

32.(28’) Petioles with glandular dots or lobes at distal end. 33
32’ Petioles not glandular at distal end. 35

33.(32) Largest medial leaf blade margins crenate; petioles deeply grooved adaxially, margins covering groove. ..... **Salix triandra var. triandra**
33’ Largest medial leaf blade margins serrulate or crenulate, petioles flat to convex, or shallowly grooved adaxially, if deeply grooved margins not touching. 34

34.(33’) Stipules convex or rounded; petioles with clusters of spherical glands, stalked spherical glands, or foliaceous glands at distal end; largest medial leaf blades not glaucous on abaxial surface; floral bracts tawny, pistillate bracts deciduous in fruit. ..... **Salix lucida**
34’ Stipules acuminate or acute; petioles with paired spherical glands at distal end; largest medial leaf blades glaucous on abaxial surface, floral bracts bicolor or brown, pistillate bracts persistent in fruit. ..... **Salix myricoides**

35.(32’) Largest medial leaf blades not glaucous on abaxial surface, adaxial surface moderately to very densely hairy. ..... **Salix cordata**
35’ Largest medial leaf blades glaucous on abaxial surface, adaxial surface sparsely hairy. 36

36.(35) Largest medial leaf blades only with white hairs, margins toothed; stigmas two plump lobes, 0.16-0.28 mm; pistillate catkins densely or moderately densely flowered; anthers 0.4-0.64 mm. ..... **Salix eriocephala**
36’ Largest medial leaf blades often with ferruginous hairs, margins entire or toothed; stigmas flat or slender-cylindrical lobes, 0.24-0.56 mm; pistillate catkins loosely flowered; anthers 0.6-0.8 mm. ..... **Salix myricoides**

37.(27’) Petioles with glandular dots or lobes at distal end. 38
37’ Petioles not glandular at distal end. 44

38.(37) Largest medial leaf blades not glaucous on abaxial surface. 39
38’ Largest medial leaf blades glaucous on abaxial surface. 41

39. Largest medial leaf blades dull or shiny on adaxial surface; petioles glabrescent, puberulent, or pubescent; juvenile leaves puberulent or pubescent on abaxial surface; largest medial leaf blade margins crenate; stigma lobes 0.14-0.24 mm. ..... **Salix triandra var. triandra**
39’ Largest medial leaf blades highly glossy on adaxial surface; petioles glabrous; juvenile leaves glabrous on abaxial surface, largest medial leaf blade margins serrulate; stigma lobes 0.36-0.68 mm. 40

40.(39’) Branches dull to shiny; pistillate catkins stout to globose, 1-2.3 times as long as wide; floral bracts moderately densely hairy all over; ovaries with beaks slightly bulged below, or abruptly tapering to, styles; native. ..... **Salix serissima**
40’ Branches highly glossy; pistillate catkins slender to stout, 3.4-5.3 times as long as wide; floral bracts sparsely hairy at proximal end; ovaries with beaks gradually tapering to styles; introduced and naturalized. ..... **Salix pentandra**
41. (38’) Plants trees. 42
41’ Plant low to tall shrubs. 43

42. Largest medial leaf blades glabrous from the start or almost so, shiny to glossy on adaxial surface, glabrous on adaxial surface, amphistomatous or hypostomatous, margins usually irregularly serrate; petioles glabrous or puberulent on adaxial surface; stipes 0.5-1.5 mm; ovaries obclavate. ..... **Salix fragilis**
42’ Largest medial leaf blades at first long-silky but soon glabrous, dull to shiny on adaxial surface, glabrous to long-silky on adaxial surface, amphistomatous, margins uniformly serrulate or serrate; petioles pilose or villous on adaxial surface; stipes 0.3-0.5 mm; ovaries pyriform. ..... **Salix ×rubens**

43.(41’) Stipules on later leaves and vigorous shoots minute rudiments; petioles glabrous; largest medial leaf blades highly glossy on adaxial surface; pistillate fruiting catkins persistent through the winter; floral bracts tawny, pistillate bracts deciduous in fruit. ..... **Salix serissima**
43’ Stipules on later leaves and vigorous shoots foliaceous; petioles hairy; largest medial leaf blades shiny on adaxial surface; pistillate fruiting catkins deciduous by end of growing season; floral bracts bicolor or brown, pistillate bracts persistent in fruit. ..... **Salix myricoides**

44.(37’) Stipules on later leaves and vigorous shoots absent or minute rudiments. 45
44’ Stipules on later leaves and vigorous shoots foliaceous. 49

45.(44) Leaves opposite or subopposite; largest medial leaf blades amphistomatous; ovaries obturbinate beak gradually tapering to style, stipes 0-0.1 mm ..... **Salix purpurea**
45’ Leaves alternate; largest medial leaf blades hypostomatous; ovaries obclavate, or pyriform, beak slightly bulged below or abruptly tapering to style stipe 1-6 mm. 46

46.(45’) Largest medial leaf blades glabrous on abaxial surface, glaucous on adaxial surface, branchlets sparsely hairy, petioles: adaxial surface indumentum type: glabrous, or puberulent; ovaries glabrous. ..... **Salix pedicellaris**
46’ Largest medial leaf blades variously hairy to sometimes glabrescent on abaxial surface, not glaucous on adaxial surface; branchlets moderately to very densely hairy; petioles pubescent, pilose, villous, or velvety; ovaries villous or short-silky. 47

47.(46’) Petioles pubescent; plants not colonial; largest medial leaf blades glabrescent, pubescent, or long-silky on abaxial surface; catkins flowering just before or as leaves emerge; floral bracts tawny. ..... **Salix bebbiana**

47’ Petioles pilose, villous, or velvety; plants forming colonies by layering, largest medial leaf blades tomentose or woolly on abaxial surface; catkins: flowering: before leaves emerge, floral bracts bicolor, brown, or black. 48

48.(47’) Stipules foliaceous; largest medial leaf blades (20-)50-90(-135) mm, hairs on abaxial surface white or ferruginous; petioles (1.5-)3-7(-12) mm; staminate catkins 14.5-34 mm; pistillate catkins generally longer than 20 mm; decorticated wood with prominent, long striae. ..... **Salix humilis var. humilis**
48’ Stipules absent or minute rudiments; largest medial leaf blades (13-)20-50(-70) mm, hairs on abaxial surface gray; petioles 0.5-3(-6) mm; staminate catkins 6.5-13.5 mm; pistillate catkins generally shorter than 20 mm; decorticated wood smooth or with a few small striae. ..... **Salix humilis var. tristis**

49.(44’) Largest medial leaf blade margins serrulate or crenulate; ovaries glabrous.... **Salix myricoides**
49’ Largest medial leaf blade margins entire, remotely or irregularly serrate, or crenate; ovaries hairy. 50

50.(49’) Ovaries tomentose or woolly; branchlets densely woolly. ..... **Salix candida**
50’ Ovaries villous or silky; branchlets glabrescent, pubescent, pilose, villous, tomentose, or velvety.51

51.(50’) Largest medial leaf blade margins flat. 52
51’ Largest medial leaf blade margins strongly or slightly revolute. 54

52.(51) Petioles pilose or velvety on adaxial surface, largest medial leaf blades tomentose or woolly on abaxial surface; plants forming colonies by layering. ..... **Salix humilis var. humilis**
52’ Petioles pubescent or tomentose on adaxial surface; largest medial leaf blades glabrous, glabrescent, pubescent, pilose, or long-silky abaxial surface; plants not colonial or forming colonies by stem fragmentation. 53

53.(52’) Petioles tomentose on adaxial surface; catkins flowering before leaves emerge, pistillate catkins very densely flowered; floral bracts bicolor, brown, or black, apex acute or convex. ..... **Salix discolor**
53’ Petioles pubescent on adaxial surface; catkins: flowering as or just before leaves emerge; pistillate catkins loosely flowered; floral bracts tawny apex rounded. ..... **Salix bebbiana**

54.(51’) Petioles pilose or velvety on adaxial surface; plants mid shrubs, forming colonies by layering, branches red-brown; branchlets yellow-green or red-brown; anthers 0.4-0.6 mm; ovaries obclavate, sparsely to moderately densely hairy. ..... **Salix humilis var. humilis**
54’ Petioles tomentose or glabrescent on adaxial surface; plants tall shrubs or trees, not colonial; branches gray-brown or brownish; branchlets yellow-, or gray-brown; anthers 0.7-1.1 mm; ovaries pyriform, very densely hairy. 55

55.(54’) Plants 3-7 m tall; wood of peeled branches with prominent, raised striae; ovaries long-silky, beaks slightly bulged below style. ..... **Salix cinerea**
55’ Plants 8-15 m tall; wood of peeled branches smooth; pistillate flowers: ovaries short-silky, beaks gradually tapering to style. ..... **Salix caprea**

56.(16) Largest medial leaf blades glaucous on adaxial surface, abaxial surface glabrous; juvenile leaves glabrous, puberulent, pubescent. 57
56’ Largest medial leaf blades not glaucous on adaxial surface, abaxial surface villous, tomentose, woolly, short-silky, long-silky or glabrescent; juvenile leaves tomentose, short-silky, long-silky, or glabrescent. 58

57.(56) Leaves opposite or subopposite; stipules on later leaves and vigorous shoots absent, largest medial leaf blades amphistomatous, pistillate catkins very densely flowered; floral bracts bicolor or black; ovaries short-silky, stipes 0-0.1 mm. ..... **Salix purpurea**
57’ Leaves alternate; stipules on later leaves and vigorous shoots minute rudiments, largest medial leaf blades hypostomatous; pistillate catkins loosely flowered, floral bracts tawny or light rose; ovaries glabrous, stipes 2.1-3.2 mm. .....**Salix pedicellaris**

58. (56’)Largest medial leaf blades linear, amphistomatous, margins remotely spinulose-serrulate; plants forming colonies by root shoots; pistillate floral bracts deciduous in fruit; staminate flowers with an abaxial; ovaries glabrescent or long-silky. ..... **Salix interior**
58’ Largest medial leaf blades broader, {{sometimes narrow but not linear}}, hypostomatous. margins entire, serrate, serrulate, spinulose-serrulate, crenate, or crenulate; plants not colonial or forming colonies by layering or stem fragmentation; pistillate floral bracts persistent in fruit; staminate flowers lacking an abaxial nectary; ovaries villous or short-silky. 59

59.(58’) Largest medial leaf blades short-silky on abaxial surface; branches highly brittle at base; juvenile leaves short-silky; ovaries ovoid, capsules 2.5-4 mm. ..... **Salix sericea**
59’ Largest medial leaf blades glabrescent, tomentose, woolly, or long-silky on abaxial surface; branches flexible at base, juvenile leaves glabrescent, tomentose, or long-silky; ovaries obclavate or pyriform, capsules 5-12 mm. 60

60. (59’) Largest medial leaf blades lorate or very narrowly elliptic, largest medial leaf blades: position of glands marginal, abaxial surface glabrescent or long-silky; juvenile leaves long-silky; plants tall shrubs, not colonial, catkins flowering as leaves emerge. ..... **Salix petiolaris**
60’ Largest medial leaf blades narrowly oblong, narrowly elliptic, elliptic, oblanceolate, obovate, or broadly obovate, glands submarginal, abaxial surface tomentose or woolly; juvenile leaves glabrescent or tomentose; plants low to mid shrubs, forming colonies by layering; catkins: flowering before leaves emerge. 61

61.(60’) Stipules foliaceous; leaf blades (20-)50-90(-135) mm; petioles (1.5-)3-7(-12) mm; staminate catkins 14.5-34 mm; pistillate catkins generally longer than 20 mm; decorticated wood with prominent, long striae. ……..…… **Salix humilis var. humilis**
61’ Stipules absent or minute rudiments; leaf blades (13-)20-50(-70) mm; petioles 0.5-3(-6) mm; staminate catkins 6.5-13.5 mm; pistillate catkins generally shorter than 20 mm; decorticated wood smooth or with a few small striae. ……..…….... **Salix humilis var. tristis**

TAXONOMIC TREATMENT

Salix alba L. Sp. pl. 2: 1021. 1753. ● White willow

Salix alba subsp. *caerulea* (Sm.) Rech. f.; *Salix alba* subsp. *vitellina* (L.) Arcang.; *Salix alba* var. *caerulea* (Sm.) Sm.; *Salix alba* var. *calva* G. F. W. Mey.; *Salix alba* var. *vitellina* (L.) Stokes; *Salix vitellina* L.

Trees 10-25 m, not colonial or forming colonies by stem fragmentation. **Stems, branches** flexible or somewhat brittle at bases, gray- or red-brown, glabrous or long-silky; **branchlets** yellowish or gray- to red-brown, pilose, villous, or long-silky. **Leaves, stipules** on first leaves minute rudiments or absent, on later leaves minute rudiments or foliaceous, early deciduous or deciduous in autumn, apices acute; **petioles** 3-13 mm with pairs or clusters of spherical glands at distal ends, adaxial surfaces long-silky; **juvenile blades** yellowish green or reddish, abaxial surfaces very densely long-silky, hairs white;

largest medial blades amphistomatous, narrowly oblong, very narrowly elliptic, narrowly elliptic, or lanceolate, 63-115 × 10-20 mm, length-width ratio 4.2-7.3; bases cuneate, slightly decurrent, or convex; margins flat, serrate or serrulate; apices acuminate, caudate, or acute; abaxial surfaces glaucous, very densely long-silky to glabrescent, hairs appressed, white, straight, adaxial surfaces dull, sparsely long-silky to glabrescent. **Catkins** flowering as leaves emerge; **staminate** slender or stout, 27-60 × 6-10 mm, flowering branchlets 2-8 mm; **pistillate** loosely flowered, slender, 31-51 × 4-8 mm, flowering branchlets 3-14 mm; **floral bracts** tawny, 1.6-2.8 mm, abaxial surfaces hairy all over, hairs straight; apices rounded, entire; pistillate bracts deciduous after flowering. **Flowers, staminate** abaxial nectaries present; adaxial nectaries oblong to square, 0.3-0.7 mm, abaxial and adaxial nectaries distinct or rarely connate forming shallow cups; stamens 2; anthers purple becoming yellow, short-cylindrical or globose, 0.5-0.7 mm, filaments distinct, hairy on lower halves or at bases; **pistillate** adaxial nectaries square, 0.3-0.65 mm, equal to or shorter than stipes; stipes 0.2-0.8 mm; ovaries obclavate to pyriform, glabrous, not glaucous; styles 0.16-0.44 mm; stigmas broad-cylindrical, lobes 0.32-0.4-0.56 mm, 8-9 ovules per ovary. **Capsules** 3.5-5 mm. 2*n* = 76.

