

WILLOW HYBRIDS: *SALIX* *HEBECARPA* FERNALD
AND *S. SIMULANS* FERNALD

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IN an attempt at monographic treatment of American willows, it becomes necessary to study critically the various new sections, species, and varieties which have been proposed. This is a difficult and laborious task because, while no proof of validity is required when novelties are published, abundant proof of its lack must be furnished when their validity is questioned. In the interest of accurate knowledge, however, such questions must be raised.

The writer already has done this in the case of two monospecific sections (*Argyrocarpae* and *Uva-ursi*) proposed by Dr. Fernald.¹ It also has been done for new species (or names) in the case of Small's renaming of *Salix floridana* and Murrill and Palmer's publishing of *S. astatulana*;² of Fernald's renaming of long-established (145 years) *S. petiolaris*;³ and of Schneider's publishing of three new species of Canadian subarctic willows, of which only *S. fullertonensis* could be maintained.⁴ During this monographic work, a new "centripetal" method has been developed for the study of abundant material supposedly representing two or more different entities.⁵ This method was illustrated by a study of *Salix cordata* Muhl. and *S. missouriensis* Bebb, which showed that the latter could not be maintained as a separate species. Other discussions are in press or in preparation.

Recently, it has been necessary to study two little-known species, *S. hebecarpa* Fernald, and *S. simulans* Fernald, both of which were assigned to Section *Roseae* by their author. Both are from the St. Lawrence River area of southern Quebec. The results presented below led to the conclusion that both are hybrids of *S. pedicellaris* Pursh, var. *hypoglauca* Fernald.

¹ Ball, Carleton R. Studying willows or making new sections in the genus *Salix*. *RHODORA* 49: 37-49. 1947.

² Ball, Carleton R. *Salix floridana* Chapman, a valid species. *Journ. Arnold Arb.* 24: 103-106, pl. 1. 1943.

³ Ball, Carleton R. *Salix petiolaris* J. E. Smith, American, not British. *Bull. Torr. Bot. Club* 75 (2): 178-187. 1948.

⁴ Ball, Carleton R. Schneider's three new Canadian willow species (*S. anamesa*, *S. fullertonensis*, and *S. hudsonensis*). *Canad. Field-Nat.* 62 (5): 150-152. 1948.

⁵ Ball, Carleton R. More plant study: Fewer Plant names. *Journ. Arnold Arb.* 27: 371-385. 1946.

This is the only species of Section *Roseae* in that part of North America and they strongly resemble it in many characters, as Fernald pointed out. The resemblance is so close, in fact, that the other parent cannot be certainly identified. This frequently is the case with hybrids.

In evaluating questions of hybrid origin, some important facts about natural hybrids must be kept in mind. 1, The two parents must have about the same flowering period if wind-blown or insect-carried pollen grains from the male parent are to find receptive stigmas on the ovaries of the female plant. 2, Unless such cross pollination results in the production of fertile seeds, there can be no hybrid progeny. 3, If several or many fertile hybrid seeds are produced by the same pollen on a given plant, the plants which grow from these seeds will not all look alike, because of the laws of inheritance of differing characters. 4, There are many characters, such as size, shape, color, hairiness, tooting, division, glandulation, glaucousness, etc., for each of the many different organs of a single plant (stems, buds, stipules, leaves, peduncles, flower scales, capsules, pedicels, styles, stigmas, stamens, glands, etc.). 5, If all of the hybrid seeds were fertile and most of them produced plants, enormous diversity in the progeny would be evident. 6, In nature, many cross-pollinated ovaries produce no seeds at all, and many seeds which do form are not fertile. 7, Those hybrid plants which most nearly resemble one of the parents are most likely to produce fertile seeds. 8, As their characters are more nearly those of one parent, their progeny from different seeds will show relatively little diversity. That is why the other parent often cannot be identified.