Flowering early May to late June. Introduced and sometimes naturalized; Canada: Alta. (?), B.C. (?), Man. (?), N.B., Ont., Que., Sask.; U.S.A.: Ariz., Ark., Calif., Colo., Conn., Del., D.C., Ga., Idaho, Ill., Ind., Ky., Maine, Md., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N.H., N.C., N.Y., Ohio, Pa., R.I., Tenn., Vt., Va., Wash. (Jacobson 1995), W.Va., Wis., Wyo. (?). Eurasia.

The several cultivars of *Salix alba*, which are commonly cultivated in our area, have been variously treated as subspecies (Akeroyd 1993) or varieties (Meikel 1984) but they are all cultivars. The most common ones are: *S. alba* cv Sericea (*S. alba* var. *sericea* Gaudin) which has densely and persistently long-silky leaves and branchlets; *S. alba* cv Vitellina (*S. alba* var. *vitellina* (L.) Stokes) which has yellow to yellow-brown twigs; and *S. alba* cv Chermesina (S. alba var. chermesina Hartig) which has reddish twigs; *S. alba* cv Caerulea (*S. alba* var. *caerulea* (Smith) Smith which has dark brown branchlets and leaves that are more coarsely toothed and sparsely silky on abaxial surfaces. Plants referred to in the literature as *S. alba* var. *vitellina* cv Pendula are *S.* ×*sepulcralis*.

Salix ×*sepulcralis* (*Salix alba* × *Salix babylonica*). See *Salix* ×*sepulcralis*.

Salix ×*rubens* (*Salix alba* × *Salix fragilis*). See *Salix* ×*rubens*.

Salix ×*jesupii* Fernald *(Salix alba* × *Salix lucida).* See *Salix* ×*jesupii*

Salix amygdaloides Andersson, Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 15: 114. 1858 ● Peach-leaf willow

Salix amygdaloides var. *wrightii* (Andersson) C. K. Schneider; *Salix nigra* var. *amygdaloides* (Andersson) Andersson; *Salix nigra* var. *wrightii* (Andersson) Andersson; *Salix wrightii* Andersson.

Trees 4-20 m, not colonial or forming colonies by stem fragmentation. **Stems, branches** flexible to somewhat brittle at bases, yellowish to gray-brown, glabrous; **branchlets** yellowish to gray- or red-brown, glabrous, bud scales margins distinct and imbricate. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves foliaceous or minute rudiments, early deciduous or deciduous in autumn, apices rounded; **petioles** deeply grooved adaxially; margins, 7-21 mm, not glandular or with spherical glands at distal ends, adaxial surfaces glabrous or puberulent; **juvenile blades** reddish or yellowish green, abaxial surfaces glabrous or sparsely pubescent, hairs white and ferruginous; **proximal blades** entire or shallowly serrulate; **largest medial blades** hypostomatous or amphistomatous, very narrowly elliptic, elliptic, lanceolate, or narrowly oblanceolate to oblanceolate, 55-130 × 24-37 mm, length-width ratio 2.8-6; bases convex, cuneate, cordate (uncommon), or rounded (rare); margins flat, serrulate; apices acuminate to caudate; abaxial surfaces glaucous, glabrous; adaxial surfaces dull, glabrous or sparsely pubescent, hairs white. **Catkins** flowering as leaves emerge; **staminate** slender or stout, 23-80 × 5-12 mm, flowering branchlets 3-28 mm; **pistillate** loosely

flowered, 41-110 (to 127 mm in fruit) × 8-16 mm, flowering branchlets 17-35 mm; **floral bracts** tawny, 1.5-2.8 mm, abaxial surfaces sparsely to moderately densely hairy at proximal ends, hairs wavy; apices acute to rounded, entire or toothed; pistillate bracts deciduous after flowering. **Flowers, staminate** abaxial nectaries 0.15-0.73 mm; adaxial nectaries narrowly oblong to square, 0.25-0.75 mm, abaxial and adaxial nectaries distinct; stamens 3-7; anthers yellow, globose, 0.5-0.6 mm, filaments distinct, hairy on lower halves or at bases. **pistillate** adaxial nectaries square, 0.1-0.6 mm, shorter than stipes; stipes 1-3.2 mm; ovaries pyriform, glabrous; styles 0.2-0.4 mm; stigmas flat with rounded tips, lobes 0.24-0.31-0.4 mm, 16-18 ovules per ovary. **Capsules** 3-7 mm. 2*n* = 38.

Flowering early April to June. Moist to mesic floodplains rivers and streams, shores of lakes on sandy, silty, or gravelly substrates, and marshes, and wet sand dune slacks; 60-2350 m.; North American endemic. Canada: Alta., B.C., Man., Ont., Que., Sask.; U.S.A.: Ariz., Colo., Idaho, Ill., Ind., Iowa, Kans., Ky., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N.Mex., N.Dak., N.Y., Ohio, Okla., Oreg., Pa., S.Dak., Tex., Utah, Wash., Wis., Wyo.

Salix amygdaloides × *S. caroliniana* was reported from Missouri by N. M. Glatfelter (1897) but it has not been confirmed.

Salix amygdaloides × *S. eriocephala* reported by M. L. Fernald (1950) but unconfirmed.

Salix amygdaloides × *S. nigra* (*S.* ×*glatfelteri* C. K. Schneider) was reported from St. Louis, Missouri, where (Glatfelter 1894) it was estimated that about 40% of the populations were hybrids. The leaves are somewhat glaucous abaxially, as in *S. amygdaloides*, but they are linear to very narrowly elliptical, as in *S. nigra.* It probably occurs wherever the parents grow together (Argus 1986a)

Controlled pollination between *Salix amygdaloides* and *S. eriocephala*, *S. interior*, and *S. petiolaris* set no seed; controlled pollination with *S. lucida.* produced a few seeds but seedlings suffered from necrosis in the cotyledon stage (A. Mosseler 1990).

Salix atrocinerea Brotero, Fl. Lusit. 1: 31. 1804. ● Rusty willow

Salix cinerea subsp. *atrocinerea* (Brot.) Guinier; *Salix cinerea* subsp. *oleifolia* (Smith) Macreight; *Salix oleifolia* Smith, non Villars

Tall shrubs 3-12 m. **Stems, branches** yellow-, gray-, or red-brown, pilose or villous to glabrescent; **branchlets** gray- or yellow-brown, puberulent, pilose, villous, or velvety. **Leaves, stipules** early deciduous or persistent for 2 or more years, foliaceous, apices acute; **petioles** convex to flat adaxially, 3-15 mm, adaxial surfaces tomentose or velvety to glabrescent; **juvenile leaves** yellowish green or reddish, abaxial surfaces glabrous, tomentose, or long-silky, hairs white and/or ferruginous; **proximal leaves** generally entire; **largest medial blades** elliptic, broadly elliptic, oblanceolate, obovate, narrowly elliptic, broadly obovate, 29-105 × 14-52 mm, length-width ratio 1.8-4.3; bases cuneate or convex, angles < 90°; margins slightly revolute, entire, crenate, or undulate, glands submarginal or epilaminal; apices acute, convex, or acuminate, angles < 90°; abaxial surfaces glaucous, tomentose, coarsely villous, or glabrescent, hairs erect, spreading, or appressed, white and/or ferruginous, wavy or curved; adaxial surfaces dull or shiny, pubescent or pilose, hairs white or white and ferruginous. **Catkins** flowering before leaves emerge; **staminate** 11-16 mm, flowering branchlets 0-5 mm; **pistillate** densely to loosely flowered, stout, 11-18 mm, flowering branchlets 0-3 mm; **floral bracts** brown, black, or bicolor, 1-3 mm, abaxial surfaces hairy all over, hairs straight or wavy; apices acute, obtuse, or rounded, entire. **Flowers, staminate** adaxial nectaries narrowly oblong, oblong, or ovate, 0.4-0.93 mm; anthers yellow, short-cylindrical or ovoid, 0.6-1 mm, filaments distinct, glabrous, hairy on lower halves or only at bases; **pistillate** adaxial nectaries oblong, square, or obovate, 0.4-0.9 mm, shorter than stipes; stipes 1.2-2.7 mm; ovaries pyriform or obclavate, long- or short-silky; styles 0.2-0.5 mm; stigmas broad-cylindrical, lobes 0.23-0.43-0.63 mm, 12 ovules per ovary. **Capsules** 5-7 mm. 2*n* = 76.

Introduced and naturalized. Canada: B.C. (?), Ont.; U.S.A.: Maine, Mass., Nebr., N.C., N.Y., Pa., R.I. Europe.

Salix cinerea and *S. atrocinerea* are very closely related species. Their occurrence in our flora, as naturalized introductions, has not been well understood, probably because they have gone under the name *S. caprea*, and they do not appear in most floras (e.g. Schneider 1921, Fernald 1950). They are likely to have been introductions of long standing because of their prominent catkins and their value in the ornamental market. *Salix atrocinerea* was first documented in the Southeastern United States (Argus 1986a) when plants with ferruginous hairs and prominently striate wood were found in North Carolina and since that time it has been found in many states and provinces. This has led to the recognition of both species throughout the flora area. There are even articles in the popular press about new invasive willows in northeastern United States that seem to be referring to *S. atrocinerea* but it is likely that the presence here of both species is of long standing but unrecognized.

The presence of long, prominent, striae on the peeled wood of 4-5 year old branches is commonly used in the European literature (Rechinger 1993; Skvortsov 1999) to separate *Salix cinerea* and *S. atrocinerea* from *S. caprea* et al., in which the wood is smooth or with only a few short striae. In our flora, long striae sometimes also occur in *S. bebbiana*, *S. humilis*, and *S. discolor*; but generally they are not as long or as prominent as in *S. cinerea* and *S. atrocinerea*. Some floras (e.g. Martini and Paiero 1988) use the relative prominence of striae to separate *S. cinerea and S. atrocinerea* but their separation remains difficult. The presence of ferruginous hairs on the leaves of *S. atrocinerea* is the best diagnostic character, but they are not always present.

The hybrid *Salix cinerea* × *S. viminalis* (*S.* ×*smithiana* Willd.) is sometimes naturalized.

Salix aurita L. Sp. pl. 2: 1019. 1753. ● Eared willow

Mid or tall shrubs 1-3 m. **Stems, branches** brownish, pubescent to glabrescent; **branchlets** red- or yellow-brown, weakly glaucous, sparsely tomentose. **Leaves, stipules** foliaceous, apices acute or obtuse; **petioles** convex to flat adaxially, 2-9 mm, adaxial surfaces velvety; **juvenile leaves** reddish or yellowish green, abaxial surfaces very densely tomentose or glabrescent, hairs generally white; **proximal leaves** entire; **largest medial blades** obovate, broadly obovate, or elliptic, 27-85 × 14-35 mm, length-width ratio 1.5-2.8; bases convex or cuneate, angles < 90°; margins slightly revolute, entire, remotely or irregularly serrate, or crenate, glands submarginal; apices acuminate or convex; abaxial surfaces glaucous, pubescent or pilose, hairs spreading or erect, white or white and ferruginous, wavy or crinkled; adaxial surfaces dull or shiny, pubescent or pilose to glabrescent, veins more hairy, hairs white or white and ferruginous. **Catkins** flowering before leaves emerge; **staminate** subglobose or globose, 15.5-21.5 × 10-15 mm, flowering branchlets 0.5-4 mm; **pistillate** loosely to moderately densely flowered, 15-37 × 9-20; flowering branchlets 2.5-7 mm; **floral bracts** brown, tawny, or bicolor, 1-2.2 mm, abaxial surfaces hairy all over, hairs straight; apices acute or tapering and rounded, entire. **Flowers, staminate** adaxial nectaries oblong or square, 0.3-0.7 mm; anthers purple becoming yellow, ellipsoid or short-cylindrical, 0.5-0.8 mm, filaments distinct, glabrous, hairy on lower halves or at bases; **pistillate** adaxial nectaries oblong or square, 0.3-0.7 mm, shorter than stipes; stipes 1.4-2.6 mm; ovaries pyriform, beaks slightly bulged below or gradually tapering styles, long-beaked, densely short-silky, hairs flattened; styles 0-0.25 mm; stigmas broad-cylindrical or two plump lobes, 0.25-0.37-0.5 mm, 10-12 ovules per ovary. **Capsules** 4-13 mm. 2*n* = 76, 38.

Rarely introduced and rarely naturalized. U. S. A.: Penn (naturalized), Mass. (cultivated). Europe.

The naturalization of this species in North America is based on old specimens. Today it is probably rarely cultivated in our area and former naturalizations extirpated.

Salix bebbiana Sargent, Gard. & For. 8: 463. 1895 ● Gray willow, Bebb's willow, long-beaked willow

Salix bebbiana Sargent var. *capreifolia* (Fernald) Fernald; *Salix bebbiana* var. *depilis* Raup; *Salix bebbiana* Sargent var. *luxurians* (Fernald) Fernald; *Salix bebbiana* var. *perrostrata* (Rydberg) C. K. Schneider; *Salix bebbiana* var. *projecta* (Fernald) C. K. Schneider; *Salix depressa* Linnaeus subsp. *rostrata* (Richardson) Hiitonen; *Salix perrostrata* Rydb.; *Salix rostrata* Richards., non Thuill.; *Salix starkeana* subsp. *bebbiana* (Sarg.) Youngberg;

Mid shrubs to trees 0.5-10 m; not colonial. **Stems, branches** flexible or somewhat brittle at bases, dark red-brown, sometimes weakly glaucous, glabrous or pilose; **branchlets** yellow-green or red-brown, sometimes weakly glaucous, villous, hairs wavy, straight, or geniculate, **buds** of *alba*-type gradation. **Leaves, stipules** sometimes early deciduous, on first leaves minute rudiments or absent, on later leaves foliaceous or minute rudiments, apices acute or obtuse; **petioles** convex to flat adaxially, 2-5.5-13 mm, adaxial surfaces pubescent; **juvenile leaves** yellowish green or reddish, abaxial surfaces pilose or sparsely to moderately densely tomentose or long-silky; **proximal leaves** entire; **largest medial blades** 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; margins flat, entire, crenate, or irregularly serrate, glands submarginal; apices acute, acuminate, or convex, angles < 90°; abaxial surfaces glaucous, moderately densely pubescent-long-silky to glabrescent, hairs wavy; adaxial surfaces dull or shiny, finely impressed-reticulate, moderately densely pubescent-short-silky to glabrescent. **Catkins,** pistillate flowering as leaves emerge, staminate flowering just before leaves emerge; **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 straight or wavy; apices rounded, entire. **Flowers, staminate** adaxial nectaries oblong or ovate, 0.3-0.8 mm; anthers yellow or purple becoming yellow, ellipsoid or short-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; stipes 2-6 mm; ovaries obclavate, long-beaked, beaks slightly bulged below styles, short-silky, hairs flattened; styles 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. 2*n* = 38.

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, rich fens and disturbed areas; sandy to rocky materials derived from granitic or dolomitic limestone and shale substrates; 2-3300 m.; Canada: Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Nunavut; Ont., P.E.I., Que., Sask., Yukon; U.S.A.: 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.

Salix bebbiana × *S. candida* (*S.* ×*cryptodonta* Fernald) is intermediate between the parental species. They resemble *S. candida* in juvenile leaves densely woolly, mature leaves sparsely to moderately woolly abaxially, margins strongly revolute to crenulate, and woolly ovaries; and *S. bebbiana* in stipes 2.8-3 mm long, and capsules long beaked, 8-9 mm long. The hybrid seems to be common in Newfoundland.

Salix bebbiana × *S. eriocephala*. Controlled pollinations had low seed viability (Mosseler 1990). Reported for the Northeast (Fernald 1950) but unconfirmed.

Salix bebbiana × *S. humilis*. Reported by Schneider (1921) and Fernald (1950) and successfully synthesized by Argus (1986a).

Salix bebbiana × *S. interior* (as *S. exigua*). Controlled pollinations had low seed viability (A. Mosseler 1990).

Salix bebbiana × *S. myricoides* reported by M. L. Fernald (1950) but unconfirmed.

Salix bebbiana × *S. petiolaris* was successfully synthesized by Argus (1986a) and controlled pollinations by A. Mosseler (1990) had high seed viability; but it seems to be relatively uncommon. It is known only from Ontario, based on an infertile pistillate specimen, and from Alberta.

Salix candida Flüggé ex Willdenow, Sp. pl. 4: 708. 1806 ● Sage willow, sage-leaf willow

Salix candida Flüggé ex Willdenow (var.) *denudata* Andersson; *Salix candida* f. *denudata* (Andersson) Rouleau

Low to mid shrubs 0.3-2.5 m; often forming colonies by layering. **Stems, branches** dark gray-brown, woolly in patches, floccose or glabrescent; **branchlets** yellow- to gray-brown, densely woolly or tomentose, sometimes floccose, hairs crinkled; **bud** gradation of *alba*-type; **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, apices acute; **petioles** shallowly to deeply grooved adaxially, obscured by hairs, 3-10 mm, adaxial surfaces tomentose or densely woolly; **juvenile leaves** yellowish green, abaxial surfaces very densely tomentose; **proximal leaves** entire; **largest medial blades** 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; apices acute or convex, angles < 90°; abaxial surfaces obscured by hair or glaucous, very densely to sparsely tomentose-woolly, cobwebby in age, hairs dull white, crinkled; adaxial surfaces dull or shiny, moderately densely to sparsely tomentose, floccose, hairs dull white. **Catkins** flowering as leaves emerge; **staminate** stout or subglobose, 17-39 × 8-16 mm, flowering branchlets 0.5-7 mm; **pistillate** densely to moderately 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 hairy all over, hairs straight; apices rounded or acute, entire. **Flowers, staminate** adaxial nectaries narrowly oblong to oblong, 0.58-1 mm; 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; stipes 0.1-1.2 mm; ovaries pyriform, beaks slightly bulged or gradually tapering to styles, tomentose or woolly; styles 0.3-1.9 mm; stigmas broad-cylindrical, 0.4-0.45-0.52 mm; 12-18 ovules per ovary. **Capsules** 4-6 mm. 2*n* = 38.

Flowering mid-April to early July. River floodplains, estuary beaches, marl bogs, fens, salt marshes, and meadows; calcareous substrate. 119-2805 m; North American endemic. France: St. Pierre and Miquelon; Canada: Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., P.E.I., Que., Sask., Yukon; U.S.A.: 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.

Salix candida is geographically wide ranging but limited to calcareous habitats and for that reason it is quite local or even rare in many parts of its range. Its hybrids are easily recognized and often collected. This is largely due to the conspicuous woolly indumentum that often appears discordantly on leaves, stems, and catkins. Intermediates often have ovaries that are woolly in patches, usually only on the beaks. The second parent is often difficult to determine.

Salix bebbiana × *S. candida* (*S.* ×*cryptodonta* Fernald). See *S. bebbiana*.

Salix candida × *S. discolor* reported by Fernald (1950), but unconfirmed.

Salix candida × S. *eriocephala* (*S.* ×*rubella* Bebb ex C. K. Schneider) is discussed (as *S. candida* × *S. cordata* Muhl.) by Rowlee and Wiegand (1896). The hybrids combine the characters of the parents in a variety of ways. Even when a specimen may resemble one parent more than the other usually there are discordant characters that indicate hybridity. They note that the buds of the hybrids generally are shorter, more divergent and more blunt than in *S. eriocephala* and vary from glabrous to hairy. This hybrid is known from New York and Newfoundland; it should be expected throughout the sympatric range of the parental species.

Salix candida × *S. petiolaris*. Intermediates between these species are known from Michigan and New York (Rowlee and Wiegand 1896) as well as Ontario and Saskatchewan but it can be expected wherever the two grow in close proximity.

The glabrescent form of *Salix candida*, f. *denudata* (Andersson) Rouleau, may be of hybrid origin.

Salix caprea L. Sp. pl. 2: 1020. 1753. ● Goat willow, hoary willow

Tall shrubs or trees 8-15 m. **Stems, branches** brownish, pubescent or glabrescent; **branchlets** yellow- or gray-brown, sparsely to densely villous, velvety, or pubescent; **bud** gradation *caprea*-type. **Leaves, stipules** on first leavers minute rudiments, on later leaves foliaceous; apices acute or convex; **petioles** convex to flat adaxially, 7-25 mm, adaxial surfaces tomentose or glabrescent; **juvenile leaves** yellowish green, abaxial surfaces densely tomentose, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** narrowly elliptic, broadly elliptic, oblanceolate, obovate, or broadly oblong, 50-130 × 25-80 mm, length-width ratio 2-3; bases slightly decurrent, cuneate, or convex; margins slightly revolute, entire, crenate, or undulate, glands submarginal or epilaminal; apices acuminate or convex; abaxial surfaces glaucous, sparsely tomentose or pubescent, hairs erect, white, wavy; adaxial surfaces dull or shiny, sparsely pubescent, hairs white. **Catkins** flowering before leaves emerge; **staminate** subglobose or globose, 16-39 × 12-30 mm, flowering branchlets 0-3 mm; **pistillate** densely flowered, stout or subglobose, 27-64 × 10-25 mm, flowering branchlets 0-7 mm; **floral bracts** dark brown or black, 2-4 mm, abaxial surfaces hairy all over, hairs straight, white; apices acute or rounded, entire. **Flowers, staminate** adaxial nectaries oblong or square, 0.38-0.73 mm; anthers yellow, ellipsoid or short-cylindrical, 0.7-1.1 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong, narrowly oblong, or square, 0.4-0.9 mm, shorter than stipes; stipes 2-2.5 mm; ovaries pyriform, densely short-silky, hairs flattened; styles 0.3-0.6 mm; stigmas broad- or slender-cylindrical, 0.4-0.55-0.6 mm; 6-12 ovules per ovary. **Capsules** 6-12 mm. 2*n* = 38.

Introduced and sometimes naturalized. Canada: Ont.; U.S.A.: Ala., Ark., Conn., Del., D.C., Ill., Md., Mich., Nebr., N.C., N.Y., Ohio, Pa. Europe.

Salix caroliniana Michaux, Fl. bor.-amer. 2: 226. 1803 Carolina willow, coastal plain willow

Salix longipes var. *venulosa* (Andersson) C. K. Schneider; *S. longipes* var. *wardii* (Bebb) C. K. Schneider; *S. nigra* var. *longipes* (Shuttlw. ex Andersson) Bebb

Trees 5-10 m. **Stems, branches** somewhat brittle at base, gray- to red-brown, glabrous or villous or tomentose; **branchlets** yellow- to red-brown, glabrous, sparsely or very densely villous or tomentose. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, apex convex to acute; **petioles** (3-) 4.5-14 (-22) mm, with spherical glands at distal end, adaxial surface tomentose or pilose; **juvenile leaves** abaxial surface glabrous, or moderately densely tomentose or silky, hair white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** lorate or lanceolate to narrowly so, (50-) 75-115 (-220) × 10-22 (-35) mm, 5-10 times as long as wide; base convex or cuneate, uncommonly rounded to cordate, margins flat, serrate or serrulate, apex acuminate, acute, or caudate, abaxial surface glabrous or sparsely tomentose on midribs, hair white and/or ferruginous, wavy, adaxial surface highly glossy, glabrous or pilose, hair white and/or ferruginous. **Catkins**, **staminate** 28-97 × 5-11 mm, flowering branchlet 4-25 mm; **pistillate** 33-93 × 7-15 mm, flowering branchlet 3-35 mm; **floral bracts** 1-3 mm, abaxial surface sparsely hairy all over, hair wavy, apex acute or rounded, entire or erose. **Flowers, staminate:** abaxial nectary 0.25-0.53 mm, adaxial nectary oblong to narrowly so, 0.3-0.6 mm, abaxial and adaxial nectaries distinct; stamens 4-7; anthers 0.4-0.6 mm; filaments distinct or connate less than half, hairy at base; **pistillate** adaxial nectary oblong, square, or ovate, 0.3-0.73 mm, shorter than stipe; stipe 1.3-5.3 mm; ovary pyriform to obclavate, slightly bulged below styles, styles connate or slightly distinct at distal ends, 0.12-0.24 mm; with flat,

non-papillate abaxial surface and rounded tip, 0.16-0.2-0.28 mm; 12-16 ovules per ovary. **Capsules** 4-6 mm.

Flowering in the south from December to early May, and northward from mid-April to early June. Alluvial woods on floodplains of rivers and streams, swamps, hammocks, marshes, wet interdunal depressions, rocky or gravelly streambeds, and along ditches and canals. Generally on calcareous substrates; 6-520 m; U.S.A.: Ala., Ark., D.C., Fla., Ga., Ill., Ind., Kans., Ky., La., Md., Miss., Mo., N.J., N.C., Ohio, Okla., Pa., S.C., Tenn., Tex., Va., W.Va.; Mexico (Nuevo Leon); West Indies (Cuba); Central America (Guatemala).

Salix amygdaloides × *S. caroliniana.* See *S. amygdaloides*.

Salix caroliniana × *S. nigra* is characterized by short stipes (generally less than 1.3 mm) and glaucous leaves. It probably occurs wherever the two parents come into contact. In the Southeastern United States it occurs from northern Florida to West Virginia and Maryland with intergradation mainly on the Atlantic Coastal Plain from northern Florida and southern Georgia (1986a).

Salix cinerea L. Sp. pl. 2: 1021. 1753. ● Large gray willow, gray willow

Tall shrubs 3-7 m. **Stems, branches** brownish, pilose, villous, or tomentose to glabrescent; **branchlets** yellow-brown, pilose or densely villous, hairs straight, wavy, or curved; **bud** gradation of *caprea*-type. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, apices acute or rounded; **petioles** convex to flat adaxially, 4-15 mm, adaxial surfaces tomentose; **juvenile leaves** yellowish green, abaxial surfaces sparsely to densely tomentose, hairs white; **proximal leaves** entire; **largest medial blades** elliptic, broadly elliptic, oblanceolate, or obovate, 65-105 × 22-52 mm, length-width ratio 2-3; bases convex, cuneate, or slightly decurrent; margins slightly revolute, entire, crenate, or undulate, glands submarginal; apices acuminate or convex, angles < 90^{o}; abaxial surfaces glaucous, tomentose, hairs erect or spreading, white, curly; adaxial surfaces dull or shiny, pubescent or tomentose, hairs white. **Catkins** flowering before leaves emerge; **staminate** stout or subglobose, 26-39 × 12-26 mm, flowering branchlets 0-5 mm; **pistillate** densely flowered, stout or subglobose, 27-54(to 75 mm in fruit) × 4-15 mm, flowering branchlets 1-5(-10) mm; **floral bracts** dark brown, black, or bicolor, 2-3 mm, abaxial surfaces hairy all over, hairs straight; apices acute or obtuse, entire. **Flowers, staminate** adaxial nectaries oblong or ovate, 0.5-1 mm; anthers yellow or purple becoming yellow, ellipsoid or short-cylindrical, 0.7-1 mm, filaments distinct, glabrous, hairy at bases; **pistillate** adaxial nectaries oblong or square, 0.4-0.95 mm, shorter than stipes; stipes 1.2-2.7 mm; ovaries pyriform, long-silky; styles 0.2-0.5 mm; stigmas broad-cylindrical, 0.3-0.6 mm; 12 ovules per ovary. **Capsules** 5-5.6 mm. 2*n* = 76.

Introduced and naturalized; Canada: B.C. (?), Ont.; U.S.A.: Ala., D.C., Ga., Iowa, Ky., La., Md., Mass., Mich., Mo., N.C., N.Y., Ohio (?), Pa., R.I., S.C., S.Dak., Tenn., Utah, Va., W.Va., Wis. Eurasia.

See *Salix atrocinerea.*

Salix cordata Michaux, Fl. bor.-amer. 2: 225. 1803. ● Heart-leaf willow, sand dune willow
Salix adenophylla Hooker; *Salix syrticola* Fernald

Low shrubs to tall shrubs 0.4-3 m; often forming colonies by layering or stem fragmentation. **Stems, branches** flexible to somewhat brittle at bases, red-brown, shiny, tomentose or glabrescent; **branchlets** red-brown, moderately to very densely villous; **buds** of the *alba*-type. **Leaves, stipules** foliaceous, apices acute or rounded; **petioles** shallowly grooved adaxially, 1-13 mm, adaxial surfaces tomentose; **juvenile leaves** yellowish green, abaxial surfaces villous or long-silky on midrib, hairs white; **proximal leaves** entire or serrulate; **largest medial blades** narrowly oblong, narrowly elliptic,

elliptic or broadly elliptic, 47-88 × 13-45 mm, length-width ratio 1.6-3.2; bases cordate, rounded, or convex, angles < 90°; margins flat or slightly revolute, serrulate or spinulose-serrulate, apices acuminate, angles < 90°; abaxial surfaces not glaucous, moderately densely villous to glabrescent, midrib remaining hairy, hairs straight or wavy; adaxial surfaces dull or shiny, very densely villous to glabrescent, midrib remaining hairy. **Catkins** flowering as leaves emerge; **staminate** 17-40 × 8-15 mm, flowering branchlets 1-8 mm; **pistillate** moderately densely flowered, stout or slender, 27-65 × 8-19 mm, flowering branchlets 3-16 mm; **floral bracts** brown, 1-2.6 mm, abaxial surfaces hairy all over, hairs straight or wavy; apices acute or rounded, entire. **Flowers, staminate** adaxial nectaries oblong narrowly or oblong, 0.3-1.25 mm; anthers yellow, ellipsoid or short-cylindrical, 0.6-0.8 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries oblong or narrowly oblong, 0.4-1.3 mm, about same length as stipes; stipes 0.5-1.4 mm; ovaries pyriform or obclavate, glabrous; styles 0.7-1.6 mm; stigmas two plump lobes, 0.2-0.3-0.36 mm; 11-24 ovules per ovary. **Capsules** 3.6-7 mm. 2*n* = 38.