It must be remembered also that a hybrid plant of *Salix*, after once becoming established, may continue to multiply vegetatively. This may be done by creeping stems, subterranean rootstocks, or even the roots themselves, all of which may produce new shoots. Later, these become independent plants when the connection decays. Spread occurs also by twigs broken off accidentally by wind, water, snow, ice, or animals, and which readily take root in soil or sand, sometimes far away from the parent plant. The new plants from this vegetative reproduction all will be like the plant from which they were

detached. With these facts in mind let us consider the two species named.

SALIX HEBECARPA FERNALD

This plant of Mt. Albert, Gaspe Peninsula, Quebec, was first published⁶ in 1907 as *S. fuscescens* var. *hebecarpa* Fernald, n. var. This name was given because the more glabrous and partly creeping form was thought to be *S. fuscescens*, a prostrate willow of Alaska. In 1924, it was raised to specific rank,⁷ the more glabrate and the more pubescent forms being considered a single species. Fernald discussed its characters and relationships in both these papers, and again, briefly, in 1930, when publishing his second species, *S. simulans*.⁸

In 1907, Fernald stated that *S. fuscescens* Andersson, an Alaskan creeping species,—

“ . . . is abundant in bogs on the serpentine tableland of Mt. Albert. It is a very attractive creeping shrub, in foliage and other characters strongly suggesting *S. pedicellaris* Pursh . . . [but] . . . quickly distinguished by its usually obovate leaves, the more pubescent scales . . . , the very short thickish pedicels (barely exceeding the scales), the long subulate nectary which is usually half as long as the pedicel, and the definite though short style.”

He then states that many colonies on Mt. Albert have the capsules quite glabrous as in the type of the species (*S. fuscescens*) while other colonies, occupying extensive areas, have the capsules distinctly pilose. Fernald and Collins No. 207, the only collection of the pubescent-capsuled form, is designated the type of the new variety *hebecarpa*, differing from the species (*S. fuscescens*) only in “pilose capsules”. No reference was made then to the two collections of the creeping plant with glabrous capsules, made in 1905 and 1906. They represent the plant then held to be *fuscescens* itself.

In 1924 (l. c. above), Fernald raised his variety to specific rank as *Salix hebecarpa* (Fernald) n. comb., and included in it the more abundant glabrous-capsuled plant, which he then admitted was not *S. fuscescens* Andersson as he had thought it to be in 1907. Besides the type, pubescent-capsuled No. 207, he cites

⁶ Fernald, M. L. (Some new Willows of Eastern America). *Salix fuscescens* Andersson, var. *hebecarpa* Fernald, n. var. RHODORA 9: 224. 1907.

⁷ Fernald, M. L. (New or recently restudied plants of Eastern America). *Salix hebecarpa* (Fernald) n. comb. RHODORA 26: 123. 1924.

⁸ Fernald, M. L. A new willow from the Côte Nord, Quebec. RHODORA 32: 112-113. 1930. (*S. simulans* Fernald, n. sp.).

three other collections, namely, the unnumbered collection of 1905, No. 206 of 1906, and a recent No. 25,686 of 1923. He states once that all three have "glabrous" capsules and once that they have "glabrous or glabrescent" capsules. He further said that, except for the pubescence of capsules, all four collections formed a "consistent series," and that *S. hebecarpa* stands between *S. fuscescens* and *S. pedicellaris* but that *S. fuscescens* has "quite different leaf-venation", and that the Alaskan shrub has darker scales and smaller capsules."

From *S. pedicellaris* Pursh (meaning var. *hypoglauca* Fernald), he says his new species ". . . is separated by its more obovate leaves, the more pubescent and darker scales . . . , the much shorter, thicker and pubescent pedicels (about equalling to twice as long as the scales), the long nectary and the definite style."

In 1930 (l. c. above), in publishing his *S. simulans*, Fernald discusses *S. hebecarpa* again and states that the name (*hebecarpa*) is a misnomer because "most specimens have the capsules glabrous or only sparsely pubescent." He notes also that the capsules are "6-8 mm. long."