Flowering mid-April to early July. Sand dunes and beaches; 0-185 m; North American endemic. Canada: Lab., Nfld., Ont., Que.; U.S.A.: Ill., Ind., Mich., N.H. (?), N.Y., Wis.

Some floras (Fernald 1950, Seymour 1982) recognize var. *abrasa* Fernald as belonging to *S. cordata* Michx. The type of this variety, however, is *S. eriocephala* Michx. (*S. rigida* Muhl., *S. cordata* Muhl.).

Plants with leaves weakly glaucous abaxially may be hybrids with *Salix eriocephala*.

Salix discolor Muhlenberg, Ges. Naturf. Freunde Berlin II. 4: 234. 1803. ● Pussy willow, large pussy willow

Salix ancorifera Fernald; *Salix discolor* var. *latifolia* Andersson, *Salix discolor* Muhlenberg var. *overi* C. R. Ball; *Salix discolor* (var.) *prinoides* (Pursh) Andersson; *Salix discolor* var. *rigidior* (Andersson) C. K. Schneider; *Salix prinoides* Pursh

Tall shrubs 2-4(-8) m; sometimes forming colonies by stem fragmentation. **Stems, branches** dark red-brown or yellowish, villous or glabrescent, sometimes glaucous; **branchlets** yellowish, red-, or yellow-brown, or dark brown, moderately densely velvety or tomentose to glabrescent, hairs wavy, crinkled or geniculate; **bud** gradation of *caprea*-type. **Leaves, stipules** on first leaves minute rudiments, on later leaves foliaceous, sometimes early deciduous, apices acute to acuminate; **petioles** convex to flat adaxially, 6-17 mm, adaxial surfaces tomentose; **juvenile leaves** reddish or yellowish green, abaxial surfaces pilose, tomentose or moderately densely short-silky, hairs white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** narrowly elliptic, elliptic, oblanceolate, or obovate, 30-80(-135) × 12-33 mm, length-width ratio (2.3-)3-3.5(-4.5); bases convex, cuneate, or slightly decurrent; margins flat, crenate, irregularly toothed, undulate, or entire; apices acute, convex, or acuminate; abaxial surfaces glaucous, glabrous, pilose, sparsely pubescent or long-silky, midrib glabrous or densely pubescent, hairs white and ferruginous or white, wavy; adaxial surfaces dull or shiny, glabrous or pilose, hairs white, or rarely ferruginous. **Catkins** flowering before leaves emerge; **staminate** stout or subglobose, 23-52 × 12-22 mm, flowering branchlets 0-3 mm; **pistillate** densely flowered (loose in fruit), slender or stout, 25-108 (to 115 mm in fruit) × 12-33 mm, flowering branchlets 0-10 mm; **floral bracts** brown, black, or bicolor, 1.4-2.5 mm, abaxial surfaces hairy all over, hairs straight, apices acute or obtuse, entire. **Flowers, staminate** adaxial nectaries oblong, 0.6-1.1 mm; anthers yellow or purple becoming yellow, ellipsoid, short-, or long-cylindrical, 0.5-1 mm, filaments distinct, glabrous, hairy at bases; **pistillate** adaxial nectaries oblong or ovate, 0.7-1.3 mm, shorter than stipes; stipes 2-2.7 mm; ovaries obclavate or pyriform, short-silky, hairs flattened; styles 0.3-1 mm; stigmas slender-cylindrical, 0.48-0.64-0.72 mm; 6-16 ovules per ovary. **Capsules** 6-11 mm. 2*n* = 76, 95, 114.

Flowering early-April to late-May. Marshy margins ponds, creeks, and open alluvial woods, fens, seepage areas; peaty substrate; 5-2440 m; North American endemic. Canada: Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., P.E.I., Que., Sask.; U.S.A.: Conn., Del., Ill., Ind., Iowa, Ky., Maine, Md., Mass., Mich., Minn., Mo., Mont., N.H., N.J., N.C., N.Dak., N.Y., Ohio, Pa., R.I., S.Dak., Vt., Va., W.Va., Wis., Wyo.

Salix ×*conifera* Wang. (*S. discolor* × *S. humilis*) is intermediate having the tomentose leaves of *S. humilis* and the longer catkins and styles of *S. discolor*. *Salix discolor* var. *latifolia* is probably a synonym.

Salix ×*pedunculata* Fernald (*S. discolor* × *S. pellita*) is characterized by juvenile leaves with infolded or, sometimes, revolute margins, ovaries with patchy indumentum composed of short, flattened, crinkled, refractive hairs, and catkins borne on distinct flowering branchlets 2-10 mm long. This sporadic hybrid does not appear to be fertile. It occurs in Newfoundland, Labrador and adjacent Quebec, but is not known from our area. It is, however, likely to be more common than this suggests and it could be expected wherever the two species grow together. The type material and other collections compare very well with synthetic hybrids between these two species (Mosseler 1990). He had limited success with these synthetic hybrids; seed set and F_1 viability was low. According to Floderus (1939: 35) *S.* ×*pedunculata* is the cross *S. myricoides* × *S. planifolia*. It is not possible to rule out either *S. planifolia* or *S. myricoides* as parents of similar wild hybrids. *Salix* ×*pellicolor* Lepage is a synonym.

Salix ×*laurentiana* Fern. (putative *S. discolor* × *S. myricoides*). See *Salix myricoides.*

Salix eriocephala Michaux, Fl. bor.-amer. 2: 225. 1803 ● Missouri willow, diamond willow, heart-leaf willow

Salix cordata Muhlenberg non Michaux; *Salix cordata* var. *abrasa* Fernald; Salix cordata var. rigida (Muhl.) Boivin; *Salix missouriensis* Bebb; Salix myricoides var. angustata (Pursh) Dippel; *Salix rigida* Muhl.; *Salix rigida* var. *angustata* (Pursh) Fernald; *Salix rigida* var. *vestita* (Andersson) C. R. Ball

Tall or mid shrubs 0.2-6 m; sometimes forming colonies by stem fragmentation. **Branches** flexible or highly brittle at bases, red-brown, glabrous or glabrescent; **branchlets** yellow- to red-brown, pilose, moderately to very densely velvety, pubescent, or villous. **Leaves, stipules** foliaceous, apices rounded or acute; **petioles** shallowly grooved adaxially, 3-18 mm, adaxial surfaces tomentose; **juvenile** reddish or yellowish green, abaxial surfaces glabrous, pilose, or villous; **proximal leaves** entire or shallowly serrulate; **largest medial blades** narrowly oblong, very narrowly elliptic, narrowly elliptic, or obovate, 58-135 × 9-36 mm, length-width ratio 2.3-8; bases cordate, convex, rounded, or subcordate, sometimes cuneate, angles < 90°; margins flat, serrate or serrulate; apices acute to acuminate, angles < 90°; abaxial surfaces glaucous, glabrous, puberulent, sparsely pubescent or short-silky, hairs straight or wavy, adaxial surfaces dull or shiny, glabrous or sparsely villous, hairs white or white and ferruginous. **Catkins** flowering just before or as leaves emerge {{are sexes different?}}; **staminate** slender or stout, 19-44 × 7-14 mm, flowering branchlets 0.5-5 mm; **pistillate** densely or moderately densely flowered, slender or stout, 22-65 × 7-14 mm, flowering branchlets 2-10 mm; **floral bracts** dark brown or bicolor, 0.8-1.6 mm, abaxial surfaces hairy all over, hairs wavy; apices rounded, entire. **Flowers, staminate** adaxial nectaries narrowly oblong, oblong, or ovate, 0.2-0.75-1 mm; anthers yellow or purple becoming yellow, ellipsoid or short-cylindrical, 0.4-0.64 mm, filaments distinct or connate less than half, glabrous; **pistillate** adaxial nectaries oblong or flask-shaped, 0.3-0.8 mm, shorter than stipes; stipes 1.2-2.8 mm; ovaries pyriform, glabrous; styles 0.3-0.6 mm; stigmas two plump lobes, 0.16-0.2-0.28 mm; 12-16 ovules per ovary. **Capsules** 3.5-7 mm.

Flowering early April to mid-June. Gravelly or rocky river and stream banks, in marshy fields, and in mixed mesophytic woods on alluvium; 0-1220 m; North American endemic. Canada: Man., N.B., Nfld., N.S., Ont., P.E.I., Que., Sask.; U.S.A.: Ala., Ark., Conn., Del., D.C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., Maine, Md., Mass., Mich., Minn., Mo., Nebr., N.H., N.J., N.Dak., N.Y., Ohio, Pa., R.I., S.Dak., Tenn., Vt., Va., W.Va., Wis.

Some floras (Fernald 1950, Seymour 1982) use the name *Salix rigida*, which. was replaced by *S. eriocephala* (Argus 1980). The variations described by the narrow-leaved, var. *angustata*, and leaves with hairy midribs and petioles, f. *mollis* (Palmer & Steyermark) Fernald, are within the normal range of variation for the species.

Salix eriocephala × *Salix petiolaris* are generally intermediate between the two parents. Clear evidence of hybridization, based on synthetic hybrids made by A. Mosseler (1990), can be seen in its variably hairy ovaries. The ovaries may be sparsely hairy all over (except for bare patches near the proximal ends), or they may appear as patches at the proximal or distal ends; in age they may be very sparsely hairy or glabrescent. They resemble *S. eriocephala* in branchlets red-brown and inner bud membranes free and separating and *Salix petiolaris* in loosely-flowered pistillate catkins. Plants identified as *S. petiolaris* but with small, foliaceous stipules probably are this hybrid.

Salix eriocephala × *S. sericea* is relatively common wherever the two taxa overlap. Hybrids were studied in the southeastern United States (Argus 1998) and in eastern Canada. Putative hybrids often are misidentified as *S. eriocephala* but on closer examination will show evidence of hybridization. The leaves are sparsely to moderately densely short-silky on the abaxial surfaces suggesting *S. sericea*; the ovaries are not completely glabrous, as in *S. eriocephala*, but have hairs on the beak or, if hairy all over, then with glabrous patches near the bases; stipules may be foliaceous even on the first leaves, as in *S. eriocephala*, but they are not as large (in *S. sericea* stipules generally are lacking or rudimentary); and the petioles and branchlets are finely velvety as in *S. sericea*. In general the plants combine characters of the two parents. Morphological characters that can be used to separate these species are given in Table 1.

Table 1. Morphological characters separating *Salix eriocephala* and *S. sericea*

	Salix eriocephala	*Salix sericea*
Stipules	foliaceous	on first leaves absent or minute rudiments, later leaves minute rudiments or foliaceous
-length mm	4-6.2-8.3	1.1-1.6-2.1
-width mm	2.5-3.6-4.6	0.4-0.6-0.8
-L/W	1.5-1.8-2	2.3-2.8-3
Leaves abaxially	glabrous or sparsely silky	densely silky
Ovaries	glabrous	densely short-silky
Leaf base	convex to cordate	cuneate to convex
Juvenile leaves	glabrous or sparsely hairy	very densely short-silky
Ovule # per ovary	12-16	6
Styles	0.3-0.6 mm	0.2-0.4 mm
Stipes	1.2-2.8 mm	0.6-1.5 mm
Pist. fl. branchlets	2-10 mm	1-3 mm
Capsules	3.5-7 mm	2.5-4 mm

A morphological and molecular study of hybridization and introgression between *S. eriocephala* and *S. sericea* (Hardig et al. 2000) revealed complex morphological variation. The morphological data they employed, however, included only stipule characters and, the precisely measured, density of hair

on the abaxial leaf surfaces. Their conclusion that, "... 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" generally is correct; but they did not use other evidence of hybridization, such as ovary hairiness patterns, etc. that could have been used to minimize errors in identification.

Salix fragilis L. Sp. pl. 2: 1017. 1753. ● Crack willow.

Trees 3-15 (-20) m, sometimes forming colonies by stem fragmentation. **Stems**, **branches** highly brittle at bases, yellow-, gray-, or red-brown, glabrous or glabrescent; **branchlets** olive-brown, yellow-green, or red-brown, pilose, sparsely pubescent, or densely long-silky or velvety to glabrescent. **Buds** of *alba*-type. **Leaves, stipules** first leaves minute rudiments, on later leaves foliaceous, stipules early deciduous, apices acuminate; **petioles** shallowly grooved adaxially or deeply grooved adaxially, 4.4-20 mm, with pairs or clusters of stalked spherical or foliaceous glands at distal ends, adaxial surfaces glabrous or puberulent; **juvenile blades** yellowish green or reddish, abaxial surfaces glabrous, pubescent, or moderately densely silky; **largest medial blades** amphistomatous or hypostomatous; lanceolate, narrowly oblong, or very narrowly elliptic, 70-150(-180) × 13-30 mm, length-width ratio 3.5-7.5; bases convex or slightly decurrent; margins flat, irregularly or uniformly serrate; apices acuminate or caudate; abaxial surfaces glaucous, usually glabrous but sometimes very sparsely silk-hairy, hairs appressed, white, straight or wavy; adaxial surfaces shiny or highly glossy, glabrous. **Catkins** flowering as leaves emerge; **staminate** slender or stout, 29-63 × 8-11 mm, flowering branchlets 3-12 mm; **pistillate** loosely flowered, slender, 37-80 × 4-10; flowering branchlets 8-20 mm; **floral bracts** tawny or greenish,1-3 mm, abaxial surfaces sparsely hairy all over, hairs straight; apices acute or rounded, entire or erose; pistillate bracts deciduous in fruit. **Flowers, staminate** abaxial nectaries (0.25-)0.5-0.88 mm; adaxial nectaries oblong, 0.3-0.63 mm, abaxial and adaxial nectaries distinct; anthers yellow, ellipsoid or short-cylindrical, 0.4-0.7 mm, filaments distinct or connate less than half, hairy on lower halves; **pistillate:** adaxial nectaries oblong or square, 0.3-0.63 mm, shorter than stipes; stipes 0.5-1.5 mm; ovaries obclavate, beaks gradually tapering to style or slightly bulged below style, glabrous; styles 0.5-0.8 mm; stigmas flat with rounded tips, lobes 0.2-0.4 mm; 8-10 ovules per ovary. **Capsules** 4-5 mm. $2n = 38$?, 76, 114.

Rarely introduced or naturalized; Canada: Alta., N.B., Nfld., Ont., Que.; U.S.A.: Conn., D.C., Ill., Iowa, Kans., Ky., Maine, Md., Mass., Mich., Minn., Nebr. (not verified), N.H., N.Y., Pa., R.I., Utah, Vt., Va., Wash. (Jacobson 95), W.Va., Wis. (range incompletely known). Europe.

Salix fragilis is poorly understood in North America. Although it apparently is uncommonly cultivated there are many references to it in the literature. Most of them, however, are attributable to the commonly cultivated and widely naturalized *S.* ×*rubens* (*S. alba* × *S. fragilis*). See the hybrid for further comments.

Salix humilis Marshall, Arbust. amer. 140. 1785 ● Prairie willow, gray willow, small pussy willow, upland willow

Low to mid shrubs forming colonies by layering. **Stems**, **branches** dark red-brown, not glaucous or weakly so; **branchlets** not glaucous or weakly so, moderately to very densely villous, tomentose, or velvety-tomentose to glabrescent, hairs straight, wavy, or curved; **bud** gradation of transitional type. **Leaves, petioles** convex to flat or shallowly grooved adaxially; **juvenile blades** yellowish green, abaxial surfaces densely tomentose or glabrescent, hairs white or white and ferruginous; **largest medial blades** bases cuneate, convex, or slightly decurrent, angles < 90°; margins entire, crenate, or undulate, glands submarginal; apices acuminate or convex, angles < 90°; abaxial surfaces glaucous, sparsely to densely tomentose or woolly, hairs erect or spreading, wavy. **Catkins** flowering before

leaves emerge; **staminate** and **pistillate** moderately to very densely flowered, stout, subglobose, or globose, **floral bracts** brown, black, or bicolor, abaxial surfaces moderately densely hairy all over, hairs white, straight or wavy; apices rounded or acute, entire. **Flowers, staminate** adaxial nectaries oblong or square, 0.2-0.7 mm; anthers purple becoming yellow, ellipsoid or cylindrical, 0.4-0.6 mm, filaments distinct; **pistillate** adaxial nectaries square, 0.4-0.75 mm, shorter than stipes; stipes 1-2.5 mm; ovaries obclavate or pyriform, valves recurved in fruit, moderately densely to sparsely, short-silky-villous, hairs flattened (refractive); styles 0.2-0.44 mm; stigmas slender-cylindrical.

1. Leaves stipulate; leaf blades (20-)50-90(-135) mm; petioles (1.5-)3-7(-12) mm; staminate catkins 14.5-34 mm; pistillate catkins usually longer than 20 mm. .....……. *Salix humilis* var. *humilis*
1. Leaves not stipulate; leaf blades (13-)20-50(-70) mm; petioles 0.5-3(-6) mm; staminate catkins 6.5-13.5 mm; pistillate catkins usually shorter than 20 mm. .....…….. *Salix humilis* var. *tristis*

Salix humilis Marshall var. **humilis** ● Prairie willow
Salix humilis Marshall var. *hyporhysa* Fernald; *Salix humilis* Marshall var. *keweenawensis* Farwell; *Salix humilis* var. *rigidiuscula* (Andersson) Robinson & Fernald

Mid shrubs 0.3-3 m. **Stems** erect (sometimes decumbent), **branches** tomentose to glabrescent; **branchlets** red-brown or greenish brown. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves foliaceous or rarely minute rudiments, sometimes early deciduous, apices acute; **petioles** (1.5-)3-7(-12) mm, adaxial surfaces velvety or pilose, **proximal blades** entire or serrulate; **largest medial blades** narrowly oblong, narrowly elliptic, elliptic, oblanceolate, obovate, or broadly obovate, (20-)50-90(-135) × (7-)13-23(-35) mm, length-width ratio 2.3-4-7.5; margins strongly revolute to flat; abaxial surfaces hairs white, rarely white and ferruginous; adaxial surfaces shiny or highly glossy, glabrous, pubescent, or pilose, hairs white or white and ferruginous. **Catkins, staminate** 14.5-34 × 7-19 mm, flowering branchlets 0 mm; **pistillate** 9-47 (to 55 mm in fruit) × 5.5-19 mm, flowering branchlets 0-4 mm; **floral bracts** 1.2-2 mm. **Flowers, staminate**, filaments glabrous; **pistillate**; ovaries obclavate, stigma lobes 0.24-0.33-0.56 mm; 6-12 ovules per ovary. **Capsules** 7-12 mm. 2*n* = 38 or 76.

Flowering early March to early June in north, late January to late April in south. Dry mixed woods and forests, *Picea mariana* - lichen woods, *Picea glauca – Abies balsamea* forests, wet to dry prairies, grassy balds, loess bluffs, sandy river terraces, coastal barrens, *Carex – Typha* meadows; fine sand to rocky granitic, gneissic, limestone, and serpentine substrates; 20-1640 m; North American endemic. Canada: Lab., Man., N.B., Nfld., N.S., Ont., P.E.I., Que.; U.S.A.: Ala., Ark., Conn., Del., D.C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Mass., Mich., Minn., Miss., Mo., Nebr., N.H., N.J., N.C., N.Dak., N.Y., Ohio, Okla., Pa., R.I., S.C., Tenn., Tex., Va., W.Va., Wis.

Salix ×*conifera* Wangenh. (*Salix discolor* × *S. humilis*). See *Salix discolor*.

Salix humilis Marshall var. **tristis** (Aiton) Griggs, Proc. Ohio Acad. Sci. 4: 301. 1905 ● Dwarf prairie willow
Salix tristis Aiton, Hort. kew. 3: 393. 1789; *Salix humilis* Marshall var. *microphylla* (Andersson) Fernald

Low to mid shrubs 0.3-1 m. **Stems** decumbent, **branches** tomentose; **branchlets** yellow-brown. **Leaves, stipules** absent; **petioles** 0.5-3(-6) mm, adaxial surfaces velvety or villous; **proximal blades** entire; **largest medial blades** narrowly oblong, narrowly elliptic, oblanceolate, or obovate, (13-)20-50(-70) × 3-13 mm, length-width ratio 2.25-9; margins strongly revolute; abaxial surfaces hairs gray; adaxial surfaces shiny, moderately densely tomentose, hairs gray. **Catkins, staminate** 6.5-13.5 × 5-10 mm, flowering branchlets 0-1 mm; **pistillate** 11-17.5 × 5.5-12 mm, flowering branchlets 0-1.5 mm;

floral bracts 0.8-1.4 mm. **Flowers, staminate**, filaments glabrous or hairy at least at bases; **pistillate** ovaries pyriform; stigmas 0.2-0.24-0.32 mm; 6 ovules per ovary. **Capsules** 5-9 mm.

Flowering mid-April to mid-May. Moist limestone and serpentine barrens, open heath balds, open pine woods, moist prairies, swampy places in open deciduous woods, and along stream banks; 60-80 m small sample; North American endemic. Ark., Conn., Del., D.C., Ga., Ill. (?), Ind. (?), Kans., Ky., La., Maine, Md., Mass., Mich., Minn., Miss., Mo., Nebr., N.H., N.J., N.C., N.Y., Ohio, Okla. (?), Pa., R.I., S.C., Tenn., Va., W.Va., Wis.

Salix interior Rowlee, Bull. Torr. Bot. Club 27: 253. 1900 ● Sandbar willow

Salix exigua var. *exterior* (Fernald) C.F. Reed; *Salix exigua* subsp. *interior* (Rowlee) Cronquist; *Salix exigua* var. *pedicellata* (Andersson) Cronq.; *Salix exigua* var. *sericans* (Nees) Nesom; Salix *fluviatilis* var. *sericans* (Nees) Boivin; *Salix interior* var. *exterior* Fernald; *Salix interior* var. *pedicellata* (Andersson) C. R. Ball; *Salix interior* var. *wheeleri* Rowlee; *Salix longifolia* Muhl. non Lam.; *Salix longifolia* var. *interior* (Rowlee) M.E. Jones; *Salix longifolia* (var.) *pedicellata* Andersson; *Salix longifolia* var. *sericans* Nees; *Salix longifolia* var. *wheeleri* (Rowlee) C. K. Schneider; *Salix wheeleri* (Rowlee) Rydb.

Shrubs or trees 4-6 m, forming colonies by root shoots. **Stems**, **branches** flexible at bases, gray- or red-brown, glabrous or sometimes villous to glabrescent; **branchlets** yellow- or red-brown, sparsely to very densely tomentose or villous to glabrescent. **Buds** of *alba*-type. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous; **petioles** 1-5 (-9) mm, adaxial surfaces glabrous or sparsely villous; **juvenile blades** reddish or yellowish green, abaxial surfaces moderately densely to sparsely long-silky, hairs white; **largest medial blades** linear or lorate, 60-160 × 4-11 mm, length-width ratio (6.5-)11-19(-31); bases cuneate to slightly decurrent; margins flat, remotely spinulose-serrulate, glands submarginal; apices acute or acuminate; abaxial surfaces very thinly glaucous, sparsely to moderately densely villous or long-silky to glabrescent, hairs appressed, white, straight, short; adaxial surfaces shiny, pilose or moderately densely villous to glabrescent. **Catkins** flowering as leaves emerge or throughout the season, sometimes branched; **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 wavy; apices 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; anthers yellow, ellipsoid or short-cylindrical, 0.4-0.7 mm, filaments distinct, hairy on lower halves; **pistillate** adaxial nectaries narrowly oblong, 0.4-1.1 mm, shorter than or equal to stipes; stipes 0.5-0.8 mm; ovaries obclavate or pyriform, beaks abruptly tapering to style, sparsely long-silky or glabrescent; styles connate to free about half their lengths, 0-0.2 mm; stigmas broad-cylindrical, 0.32-0.38-0.72 mm; 6-36 ovules per ovary capsules 6-10 mm.. $2n = 38$.

Flowering early May to early July. Riparian sand bars and shores, wet meadows; 15-1770 m; North American endemic. Canada: Alta., B.C., Man., N.B., N.T., Ont., Que., Sask., Yukon; U.S.A.: [Ala?] Alaska, Ark., Colo., Conn. (N. Murray, pers. comm.), 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).

Salix ×jesupii Fernald, Rhodora 48: 38. 1946

(*Salix. alba* L.× *S. lucida* Muhl.), S. ×*ehrhartiana* (*S. alba* × *S. pentandra*) auct. non G. Meyer

Tall shrubs or trees 4-8 m, sometimes forming colonies by stem fragmentation. **Stems**, **branches** somewhat brittle at bases, red-brown or brownish, shiny, glabrous; **branchlets** yellow- or red-brown,

sparsely short-silky to glabrescent; **bud** gradation of *alba*-type. **Leaves, stipules** on first leaves minute rudiments, on later leaves foliaceous or minute rudiments, stipules early deciduous, apices acute or acuminate; **petioles** 6-14 mm, leaf length-petiole length ratio 8.7-11.7-18, with pairs or clusters of spherical or sometimes foliaceous glands at distal ends, adaxial surfaces short-silky; **juvenile blades** yellowish green or reddish, abaxial surfaces very densely long-silky, hairs white and ferruginous; **proximal blades** serrulate or entire; **largest medial blades** amphistomatous; very narrowly elliptic to elliptic (in Europe also oblong, lanceolate, oblanceolate, ovate or obovate (T. Berg 2000), 68-128 × 10-40 mm, length-width ratio 2.8-4.4-8; bases cuneate, convex, or slightly decurrent; margins flat, serrulate or serrate; apices acuminate to caudate; abaxial surfaces glaucous, moderately densely silky to glabrescent, hairs white and ferruginous, straight, short or long; adaxial surfaces shiny, sparsely silky, hairs appressed, white and ferruginous. **Catkins** flowering as leaves emerge; **staminate** stout or slender, 9-14 mm; flowering branchlets 5-16 mm; **pistillate** loosely flowered, slender, 6-12 mm; flowering branchlets 7-22 mm; **floral bracts** tawny, 1.9-3 mm, abaxial surfaces sparsely hairy at proximal ends, hairs straight, apices acute, toothed or entire; pistillate bracts deciduous in fruit. **Flowers, staminate** abaxial nectaries 0.25-0.95 mm; adaxial nectaries square or oblong or narrowly ovate, 0.3-0.88 mm, abaxial and adaxial nectaries distinct or connate and cup-shaped; stamens 2-4; anthers yellow, ellipsoid or short-cylindrical, 0.48-0.83 mm; filaments connate less than half, hairy at bases or lower halves; **pistillate** adaxial nectaries square or ovate, 0.3-0.63 mm, shorter or longer than stipes; stipes 0.32-0.68 mm; ovaries pyriform, glabrous; styles connate to distinct, 0.28-0.52 mm; stigmas two plump lobes or flat with rounded tips, 0.22-0.52 mm; 10-16 ovules per ovary. **Capsules** 3.5-5.5 mm.

Introduced and naturalized; Ont., Que.; Conn., Ill., Mass., N.H., N.Y., Pa., Vt., Wash., Wis.

Salix ×*jesupii* was first described by Bebb (Garden and Forest 8: 423. 1895) as a formula hybrid, *S. alba* × *S. lucida*. Fernald (1946) based his name on Bebb's exsiccatae. It is characterized by leaves glaucous abaxially but with juvenile and mature leaves with white and ferruginous hairs. It was mistaken for *Salix* ×*ehrhartiana* G. Meyer (*S. alba* L. × *S. pentandra* L.) by Argus (1986a). Subsequent study of nectary morphology (Argus, unpublished) confirmed that the North American plants are not the same as the European hybrid. In herbaria, specimens of *S.* ×*jesupii* are variously misidentified as *S. alba*, *S. fragilis*, S. ×*rubens*, or *S. lucida*. A specimen of this hybrid, misidentified as *S. lucida*, was used as a pistillate parent in a synthetic hybridization study (Argus 1974). The reported failure of *S. lucida* to cross with other species in the study should be discounted. The two putative parents generally occur in the same area as the hybrids but plants from Kentucky, Virginia, West Virginia, and Ohio (Braun 1961) are from just outside the range of *S. lucida*. Some of them may be cultivated introductions.