Fernald never described his *S. hebecarpa*, either when publishing it as a variety in 1907 or as a species in 1924, nor in this third discussion in 1930. In all three papers he merely compared it with species in the Section *Roseae*. It is necessary to consider carefully the characters assigned to *S. hebecarpa* and also to *S. fuscescens* and *S. pedicellaris* (var. *hypoglauca* Fernald) in these three discussions. In raising variety *hebecarpa* to specific rank in 1923 he says that its type (No. 207) and the three collections formerly held to represent *S. fuscescens* form a "consistent series" except for the hairy capsules of the type. The consistency of the expression of the characters assigned must be considered, as well as the accuracy of the comparisons with other species. For these purposes, the writer has given critical study⁹ to 1 sheet of the unnumbered collection of 1905, 6 sheets of No. 206, 6 sheets of No. 207 (type), and 6 sheets of No. 25686. Eight comparisons are analyzed.

1. *Prostrate habit*. The first character assigned to var. *hebecarpa* was "creeping shrub", which means both prostrate

⁹ The curators of Gray Herbarium, and that of the Arnold Arboretum, have made available much of this material and their courtesy is greatly appreciated.

and rooting. The type, No. 207, shows rooting on the specimens of all six sheets. No. 206 shows rooting on only 4 out of 6 sheets. The unnumbered specimen of 1905 shows rooting on the one sheet seen. No. 25686 shows no rooting on any of the 6 sheets examined, and in other ways does not look like a prostrate plant. In fact, the non-rooting and often elongated apical portions of Nos. 206 and 207 and the unnumbered specimen appear to be ascending or perhaps erect rather than prostrate but this can not be certainly determined without field observations.

2. *Obovate leaves*. In 1907, the varietal type (No. 207) was said to have "leaves mostly obovate", which is correct. But in 1924, the species, then represented by four collections, was said to have "more obovate leaves" than *S. pedicellaris* (i. e., var. *hypoglauca* Fern.). Of these four collections cited, however, only the type (No. 207) has obovate leaves. The unnumbered collection of 1905 has only small elliptic-oblong leaves (1 sheet); No. 206 has oblong to elliptic-oblong leaves with an occasional obovate leaf (6 sheets); and No. 25,686 has similar leaves (6 sheets), the largest broadly oblong. Only the type, therefore, is separated from *S. pedicellaris* var. *hypoglauca* by obovate leaves, if that were a real separation. But var. *hypoglauca* also has obovate leaves. An examination of 86 specimens in the writer's herbarium shows six with leaves definitely obovate and one with leaves partly obovate.

3. *Scale Color and Hairiness*. The next separating character noted by Fernald in 1907 is "more pubescent scales" (in No. 207). In 1924 it is the "more pubescent and darker scales of the ament" in *S. hebecarpa*, which by then includes all four of the collections under discussion. *S. fuscescens* is said to have still darker scales than *S. hebecarpa*. The flower scales of *Salix* are relatively thin and tender organs greatly affected by drying. Those normally yellowish or light brown may become dark brown or blackish, through over-heating in drying. Also, scales appearing blackish by reflected light may show only varying shades of brown by transmitted light. Most of the specimens under discussion were fairly well dried.

The unnumbered specimen of 1905 has the shorter, yellowish, blunter, and almost glabrous scales of normal var. *hypoglauca*, but many of them are discolored somewhat. The other numbers

have longer, partly more acute, somewhat blackish, and more hairy scales, derived from hybridization. Those in the type, No. 207, are broader, blunter, and blacker, indicating that the other parent probably was a member of the creeping Section *Ovalifoliae*. Both *S. anglorum* and *S. arctophila* are common in the area.

4. *Capsule Hairiness*. In 1907, var. *hebecarpa* was separated wholly on "capsules distinctly pilose", those of the associated plants being "quite glabrous". In 1924, it was stated that "the pubescence of the fruits is by no means constant", which is true. The capsules of the three collections other than the type then are referred to once as "glabrous" and once as "glabrous or glabrescent", which also is true. In 1930, it was said that "most specimens have the capsules glabrous or only sparsely pubescent." Critical study shows that the unnumbered collection of 1905 has ovaries and capsules entirely glabrous; No. 206 has ovaries minutely puberulent to glabrous, and capsules glabrous or rarely thinly pubescent at base; and No. 25,686 has ovaries glabrous or rarely puberulent at base and capsules entirely glabrous. The type, No. 207, has ovaries white-short-pubescent and capsules thinly pubescent throughout. Several species of *Salix* with wholly glabrous capsules may have thinly pubescent ovaries.

5. *Capsule Length*. Size of capsules is not mentioned in the publishing of either variety or species, but, in the 1930 comparison with *S. simulans*, the capsules of *S. hebecarpa* are said to be "6-8 mm. long". Many measurements by the writer on all four of the collections (19 sheets) show a capsule length of 5.5-7.5 mm., but it is quite possible that 8-mm. capsules occur. Important, however, is the statement of 1924 that *S. fuscescens* has "smaller capsules" than *S. hebecarpa*. The recorded range in length of mature capsules of *S. fuscescens* is 6-8 or 9 mm. long, so that they definitely are larger, not smaller, than those of *S. "hebecarpa"*, or those of var. *hypoglauca*.

6. *Pedicle Length and Thickness*. A point stressed in 1907 (for No. 207) was "the very short thickish pedicels (barely exceeding the scales)". In 1924, this reads (for all four collections), "the much shorter, thicker, and pubescent pedicels (about equalling to twice as long as the scales)". In the 1905 collection, the pedicels are glabrous and slender but short

(1–1.5 mm.) compared with var. *hypoglauca*, the whole plant being depauperate. In No. 206 the pedicels are 1–2 mm. long, stout to stoutish and minutely puberulent. In No. 25,686 they are more variable, 1–2 or 2.5 mm. long, stoutish to slenderish, and micro-puberulent to glabrous. On the type, No. 207, they are 1–1.5 mm. long, stoutish, and finely pubescent. Such variation hardly indicates a “consistent series” but does indicate hybrid origin. Occasional capsules on all four collections are almost sessile and on stout pedicels.

7. *Style Length*. In 1907, the style (of No. 207) was referred to as “definite though short”. In 1924 (for all four collections), it was called a “definite style”, which in *Salix* might mean anything from 0.3 to 3 mm. in length. Glandular structures, such as styles, stigmas, and nectaries, are more likely to be variable in length than are the firmer organs. Development is easily affected by frost and they also may shrink after maturing, even if normally developed. On the 1905 depauperate collection, the styles are 0.2–0.3 mm. long, or normal for var. *hypoglauca*. On the other three collections, they mostly are 0.4–0.8 mm. and entire, or rarely to 1 mm. long on the type.

8. *Gland Length*. In 1907, Fernald recorded “a long subulate nectary which is usually half as long as the pedicel” and in 1924 he referred to the “long nectary”. The gland on the 1905 depauperate collection is 0.4–0.5 mm. long, as in var. *hypoglauca*. On the three numbered collections, the subulate or filiform gland is from 0.4–0.8 or rarely 1 mm. long, and finely capitate.

From the preceding discussion, it will be seen that the four collections studied are all variable but that they fall into two groups.

The first group has most of the characters of *S. pedicellaris* var. *hypoglauca* but shows depauperate growth. It contains only the unnumbered 1905 collection of Collins and Fernald, alpine bogs, alt. 1000 m., Mt. Albert, Gaspé Co., Quebec, Aug. 8–15, 1905, distributed as *S. myrtilloides* L. A single Gray Herbarium specimen has been studied. This is a plant 6 dm. long, 4 mm. in diameter at the base, unbranched and rooting for 38 cm., then branching and heavily fruited. Except for the rooting habit and leaves not normally reticulate, especially above, this would pass for depauperate var. *hypoglauca*. Root-

ing could be produced by heavy snow coverage and elevation, but the plant well may be a hybrid.