Salix lucida Muhl. Ges. Naturf. Freunde Berlin II. 4: 239. 1803. ● Shining willow.
Pleiarina lucida (Muhl.) N. Chao & G. T. Gong; *Salix lucida* var. *angustifolia* (Andersson) Andersson; *Salix lucida* var. *intonsa* Fernald; *Salix pentandra* var. *lucida* (Muhl.) Kuntze

Tall shrubs or trees 4-6 m, sometimes forming colonies by stem fragmentation. **Stems**, **branches** flexible or somewhat brittle at bases, yellow-, or gray- or red-brown, shiny to highly glossy, glabrous or villous to glabrescent; **branchlets** yellow-, gray- or red-brown, glabrous, pilose, very densely villous or velvety to glabrescent, hairs straight, wavy, or crinkled. **Leaves, stipules** foliaceous, sometimes early deciduous, apices convex to rounded; **petioles** deeply or shallowly grooved adaxially, 5-13 mm, with clusters of spherical or foliaceous glands at distal ends, adaxial surfaces glabrous, pilose, or villous; **juvenile blades** reddish or yellowish green, abaxial surfaces moderately to very densely villous or long-silky to glabrous, hairs white or white and ferruginous; **proximal blades** entire and glandular dotted or shallowly serrulate or crenulate; **largest medial blades** hypostomatous, hemiamphistomatous or sometimes amphistomatous; lorate, very narrowly elliptic, narrowly elliptic, or

lanceolate, (24-) 55-133 × 11-43 mm, length-width ratio 2.5-6.2; bases convex, cuneate, or slightly decurrent; margins flat, serrulate; apices caudate to acuminate; abaxial surfaces not glaucous or rarely so, glabrous, pilose, or moderately densely villous or long-silky, hairs white and ferruginous, straight or wavy, coarse, and caducous; adaxial surfaces shiny or highly glossy, glabrous, pilose, or long-silky, hairs white and/or ferruginous. **Catkins** flowering as leaves emerge; **staminate** 19-69 × 4-15 mm, flowering branchlets 5-23 mm; **pistillate** usually moderately densely flowered to loosely flowered, stout to slender, 23-56 (to 70 mm in fruit) × 8-12 mm, flowering branchlets 8-25 mm; **floral bracts** 1.5-3 mm abaxial surfaces sparsely hairy all over or at proximal ends, hairs wavy or sometimes crinkly; apices rounded or convex, entire, toothed, or erose; pistillate bracts deciduous in fruit. **Flowers, staminate** abaxial nectaries 0.45-1.1 mm; adaxial nectaries square or ovate, 0.3-0.85 mm, abaxial and adaxial nectaries connate and cup-shaped; stamens 3-6; anthers yellow, ellipsoid, short-cylindrical, obovoid, or subglobose, 0.6-0.8 mm, filaments distinct, hairy at bases; **pistillate:** abaxial nectaries absent; adaxial nectaries square or ovate, 0.2-0.45 mm, shorter than stipes; stipes 0.5-2 mm; ovaries pyriform, glabrous; styles 0.5-0.8 mm; stigmas two plump lobes or broad-cylindrical, lobes 0.24-0.31-0.42 mm; 18-24 ovules per ovary. **Capsules** 5-7 mm. 2n = 76.

Flowering from early May to mid-July. Sandy or gravelly floodplains of rivers and streams and lake margins, sedge meadows, vernal pools, alvars, open fens, marl bogs, treed bogs; 3-600 m; North American Endemic. France: St. Pierre and Miquelon. Canada: Lab., Man., N.B., Nfld., N.S., Ont., P.E.I., Que., Sask.; U.S.A.: Conn., Del., Ill., Ind., Iowa, Maine, Md., Mass., Mich., Minn., N.H., N.J., N.Dak., N.Y., Ohio, Pa., R.I., S.Dak., Vt., Va. (naturalized), W.Va., Wis.

Salix alba × *S. lucida. See Salix* ×*jesupii*

Salix myricoides Muhlenberg, Ges. Naturf. Fr. Neue Schr. 4: 235. 1803. ● Blue-leaf willow

Salix cordata Muhlenberg var. *glaucophylla* Bebb; *Salix cordata* Muhlenberg var. *myricoides* (Muhl.) Carey; *Salix glaucophylla* (Bebb) Bebb, non Bess. nec Andersson; *Salix glaucophylla* Bebb var. *albovestita* C. R. Ball; Salix *glaucophylla* (Bebb) Bebb var. *angustifolia* Bebb; *Salix glaucophylla* (Bebb) Bebb var. *brevifolia* Bebb; *Salix glaucophylla* (Bebb) Bebb var. *latifolia* Bebb; *Salix glaucophylloides* Fernald; *Salix glaucophylloides* Fernald var. *albovestita* (C. R. Ball) Fernald; *Salix glaucophylloides* Fernald var. *brevifolia* (Bebb) C. R. Ball; *Salix glaucophylloides* Fernald var. *glaucophylla* (Bebb) C. K. Schneider; *Salix myricoides* Muhlenberg var. *albovestita* (C. R. Ball) Dorn;

Low to tall shrubs 0.25-5 m; sometimes forming colonies by stem fragmentation, or layering. **Stems, branches** flexible or highly brittle at bases, red- or yellow-brown, shiny or highly glossy, sometimes weakly glaucous, glabrous or villous; **branchlets** red- or yellow-brown, glabrous or sparsely to very densely villous, hairs straight, wavy, curved, or geniculate. **Leaves, stipules** on first leaves minute rudiments or foliaceous, on later leaves foliaceous, apices acute or acuminate; **petioles** shallowly grooved or convex to flat adaxially, 3.5-7.3-13 mm, not glandular or occasionally with paired spherical glands at distal ends; adaxial surfaces villous, tomentose, pilose, or pubescent; **juvenile leaves** reddish or yellowish green, translucent, abaxial surfaces glabrous or sparsely pubescent, midrib often very densely hairy, hairs white or white and ferruginous; **proximal leaves** entire or serrulate; **largest medial blades** narrowly oblong, narrowly elliptic, elliptic, or oblanceolate, 35-61.3-110 × 11-16-46 mm, length-width ratio 2-2.7-5.2; bases convex, rounded, subcordate, or cuneate, angles < 90°; margins flat or slightly revolute (thickened and raised), crenulte or serrulate; apices acuminate, acute, or convex, angles < 90°; abaxial surfaces glaucous, glabrous or pilose, midrib pubescent to tomentose, hairs white or white and ferruginous, curved, wavy, or straight; adaxial surfaces shiny, glabrous or pilose, midrib sparsely pubescent, hairs white or white and ferruginous. **Catkins,** pistillate flowering as leaves emerge, staminate flowering before leaves emerge; **staminate** stout or slender, 23.5-35.6-51 × 9-12.7-22 mm, flowering branchlets 1-3.9-10 mm; **pistillate** loosely

flowered, stout or slender, 19-42-62 (to 85 in fruit) × 8-13-18 mm, flowering branchlets 1.5-5.9-13 mm; **floral bracts** brown or bicolor, 1.2-1.8-3 mm, abaxial surfaces hairy all over, hairs straight or wavy; apices rounded or acute, entire or toothed. **Flowers, staminate** adaxial nectaries narrowly oblong, oblong, square, or ovate, 0.44-0.48-1.4 mm; anthers yellow, ellipsoid or globose, 0.52-0.69-0.76 mm, filaments distinct), glabrous; **pistillate** adaxial nectaries oblong, narrowly oblong, square, or flask-shaped, 0.56-0.8-1.4 mm, shorter than stipes; stipes 0.96-1.7-3.4 mm; ovaries pyriform; styles connate or free about half, 0.3-0.8-1.3 mm; stigmas slender-cylindrical or flat with rounded tips, 0.24-0.43-0.56 mm; 12-14 ovules per capsule. **Capsules** 5-7-11 mm.

Flowering early April to early July. Stream and lake shores, gravel river bars, subalpine conifer forests, alkaline fens, sea cliffs, dry limestone talus, swamps, tidal meadows, and sand dunes; 10-1169 m; North American endemic. Canada: N.B., Nfld., Ont., Que.; U.S.A.: Ill., Ind., Maine, Mich., Ohio, Pa., Wis.

Plants with densely villous branchlets and branches have been named *S. myricoides* var. *albovestita* but the two variants sometimes occur together and intergrade. There is a general geographical correlation of var. *albovestita* with sand dunes on the shores of the Great Lakes and on the coast of James Bay.

Many fruiting plants of *S. myricoides* do not appear to set seed. This may be due to hybridization or to the sporadic occurrence of individuals.

Salix ×*laurentiana* Fern. is the putative hybrid *Salix myricoides* × *S. discolor* or possibly *S. humilis*. These plants resemble S. myricoides but have hairy ovaries with the hairs arranged in patches or streaks. They also have the distinctive distinct styles of *S. myricoides* and the more or less entire leaf margins of *S. discolor*. This hybrid is common in the St. Lawrence Valley of Quebec but is not yet known in our area.

Salix nigra Marshall, Arbust. amer. 139. 1785 ● Black willow

Salix nigra var. *falcata* (Pursh) Torr.; *S. nigra* var. *lindheimeri* C. K. Schneider

Trees 5-20 m, sometimes forming colonies by stem fragmentation. **Stems, branches** highly brittle at bases, red- to yellow-brown, glabrous; **branchlets** gray- to red-brown, glabrous or pilose, bud scales margins distinct and imbricate. **Leaves, stipules** on first leaves absent or minute rudiments (often thread-like), on later leaves foliaceous or minute rudiments, early deciduous or deciduous in autumn, apices acuminate, acute, or rounded; **petioles** deeply grooved adaxially; margins, (2-) 3-10 (-15) mm, with spherical glands at distal ends, adaxial surfaces glabrous or pilose; **juvenile leaves** reddish or yellowish green, abaxial surfaces glabrous or pilose on midrib, hairs white or ferruginous; **proximal leaves** serrulate; **largest medial blades** hypostomatous or amphistomatous; linear, lorate, very narrowly elliptic, or lanceolate to narrowly so, (50-) 70-103 (-190) × (6-) 7.5-17 (-23) mm, length-width ratio 6-13; bases cuneate to convex; margins flat, serrulate; apices acuminate, acute, or caudate; abaxial surfaces not glaucous, glabrous or pilose, hairs spreading, wavy, white or white and ferruginous, wavy; adaxial surfaces shiny, glabrous or pilose, along midrib. **Catkins** flowering as leaves emerge; **staminate** slender or stout, 35-83 × 7-13 mm, flowering branchlets 5-35 mm; **pistillate** 23-74 (to 80 mm in fruit) × 5-10 mm, flowering branchlets 6-35 mm; **floral bracts** tawny, 1-3 mm, abaxial surfaces glabrous or sparsely hairy all over, hairs wavy; apices acute to rounded, entire; pistillate bracts deciduous after flowering. **Flowers, staminate** abaxial nectaries 0.3-1 mm; adaxial nectaries oblong to ovate, 0.2-0.63 mm, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped; stamens 4-6; anthers 0.4-0.6 mm, filaments generally distinct, hairy on lower halves or at bases; **pistillate** adaxial nectaries oblong, 0.2-0.53 mm, shorter than stipes; stipes 0.5-1.5 mm; ovaries pyriform to obclavate, glabrous (very rarely pilose); styles 0.1-0.25 mm; stigmas flat with rounded tips or two plump lobes, 0.2-0.28-0.36 mm; 12-16 ovules per ovary. **Capsules** 3-5 mm. 2*n* = 38.

Flowering in the south from early February to early May, and in the north from late March to early July. River margins and floodplains, edges of ponds and lakes, swamps, marshes, white cedar bogs, wet meadows, open fields, and roadside ditches, as well as in mixed upland deciduous woods along rivers; 11-1375 m; North American endemic. Canada: N.B., Ont., Que.; U.S.A.: Ala., Ark., Conn., Del., D.C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Mass., Mich., Minn., Miss., Mo., Nebr., N.H., N.J., N.C., N.Y., Ohio, Okla., Pa., R.I., S.C., Tenn., Tex., Vt., Va., W.Va., Wis.; Mexico (Chihuahua).

Salix amygdaloides × *S. nigra*. See *Salix amygdaloides*.

Salix pedicellaris Pursh, Fl. Am. Sept. 2: 611. 1814 ● Bog willow.

Salix myrtilloides var. *hypoglauca* (Fernald) C. R. Ball; *Salix pedicellaris* var. *hypoglauca* Fernald; *Salix pedicellaris* var. *tenuescens* 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, glabrous or glabrescent; **branchlets** yellow-brown or red-yellow, glabrous or puberulent, hairs straight, minute. **Leaves, stipules** absent or minute rudiments; **petioles** deeply or shallowly grooved adaxially, 3-8 mm; **juvenile blades** reddish or yellowish green, translucent, abaxial surfaces, glabrous or puberulent or sparsely pubescent, hairs white or white and ferruginous; **largest medial blades** narrowly oblong, narrowly elliptic, broadly elliptic, narrowly oblanceolate or oblanceolate, 19-53 (-69) × 5-20 mm, length-width ratio 1.8-4.9; bases convex or rounded; margins flat or slightly revolute, entire; apices acute, convex, or rounded, angles less 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; **staminate** 11-21 × 4-8 mm, flowering branchlets 3-12 mm; **pistillate** loosely flowered, stout or subglobose, 14-37 × 5-14 mm, flowering branchlets 7-25 mm; **floral bracts** tawny or light rose, 0.8-1.6 mm, abaxial surfaces very sparsely hairy mainly at distal ends, hairs straight or wavy; apices rounded, entire. **Flowers staminate** adaxial nectaries oblong or narrowly oblong, 0.5-1.1 mm; 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; stipes 1-3.2 mm, ovaries obclavate, beaks abruptly tapering to styles, glabrous; styles connate or free about half , 2.1-0.24 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. 2*n* = 38, 57, 76.

Flowering mid-April to mid-July (Argus 1964). *Sphagnum* bogs, *Alnus-Salix* and *Carex* fens, and *Picea mariana-Larix laricina* treed bogs; 5-1440 m; North American endemic. France: St. Pierre and Miquelon; Canada: Alta., B.C., Lab., Man., N.B., Nfld., N.T., N.S., Ont., Que., Sask., Yukon; U.S.A.: 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.

In some floras (Fernald 1950, Seymour 1982) varieties *hypoglauca* and *tenuescens* are recognized. Variety *hypoglauca* is an artifact, in which the leaf glaucescence was lost in drying (Argus 1964), and the narrow-leaved var. *tenuescens* is well within the range of variation in the species.

Salix ×*dutillyi* Lepage (*Salix argyrocarpa* × *S. pedicellaris*). See *S. argyrocarpa*.

Salix ×*jamesensis* Lepage (*Salix pedicellaris* × *Salix pellita*). See *S. pellita*.