The second group includes the other three collections: Fernald and Collins 206 (as *S. fuscescens* Andersson) and 207 (type, as *S. fuscescens* var. *hebecarpa* Fernald, n. var.), both from alpine bogs on the serpentine tableland, alt. 1100 meters, Mt. Albert, Gaspé Co., Quebec, July 21, 1906; Fernald, Griscom, Mackenzie, & Smith 25,686, from sphagnum bog, bordering a pond at about 1050 m. altitude in the hornblende area south of Flagstaff Peak, Mt. Albert, July 24, 1923. Six sheets of each of these have been studied. The first two numbers show rooting habit in part but the third shows none. Shape of leaves varies also, as noted in discussion. All three agree in showing some puberulene or pubescence on pedicels and capsules but both quantity and area covered vary greatly, even on the same plant. They agree also in styles 2 to 3 times as long as in var. *hypoglauca*, and also in longer stigmas and glands, and mostly stouter pedicels, but all of these characters vary greatly and on the same plant. Their strong resemblance to var. *hypoglauca*, accompanied by great variation among the three, as well as within each collection, almost certainly indicate hybrid origin. The further fact that relatively few seeds were produced in the abundant capsules, and that most of those seen seem to be infertile, is another strong indication of hybridity. As noted above, the creeping habit of two and the larger, darker, and hairier scales of all three, suggest that either *S. anglorum* or *S. arctophila* was the male parent. The capsule hairiness and longer styles also could have come from either of these parents. On Nos. 206 and 207, the most creeping collections, some of the tiny undeveloped basal leaves still are more or less densely long hairy beneath, especially toward the apex. This is characteristic of similar leaves in the creeping Section *Ovalifoliae*, to which the suggested male parents belong.

Some other specimens have been assigned to *S. hebecarpa*. Two of these have just been reviewed critically, with the following results.

Dutilly and Lepage 14,503, from Rivière aux Melezes (Larch River), rivage, un peu en haut de la Rivière Russell, in Labrador Peninsula, northern Quebec, Aug. 8, 1945, was determined as

S. hebecarpa by Ball. It proves to be primarily *S. arctophila* Ckll., and probably a hybrid, perhaps with *S. pedicellaris hypoglauca* by its narrower scales and long glabrate capsules.

Mackenzie and Griscom 11,048, from Green Gardens, headland of Cape St. George, western Newfoundland, July 20, 1922, was distributed as *S. cordifolia* var. *Macounii* (Rydb.) Schneider. Later it was annotated as *S. hebecarpa* Fernald by some one. It is undoubtedly *S. anglorum* Chamisso, the smaller than average leaves with broad bases tending toward its variety *kophophylla* Schneider.

SALIX SIMULANS FERNALD

In 1930, Fernald published⁸ his *Salix simulans*, from "Open marshy area, Betchuwun, Saguenay Co., Quebec, Harrison F. Lewis (type in Gray Herbarium, Aug. 26, 1928." He states that the plant was so puzzling that he encouraged Dr. Lewis to obtain a second collection in 1929. Lewis evidently did so, but it is not cited or further mentioned in the paper. However, two sheets of it have been received from Gray Herbarium for critical study. The labels bear the habitat data given above for the 1928 type collection, except that the 1929 date is Sept. 3 (pencil field labels) or Sept. 13 (handwritten sheet labels).

Fernald says that: "In its very tomentose and short-pedicelled capsules it would seem to belong in the § *Glaucæ*, In foliage, however, *S. simulans* is as clearly a member of the § *Roseæ*." The pubescent buds and young twigs, and the thinly pubescent young leaves (beneath), also suggest Sect. *Glaucæ*, as do the long and hairy scales. The blades, however, are not as exactly similar to those of *S. pedicellaris*, var. *hypoglauca* as Fernald would seem to indicate. Shape, color, and general appearance are much the same but the blades, even though collected in autumn, are plane to incised-reticulate above rather than raised-reticulate. The fine reticulation beneath also is not as strongly raised as is normal for var. *hypoglauca*. The primaries are distinctly raised, the secondaries moderately so, but the tertiaries often are scarcely elevated at all. Some of those not raised are fairly clearly seen, however, because they have darkened slightly in drying and so are visible through the glaucous epidermis.