Salix ×pendulina Wenderoth. Schrist. Nat. Ges. Marb. 2: 235. 1831. ● Weeping willow

Salix babylonica × *S. fragilis*; *S. babylonica* auct. non L.; *Salix* ×*pendulina* var. *blanda* (Andersson) Meikle ex Argus; *Salix* ×*pendulina* var. *elegantissima* (K. Koch) Meikle

Trees 2.5-12 m, pendulous (var. *blanda*), sometimes forming colonies by stem fragmentation. **Stems**, **branches** highly brittle at bases, yellow-, gray-, or red-brown, glabrous; **branchlets** yellowish to brownish, pilose, moderately densely villous, long-silky, or glabrescent; hairs geniculate. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves foliaceous, stipules early deciduous or deciduous in autumn, apices acute or caudate (var. blanda); **petioles** shallowly or deeply grooved adaxially, 2.5-15 mm, not glandular or with pairs or clusters of spherical or foliaceous glands at distal ends, adaxial surfaces glabrous, pilose or velvety to glabrescent; **juvenile blades** reddish, abaxial surfaces puberulent, pubescent, densely long -silky or glabrescent, hairs white; **proximal blades** entire or serrulate with extended teeth; **largest medial blades** amphistomatous or hypostomatous; very narrowly elliptic or linear to lanceolate 63-145 × 8-20 mm, length-width ratio 4.5-14.4; bases slightly decurrent or convex; margins slightly revolute or flat, serrate, serrulate, or spinulose-serrulate; apices acuminate to caudate; abaxial surfaces glaucous, sparsely long-silky to glabrescent, hairs appressed or spreading, white, straight or wavy; adaxial surfaces shiny or dull, glabrous or sparsely long-silky, hairs appressed, white. **Catkins** flowering as leaves emerge; staminate catkins stout, 16-34 × 7-11 mm, flowering branchlets 4-5 mm; **pistillate** very to moderately densely flowered, slender or stout, 20-36 × 3.5-11 mm, flowering branchlets 3-13 mm; **floral bracts** tawny or brown, 1-3 mm, sparsely hairy all over or mainly at proximal ends, hairs straight; apices acute, entire; pistillate bracts persistent in fruit. **Flowers**, **staminate** abaxial nectaries 0.38-0.53 mm; adaxial nectaries ovate or oblong, 0.4-0.63 mm, abaxial and adaxial nectaries connate and shallowly cup-shaped; anthers yellow, ellipsoid or globose, 0.5-0.6 mm, filaments distinct, glabrous or hairy on lower halves or at bases; **pistillate:** abaxial nectaries 0.3-0.75 mm; adaxial nectaries oblong or ovate, 0.4-0.8 mm, longer than stipes; stipes 0 mm; ovaries ovoid, pyriform, or obturbinate, glabrous or patchy or streaky pubescent; styles 0.15-0.6 mm; stigmas broad-cylindrical, 0.14-0.33 mm; 4-8 ovules per ovary. **Capsules** 1.8-3.5 mm. 2*n*=76.

Introduced and sometimes naturalized. Canada: B.C. (?), Ont. U.S.A.: Calif. (?), Conn., Ga., Ill., Ind., Maine, Md., Mass., Mich., Mo., Nebr., N.J., N.Mex., N.C., N.Y., Ohio, Pa., Tex., Va., Wash., W.Va. South America, Europe.

Plants of *S.* ×*pendulina* with distinctive caudate stipules are var. *blanda* and plants with patchy, silky ovaries are var. *elegantissima*.

Salix pentandra Linnaeus, Sp. pl. 2: 1016. 1753. ● Bay-leaf willow, bay willow, laurel willow.

Tall shrubs or trees 5-15 m. **Stems, branches** flexible at bases, brownish or yellow-green, glossy, smooth, glabrous; **branchlets** yellow-green or red-brown or brownish, glossy, glabrous. **Leaves, stipules** on first leaves absent or minute rudiments, on later leaves minute rudiments or foliaceous, early deciduous, apices rounded; **petioles** deeply or shallowly grooved, 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 leaf blades** hypostomatous; narrowly elliptic, elliptic, or lanceolate, 50-135 × 20-50 mm, length-width ratio 2-4; bases convex, slightly decurrent, or rounded; margins slightly revolute or flat, serrulate; apices acuminate; abaxial surfaces not glaucous (but pale), glabrous; adaxial surfaces highly glossy, glabrous. **Catkins** flowering as leaves emerge; **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, 2-4 mm, abaxial surfaces sparsely hairy mainly at proximal ends, hairs white, sometimes white and ferruginous, wavy or straight; apices acute or rounded to truncate, entire or toothed; pistillate bracts deciduous in fruit. **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:** abaxial nectaries present or absent; adaxial nectaries oblong, square, or ovate, 0.4-0.8 mm, shorter than or equal to stipes, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped ; stipes 0.5-1.6 mm; ovaries pyriform, glabrous; styles 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. 2*n* = 76.

Introduced and occasionally naturalized; to 2040 m; Canada: Alta., B.C., Man., N.B., Nfld., N.S., Ont., Que., Sask.; U.S.A.: Alaska, Colo., Conn., D.C., Ill., Iowa, Ky., Maine, Md., Mass., Mich. (Voss), Minn., Mont., Nebr., N.H., N.J., N.C., N.Y. (naturalized), Ohio (?), Pa., R.I., S.Dak., Vt., Va., Wis., Wyo. Eurasia.

Only pistillate plants of *Salix pentandra* are known to occur in North America.

Salix petiolaris Smith, Trans. Linn. Soc. 6: 122. 1802. ● Meadow willow, skeleton-leaf willow
Salix gracilis Andersson; *Salix gracilis* Andersson var. *textoris* Fernald; *Salix petiolaris* Smith var. *gracilis* (Andersson) Andersson; *Salix* ×*subsericea* (Andersson) C. K. Schneider

Tall shrubs 1-6 m. **Stems, branches** red-brown or violet, dull or shiny, sometimes weakly glaucous, puberulent; **branchlets** yellowish, sometimes weakly glaucous, sparsely pubescent or moderately densely velvety. **Leaves, stipules** minute rudiments or absent; **petioles** shallowly grooved adaxially, 3-11 mm, 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** 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; apices acute to acuminate, angles < 90°; abaxial surfaces glaucous, densely long-silky or glabrescent, hairs white or white and ferruginous, straight; adaxial surfaces dull or shiny, glabrous or sparsely pubescent, hairs white or white and ferruginous. **Catkins** flowering as leaves emerge; **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 straight; apices rounded, entire. **Flowers, staminate** adaxial nectaries square, ovate, or oblong, 0.3-0.7 mm; 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; stipes 1.5-4 mm; ovaries pyriform, beaks abruptly tapering to styles, short-silky, hairs flattened; styles 0-0.5 mm; stigmas slender-cylindrical, 0.24-0.43-0.6 mm; 6-12 ovules per ovary. **Capsules** 5-9 mm. 2*n* = 38.

Flowering mid-April to mid-June. Sedge meadows, wet willow carrs, openings in moist, low, rich deciduous woods, sandy or peaty wet prairie, lake shores; 10-2740 m; North American endemic. Canada: Alta., B.C., Man., N.B., N.T., Ont., P.E.I., Que., Sask.; U.S.A.: 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.

The name *Salix gracilis* is used in some floras (Fernald 1950, Seymour 1982), but this name has been replaced by the earlier *S. petiolaris* (Ball 1948, Argus 1964). The var. *textoris*, distinguished by slightly wider and longer leaves with more distinctly toothed margins is well within the variation of the species.

Salix eriocephala × *Salix petiolaris.* See *S. eriocephala*.

Salix purpurea L. Sp. pl. 2: 1017. 1753. ● Purple willow, basket willow, purple osier.

Mid shrubs to trees 1.5-5 m; sometimes forming colonies by stem fragmentation. **Stems, branches** flexible or somewhat brittle at base, yellow- or olive-brown, sometimes weakly glaucous, glabrous; **branchlets** yellow- or olive-brown, violet tinged, glabrous; **bud** gradation ??-type. **Leaves** opposite or subopposite, **stipules** absent; **petioles** shallowly grooved adaxially, 2-7 mm, adaxial surfaces glabrous; **juvenile leaves** yellowish green or reddish, abaxial surfaces sparsely, glabrous or pubescent, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** amphistomatous; lorate, narrowly oblong, narrowly oblanceolate, oblanceolate, 35-77 × 5-20 mm, length-width ratio 2.8-9.2; bases convex or rounded, angles < 90°; margins strongly revolute, entire, serrulate; apices acute, acuminate, or convex, angles < 90°; abaxial surfaces glaucous, glabrous; adaxial surfaces dull to sublusterous, glabrous. **Catkins** flowering before leaves emerge, subopposite, recurved; **staminate** stout or subglobose, 25-33 × 6-10 mm, flowering branchlets 0 mm; **pistillate** densely flowered, slender or stout, 13.5-34.5 (35 mm in fruit) × 3-7 mm, flowering branchlets 0.5-3 mm; **floral bracts** black or bicolor, 0.8-1.6 mm, abaxial surfaces hairy all over, straight or wavy; apices rounded, entire. **Flowers, staminate** adaxial nectaries oblong, square, or ovate, 0.4-0.8 mm; stamens 1 (filaments connate; anthers distinct); anthers purple becoming yellow, ellipsoid or globose, 0.4-0.5 mm, filaments connate, hairy at bases; **pistillate** adaxial nectaries ovate, 0.3-0.7 mm, longer than stipes; stipes 0-0.1 mm; ovaries obturbinate, short-silky; styles 0.15-0.3 mm; stigmas flat with rounded tips, lobes 0.16-0.2-0.24 mm; 6 ovules per ovary. **Capsules** 2.5-5 mm. 2n = 38.

Introduced and naturalized; 50-1600-2100 m; Canada: N.B., Nfld., N.S., Ont., P.E.I., Que.; U.S.A.: Calif., Conn., Del., D.C., Ga., Ill., Iowa, Ky., Maine, Md., Mass., Mich., Minn., Mo., N.H., N.C., N.Y., Ohio (?), Oreg., Pa., R.I., Vt., Va., W.Va., Wis.; Europe.

Salix ×rubens Schrank. Baier. Fl. 1: 226. 1789. ● Hybrid white willow.
Salix alba × *S. fragilis*

Trees 3-20 m, sometimes forming colonies by stem fragmentation. **Stems** erect or drooping; **branches** highly brittle at bases, yellow- or gray-brown, hairy or glabrescent or pubescent at nodes; branchlets red-brown or golden-yellow, pubescent, puberulent, pilose, or moderately densely long-silky, remaining hairy at nodes. **Leaves, stipules** on first leaves minute rudiments, on later leaves minute rudiments or foliaceous, early deciduous, apices acuminate or caudate; **petioles** deeply grooved adaxially, 4-16 mm with spherical or foliaceous glands at distal ends, adaxial surfaces pilose or villous; **juvenile blades** yellowish green or reddish, abaxial surfaces glabrous or sparsely to densely long-silky; **proximal blades** entire or serrulate; **largest medial blades** amphistomatous; very narrowly elliptic or narrowly elliptic, 68-157 × 11-30 mm, length-width ratio 3.8-7.3; bases cuneate, slightly decurrent, or concave; margins flat, serrate or serrulate; apices acuminate to caudate; abaxial surfaces glaucous, very sparsely long-silky to almost glabrous, hairs appressed, white, straight; adaxial surfaces shiny or dull, glabrous or sparsely long-silky, hairs white. **Catkins** flowering as leaves emerge; **staminate** slender or stout, 34-61 × 5-13 mm, flowering branchlets 3-11 mm; **pistillate** loosely flowered, slender, 33-82 × 4-12 mm, flowering branchlets 5-15 mm; **floral bracts** tawny or greenish, 1-2.8 mm, abaxial surfaces sparsely hairy all over, hairs straight; apices acute or rounded, entire; pistillate bracts deciduous in fruit. **Flowers, staminate** abaxial nectaries 0.5-0.68 mm; adaxial nectaries square, ovate, or oblong, 0.3-0.7 mm, abaxial and adaxial nectaries distinct or connate and shallowly cup-shaped; anthers yellow, ellipsoid or globose, 0.5-0.7 mm, filaments distinct, hairy on lower halves; **pistillate:** adaxial nectaries square, 0.3-0.7 mm, shorter than or equal to stipes; stipes 0.3-0.5 mm ovaries pyriform, glabrous; styles 0.4-1 mm; stigmas broad-cylindrical, 0.28-0.35-0.5 mm; 6-12 ovules per ovary. **Capsules** 4.5-6 mm. 2*n* = 57, 76.

Introduced and naturalized; Canada: Alta., B.C., Man., N.B., Nfld., N.S., Ont., P.E.I., Que., Sask.; U.S.A.: Ariz., Ark., Calif., Colo., Conn., Del., D.C., Ga., Idaho, Ill., Ind., Iowa, Ky., Maine, Md., Mass., Mich., Minn., Mo., Mont., Nebr., Nev., N.H., N.J., N.Mex., N.Y., Ohio, Oreg., Pa., R.I., S.Dak., Tenn., Utah, Vt., Va., Wash., W.Va., Wis., Wyo. Europe.

Salix ×*rubens* is the most commonly cultivated and naturalized tree willow in North America. It may persist for many years by trunk suckers and spreads easily by shoot fragmentation. In many riparian habitats it is the dominant tree willow and is often confused with native species. In Idaho it is confused with *S. lasiandra* (W. Buechler, pers. comm.) even though the two are quite different. At Sand Dunes Provincial Park in Ontario, on the shores of Lake Ontario, the dunes are stabilized by *S.* ×*rubens*; but in the park museum a large mural of a willow-stabilized dune is misnamed "black willow" *S. nigra*. *Salix* ×*rubens* has become such a fully naturalized part of the North American flora that we often cannot believe that this common riparian tree is introduced.

A series of molecular and genetic studies of the *Salix alba – S. fragilis* complex in Belgium (Triste 2001) concluded that in modern open agricultural situations natural hybridization is of low occurrence and that morphologically intermediate plants are not necessarily genetically intermediate. In these areas the hybrids and their parents mainly reproduce vegetatively. Based on the work of many taxonomists, between 1866 and 1957, as well as his own studies, A. K. Skvortsov (1999) noted that, in Europe, *S.* ×*rubens* predominates over *S. fragilis*. This also seems to be true in North America. A study of a German population of these species and their hybrid (Beismann et. al. 1997) was able to separate them using amplified fragment length polymorphism data even when some plants of *S. fragilis* and *S.* ×*rubens* could not easily be separated morphologically. Similar studies need to be done in North America

There are at least five clones of *S.* ×*rubens* in cultivation. The pistillate plants are sterile but the staminate plants produce viable pollen (T. Berg 2000).

Salix ×sepulcralis Simonk. Oesterr. Bot. Zeitschr. 40: 424. 1890. ● Weeping willow.

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

Trees up to 12 m, sometimes forming colonies by stem fragmentation. **Stems** pendulous, **branches** somewhat to highly brittle at bases, yellowish, pubescent, tomentose, or velvety at nodes to glabrescent; branchlets yellow-green, golden, or yellow-brown, sparsely to pilose or moderately densely short-silky to glabrescent. **Leaves, stipules** on first leaves minute rudiments, on later leaves minute rudiments or foliaceous, early deciduous, apices acute; **petioles** 4-8 mm, not glandular or with pairs or clusters of spherical glands at distal ends or scattered along petiole, adaxial surfaces short-silky; **juvenile blades** reddish or yellowish green, abaxial surfaces sparsely to very densely long-silky, hairs white; **largest medial blades** amphistomatous or hemiamphistomatous; narrowly elliptic to very narrowly so, 55-120 × 7-18 mm, length-width ratio 4.2-7.2; bases slightly decurrent or cuneate; margins flat, serrulate or spinulose-serrulate; apices acuminate, caudate, or acute; abaxial surfaces glaucous, sparsely long-silky to glabrescent, hairs appressed or spreading, white or white and ferruginous, straight; adaxial surfaces shiny, sparsely pubescent or long-silky to glabrescent. **Catkins** flowering as leaves emerge; staminate slender, 23-53 × 3-9 mm, flowering branchlets 3-14 mm; **pistillate** moderately densely to loosely flowered, slender to stout, 18-30 × 3-8 mm, flowering branchlets 3-14 mm; **floral bracts** tawny, 1-2 mm, abaxial surfaces hairy all over or mainly at proximal ends, hairs straight; apices acute, entire. **Flowers, staminate flowers:** 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 or square to ovate, 0.3-0.9 mm, longer than stipes; stipes 0-0.2 mm;

ovaries pyriform, glabrous; styles 0.15-2 mm; stigmas flat with rounded tips, 0.2-0.36 mm; 2-4 ovules per ovary. **Capsules** 1-2 mm. 2*n*=76.

Introduced and naturalized; Canada: Alta. (?), B.C., Ont., Que.; U.S.A.: Alaska, Ariz., Ark., Calif., Conn., D.C., Ill., Iowa, Ky., La., Maine, Md., Mass., Mich., Mo., Nebr., Nev., N.H., N.Mex., N.C., N.Y., Ohio, Oreg., Pa., Tenn., Utah, Va., W.Va. Eurasia.

The commonly cultivated, and sometimes escaped, weeping willow with golden or yellow-green branchlets is *Salix* × *sepulcralis* nothovar. *chrysocoma*. It originated as *Salix alba* var. *vitellina* × *S. babylonica* (Meikle 1984).

Salix sericea Marshall, Arbust amer. 140. 1785. ● Silky willow
Salix coactilis Fernald; *Salix petiolaris* var. *sericea* (Marshall) Andersson.

Tall shrubs 0.5-4 m; sometimes forming colonies by stem fragmentation. **Stems, branches** highly brittle at bases, gray-brown or violet, tomentose or glabrescent, **branchlets** red-brown, violet or mottled yellow-brown, sparsely to very densely velvety, hairs minute, straight; **bud** gradation of *caprea*-type. **Leaves, stipules** on first leaves absent or minute rudiments on later leaves minute rudiments or foliaceous, sometimes early deciduous; **petioles** convex to flat or shallowly grooved adaxially, 3.5-12(-21) mm, not glandular or with paired spherical glands at distal ends, adaxial surfaces velvety; **juvenile leaves** reddish or yellowish green, abaxial surfaces very densely short-silky, hairs white or white and ferruginous; **proximal leaves** entire; **largest medial blades** lorate, narrowly oblong, or narrowly elliptic, (48-)65-100(-125) × (7-)13-25 mm, length-width ratio (3.5-)4-6(-11); bases cuneate or convex, angles < 90°; margins flat, serrulate or crenulate; apices acute, acuminate, or convex, angles < 90°; abaxial surfaces glaucous or obscured by hair, densely short-silky, hairs straight; adaxial surfaces dull, sparsely pubescent to glabrescent. **Catkins** flowering as or just before leaves emerge; **staminate** 13.5-40 × 4-9 mm, flowering branchlets 0-2 mm; **pistillate** loosely to moderately densely flowered, slender to stout, 18-43 × 5-12 mm, flowering branchlets 1-3 mm; **floral bracts** dark brown, black, or bicolor, 0.8-1.5 mm, abaxial surfaces hairy all over, hairs straight or wavy; apices rounded, entire. **Flowers, staminate** adaxial nectaries ovate to oblong, 0.33-0.8 mm; anthers purple becoming yellow, 0.4-0.6 mm, filaments distinct or connate less than half, glabrous to hairy at bases; **pistillate** adaxial nectaries oblong, ovate, or flask-shaped, 0.4-0.7 mm, shorter than stipes; stipes 0.6-1.5 mm; ovaries ovoid, beaks abruptly tapering to styles, short-silky; styles 0.2-0.4 mm; stigmas broad-cylindrical, 0.12-0.16-0.2 mm; 6 ovules per ovary. **Capsules** 2.5-4 mm.

Flowering early March to early June. Wet boggy shores, sandy terraces, and ledges along rivers and streams, low woods, sedge meadows, acid bogs, and open seepages; rocky, silty, sandy, or peaty substrates, possibly also on serpentine; 7-1275 m; North American endemic. Canada: N.B., N.S., Que.; U.S.A.: Ala., Ark., Conn., Del., D.C., Ga., Ill., Ind., Iowa, Ky., Maine, Md., Mass., Mich., Minn., Mo., N.H., N.J., N.C., N.Y., Ohio, Pa., R.I., S.C., Tenn., Vt., Va., W.Va., Wis.

Salix eriocephala × *S. sericea*. See *S. eriocephala*.

Salix serissima (L. H. Bailey) Fernald, Rhodora 6: 6. 1903 [1904]. ● 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, sometimes forming colonies by stem fragmentation. **Stems, branches** usually flexible at bases, sometimes brittle, yellow-, red-, or gray-brown, shiny or dull, glabrous; branchlets yellow- or red-brown, glabrous, glossy or shiny. **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 blades** reddish or yellowish

green, glabrous. **proximal leaves** serrulate or entire; **largest medial blades** hypostomatous or hemiamphistomatous; narrowly oblong, very narrowly elliptic to elliptic, lanceolate, or narrowly ovate, 43-103 × 9-33 mm, length-width ratio 2.4-6; bases convex, cuneate, or uncommonly rounded; margins flat, serrulate; apices acuminate, caudate, or acute; abaxial surfaces not glaucous (but pale) or thinly glaucous, glabrous, shiny; adaxial surfaces highly glossy, glabrous. **Catkins** flowering as leaves emerge; **staminate** stout, 25-53 × 12-16 mm, flowering branchlets 5-14 mm; **pistillate** moderately densely to loosely flowered, stout to globose, 17-42 × 11-22 mm, flowering branchlets 5-32 mm (to 65 mm in fruit); **floral bracts** tawny to greenish-tawny, 1.2-4 mm, abaxial surfaces moderately densely hairy all over, hairs white or grayish, straight or wavy; apices acute, truncate, or rounded, glandular toothed; pistillate bracts deciduous in fruit. **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; stipes 1.2-2.4 mm; ovaries pyriform to obclavate, beaks slightly bulged below or abruptly tapering to style, glabrous; styles 0.3-1 mm; stigmas broad-cylindrical or flat with rounded tips, 0.4-0.68 mm; 12-16 ovules per ovary. **Capsules** 7-12 mm. 2*n* = 76.

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

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 triandra Linnaeus var. **triandra**, Sp. Pl. 1016. 1753. ● Almond leaf willow
Salix amygdalina Linnaeus; *S. amygdalina* var. *discolor* Wimm. & Grab.; *S. triandra* subsp. *discolor* (Wimm. & Grab.) Arcang.

Tall shrubs or trees 2-7(-10) m. **Stems, branches** somewhat brittle at base, glabrous glabrescent; **branchlets** yellow- or red-brown or brownish, glabrous or rarely pilose. **Leaves, stipules** on first leaves minute rudiments to foliaceous, on later leaves foliaceous, 4-13 mm, apex acute or acuminate; **petioles** deeply grooved adaxially, margins covering groove, 4-10-26 mm, with paris or clusters of spherical glands, stalked spherical glands, or foliaceous glands at distal end, adaxial surface pubescent, puberulent, or glabrescent; **juvenile leaves** reddish, abaxial surface sparsely, puberulent or pubescent, hairs white and ferruginous; **proximal leaves** stipules absent or minute rudiments or foliaceous, margins crenate or crenulate; **largest medial leaf blades** hypostomatous, oblong, narrowly oblong, narrowly elliptic, elliptic, or lanceolate to obovate, 53-114 × 14-35, 2.7-6.3 times as long as wide; base convex or cuneate; margins flat or slightly revolute, crenate or serrulate; apex acuminate, acute, or somewhat caudate; abaxial surface not glaucous or glaucous, glabrous or glabrescent; adaxial surface shiny or dull, glabrous or glabrescent. **Catkins, staminate** slender to stout, 20-60 × 5.5-10 mm, flowering branchlet 3-17 mm; **pistillate** catkins moderately to very densely flowered, slender to stout, 20-60 × 5-8 mm, flowering branchlet 5-31; **floral bracts** 1-2.3 mm, abaxial surface hairy mainly at proximal end, hairs wavy, apex rounded, or acute, entire or rarely undulating; pistillate bracts deciduous after fruiting or persistent. **Flowers, staminate** abaxial nectary 0.28-1.1 mm, adaxial nectary oblong, square, or ovate, 0.2-0.66 mm, distinct; stamens 3 (proximal flowers sometimes 2), anthers ellipsoid, 0.32-0.64 mm; filaments distinct, hairy on lower half; **pistillate** adaxial nectary obovate to square, 0.3-0.56 mm, shorter than stipe; stipe 1-2.7 mm; ovaries pyriform, beaks gradually tapering to or slightly bulged below style, glabrous; styles free about half their length, 0.18-0.32 mm; stigmas flat,

non-papillate abaxial surface and rounded tip, lobes 0.14-0.24 mm. **Capsules** 3-6 mm. 2n = 38 (44), 57, or 88.

Flowering late spring. Introduced, cultivated or naturalized; Ont.; Maine, Ohio.

Salix triandra generally has been overlooked in North American floras. At one time it was a very important basket-willow and probably was introduced into North America for that purpose. The leaves of *S. triandra* can be either glaucous or not glaucous abaxially. Some authors treat them as subspecies (F. Martini & P. Paiero 1988, K. H. Rechinger 1993); but A. K. Skvortsov (1998) notes that although the two have somewhat distinct ranges both characters occur through the species and sometimes can be found in the same population. His suggestion that the genetic inheritance of this character should be studied has not been taken up. The species is characterized by bark dark gray, smooth, and flaking in large irregular patches as in *Platanus ×acerifolia*. The ovary-style transition is so indistinct that styles are often described as absent; but there are two, short, distinct styles terminating in a short stigma. A color change, later in season, between the styles and the ovary suggests that the tip of the ovary and the two distinct styles are both stylar tissue. In general, it appears that the styles are connate proximally and distinct distally.

Collections made in 1934-35 by H. Hyland along the Penobscot River, Orono, Maine, were labelled by him as "introduced," but they could have spread from cultivation or have been naturalized (A. Haines, pers. comm.). A recent naturalized occurrence is known from Toronto, Ontario, and it is reported to occur in Ohio (T. D. Sydnor & W. F. Cowan 2001); but its naturalized status there is not known.

Salix viminalis L. Sp. pl. 1021. 1753. ● Osier, basket willow, silky osier

Tall shrubs 3-7 m; not colonial. **Stems, branches** yellow-, gray-brown, or yellowish, glabrous or puberulent; **branchlets** yellow-brown, yellowish or obscured by hairs, glabrous, densely to sparsely villous, velvety, or puberulent, hairs geniculate. **Leaves, stipules** sometimes early deciduous, on first leaves minute rudiments or absent, on later leaves foliaceous (sometimes brownish), linear, apices acuminate; **petioles** shallowly grooved adaxially, 4-13 mm, not glandular at distal ends, adaxial surfaces villous, puberulent, or velvety; **juvenile leaves** yellowish green, abaxial surfaces very densely tomentose or short-silky, hairs white; **proximal leaves** entire; **largest medial blades** linear, lorate, narrowly oblong, or narrowly elliptic, 53-130 × 5-33 mm, length-width ratio 4.7-13.7; bases slightly decurrent to cuneate, angles < 90°; margins strongly revolute, undulate or apparently entire, glands epilaminal; apices acuminate, acute, or convex, angles < 90°; abaxial surfaces glaucous or obscured by hair, densely short-silky, woolly, or tomentose, midrib raised and pubescent, yellowish, hairs appressed, spreading, or erect, white, straight or wavy; adaxial surfaces dull or shiny, sparsely or moderately densely pubescent, hairs gray. **Catkins** flowering just before or as leaves emerge; **staminate** 24-48 mm, flowering branchlets 0-2 mm; **pistillate** densely flowered, 23-55 mm, flowering branchlets 0-6 mm; **floral bracts** brown or tawny, 1.6-2.2 mm, abaxial surfaces hairy all over, hairs straight; apices obtuse or rounded, entire. **Flowers, staminate** adaxial nectaries narrowly oblong or oblong, 0.6-1.5 mm; anthers purple becoming yellow, ellipsoid to short-cylindrical, 0.6-0.8 mm, filaments distinct, glabrous; **pistillate** adaxial nectaries narrowly oblong or oblong, 0.9-1.4 mm, longer than stipes; stipes 0.1-0.5 mm; ovaries pyriform, densely long-silky, hairs flattened; styles 0.6-1.8 mm; stigmas slender-cylindrical, 0.72-1.3-1.8 mm; 18-19 ovules per ovary. **Capsules** 4-6 mm. 2*n* = 38.

Introduced and sometimes naturalized; Canada: N.B., Nfld., N.S., Ont., P.E.I., Que. U.S.A.: Conn., Ind., Iowa, Maine, Mass., N.J., N.Y., Ohio, R.I., Vt. Europe.

Salix caprea × *S. viminalis* (*S.* ×*sericans* Tausch ex A. Kerner) and *S. cinerea* × *S. viminalis* (*S.*×*smithiana*) are cultivated in North America. These hybrid binomial names and their parental

namess are sometimes reversed. The treatment given by Meikle (1984) is followed here. The two are very similar but *S.* ×*sericans*, which involves *S. caprea*, has smooth decorticated branches whereas *S.* ×*smithiana*, which involves *S. cinerea*, has ridged decorticated branches.

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^{o} 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*.
Marcescent. 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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Salix Web Sites

http://aknh.uaa.alaska.edu/willow/index.html. An interactive key to New World *Salix* based on the Argus DELTA database. The files, including Intkey, *Salix* database, and text instruction on its use, must be downloaded to your computer or a cd. 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* database.