Certain striking aspects of this puzzling plant strongly indicate that it is a hybrid and not a species. The plant obviously is sexually deficient, a common result of hybridity. There are five portions of the plant, from 8–12 inches long and freely branching, on these two sheets of the 1929 collection. Two portions bear 2 aments each, two bear 1 each, and the fifth bears none. Similar growth of any of the suspected parents normally would carry from three to five times as many aments. The aments also are smaller than those of species in either section named and obviously are of depauperate development.

Most important is the fact that the ovaries never had developed into capsules, although collected in September. What Fernald described as densely white-tomentose obtuse capsules 2.5–4 mm. long actually are ovaries which never developed beyond that stage. This probably was partly because of the lack of stimulation derived from fertilization and partly because of the general lack of sex vigor discussed above.

Ovaries in *Salix* are normally white-tomentose and blunt, even though the mature capsules become relatively thinly gray-pubescent and acute as they develop. That these are still only ovaries is proved by the fact that they are completely sterile, there being no sign of seeds and very little of the normally abundant parachute hairs which surround the seeds and usually elongate even if the seeds do not develop beyond the germ stage. Further proof that these are ovaries is seen in the fact that the two valves have not separated and recurved as most capsules would have done before that time in the autumn. Some valves have not separated at all and most of them have merely opened and the tips separated more or less widely. Only a few have reached a right angle and none have recurved in the normal manner.

Finally, there is that considerable variation in some of the organs which is a common result of hybridization. This diversity, however, is not as great as in many hybrids and might have been more apparent if there had been greater sex vigor and continued development of the organs. The longest styles and stigmas are 2 to 3 times as long as the shortest and there is considerable dividing of the styles. Diversity in the length of styles and stigmas and in the division of styles is relatively more common in Section *Glaucæ* than in many other Sections of *Salix*.

Fernald described the flower scales as broadly oblong, 2–2.5 mm. long, apex rounded to emarginate. They vary considerably and some appear to be almost obovate and dark brown in color. Many of the leaf blades are sparsely glandular-denticulate (not “dentatis” as stated by Fernald), especially on the basal portion. Such denticulation and also obovate blackish scales are characteristic of *S. arctophila*, of the prostrate Section *Ovalifoliae*. Sparse denticulation occurs rarely in most species of Section *Glaucæ*, and one (*S. McCalliana*) is normally rather closely crenulate-denticulate throughout. Whatever the male parent, it is practically certain that *S. simulans* is a hybrid.

Washington 15, D. C.

THREE ADDITIONS TO THE FLORA OF NOVA SCOTIA.—In late August and early September of 1932, accompanied by my daughter and son, I took a brief vacation, driving by conventional routes through southern New Brunswick and western Nova Scotia. Although this was not primarily a collecting-trip, it was inevitable that we should occasionally collect a few species which seemed of local interest. Upon returning to Cambridge, I began the intensive but perpetually interrupted work on a revision of Gray's *Manual*, and the little collection of plants was pigeonholed, to be retrieved only now, as the proof of the *Manual* is being read. Three plants collected seem not to have been reported from Nova Scotia and they are here noted.

ELEOCHARIS OVATA (Roth) R. & S., var. HEUSERI Uechtrict. CUMBERLAND Co.: sandy shore of Trueman's Pond, Treumanville, no. 1618.

POLYGONUM ACHOREUM Blake in RHODORA, xix. 232 (1917). ANNAPOLIS Co.: border of salt-marsh, Annapolis Royal, no. 2625.

When he published *Polygonum achoreum*, often a weedy species (the name meaning “without a native land”), Blake said: “the present species, although pretty certainly indigenous in the United States, has apparently never been found in a clearly native condition”. On the saline marshes of Annapolis River it is an element in the regular halophytic native flora of *Suaeda*, *Salicornia*, etc.



Ball, Carleton R. 1950. "Willow hybrids: *Salix hebecarpa* Fernald and *S. simulans* Fernald." *Rhodora* 52, 8–18.

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