PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN. XXXIII. NAJADACEAE

JAMES G. ROSS AND BARBARA M. CALHOUN

This report is based on specimens from the herbaria of the University of Wisconsin and of the Milwaukee Museum, and from collections by the United States Fish and Wildlife Service as reported by Mr. Neil Hotchkiss. Reports by Mr. Hotchkiss, not supported by specimens, are indicated on the maps by open circles. The authors acknowledge the kindness of Mr. A. M. Fuller of the Milwaukee Museum and Mr. Neil Hotchkiss of the United States Fish and Wildlife Service in providing specimens and data and also express their gratitude to Dr. N. C. Fassett for his help and supervision. Notes on water preference were taken from the "Land Economic Inventory of Northern Wisconsin, Sawyer County," Wisconsin Department of Agriculture and Markets Bulletin, No. 138. 1932. The treatment of linear-leaved and broad-leaved species of Potamogeton follow that of Fernald[1] and Ogden[2] respectively.

Physiographic features controlling distribution of aquatic plants are indicated on Map 22. The solid line encloses the Driftless Area where little standing water occurs except along the Mississippi and the Wisconsin Rivers. The stippled area is the bed of Glacial Lake Wisconsin, where are found many slow streams, reservoirs, etc. The rest of Wisconsin is glaciated, and therefore abounds with small lakes, especially in areas centering on Waukesha County, Vilas County, and Washburn County. Some of these lakes are very limy while others contain very soft water. Therefore a great diversity of species occurs in these areas.

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[1] Fernald, M. L. Mem. Amer. Acad. Arts and Sci. 17 : 1–183. 1932.
[2] Ogden, E. C. Rhodora 45 : 57–105, 119–163, 171–214. 1943.

KEY TO GENERA

1. Leaves alternate, except the uppermost; flowers and fruits in spikes or heads.....*Potamogeton.*
1. Leaves opposite; flowers not in spikes or heads.
   2. Seeds tapered to each end and enclosed in a papery envelope....*Najas.*
   2. Seeds enclosed in a fruit coat which is narrowed to a stipe at one end and a slender style at the other end is toothed down one side.....*Zannichellia.*

POTAMOGETON

1. Floating leaves usually heart-shaped at base, jointed at attachment to petiole so that they lie flat on the water surface; submersed leaves thickened, semi-terete, narrowly linear
   2. Submersed leaves 0.8–2 mm. wide; fruits with concave sides; spikes 3–6 cm. long; floating leaves mostly 3–10 cm. long. .....23. *P. natans.*
   2. Submersed leaves 0.3–1 mm. wide; fruits with plane sides; spikes 1–3 cm. long; floating leaves 2–5 cm. long....24. *P. Oakesianus.*
1. Floating leaves tapered or rounded at base or absent; submersed leaves flattened or thread-like
   3. Submersed leaves with parallel edges
      4. Stipules fused with the lower part of the leaf to form a sheath
         5. Leaves auricled at base, 3–7 mm. wide and arranged in two ranks as a rigid, flat spray.....4. *P. Robbinsii.*
         5. Leaves not auricled at base, 0.2–3.0 mm. wide, and arranged in a lax, diffuse, branched spray
            6. Sheath formed by fused stipule and leaf at least 1 cm. long; fruit without dorsal keel, the outline of the embryo not visible
               7. Leaves not filiform, 1.0–3.0 mm. wide.....2. *P. vaginatus.*
               7. Leaves filiform, 0.2–1.0 mm. wide
                  8. Leaf tips of lower leaves with long tapering points; fruits with a short beak.....3. *P. pectinatus.*
                  8. Leaf tips of lower leaves blunt or rounded; fruits without beaks
                     9. Stems 0.5–1.5 mm. thick; sheaths tight around stem; leaves 3–6 cm. long; flowers in 2–5 whorls .....1. *P. filiformis.*
                     9. Stems 2–3 mm. thick; sheaths large, loose, inflated; leaves 8–18 cm. long; flowers in 4–12 whorls .....2. *P. vaginatus.*
            6. Sheath formed by fused stipule and leaf base not more than 5 mm. long; fruit with more or less prominent dorsal keel, the outline of the embryo plainly visible

10. Submersed leaves linear, 0.5–2 mm. wide, obtuse or acute
    11. Adnate leaf sheath longer than free stipular end .....15. *P. Spirillus.*
    11. Adnate leaf sheath about half the length of free stipular end.....16. *P. diversifolius.*
10. Submersed leaves setaceous or linear-filiform, 0.1–0.6 mm. wide; adnate leaf sheath less than half the length of the free stipular end.....17. *P. capillaceus.*

4. Stipules free from the leaf
    12. Submersed leaves 0.1–5.0 mm. wide, with cellular-reticulation between inner nerves absent or inconspicuous
        13. Leaves flaccid, linear-setaceous
            14. Stem arising from delicate and branching rootstocks, filiform or slightly compressed, very low and bushy-branched or elongating to 1 m. or more and then remotely branched chiefly below the middle; dimorphic; dilated leaves (when present) coriaceous, from lance- to oval-elliptic in shape.....17. *P. capillaceus.*
            14. Stem arising from filiform extensively creeping rootstock, filiform, freely and repeatedly forking, 1–8 dm. long; not dimorphic.....6. *P. confervoides.*
        13. Leaves not flaccid, though sometimes linear-setaceous
            15. Submersed leaves 9–35-nerved; stem strongly flattened, 0.7–3.2 mm. broad; stipules 1.5–3.5 cm. long. .....7. *P. zosteriformis.*
            15. Submersed leaves 1–7-nerved
                16. Basal glands 0.6–1.2 mm. broad; fruit 2.0–2.3 mm. broad; leaves 2–5 mm. wide, rounded at tip. .....12. *P. obtusifolius.*
                16. Basal glands, if present, 0.2–0.4 mm. broad; fruit 1.2–2.0 mm. broad, leaves 0.1–2.4 mm. wide
                    17. Stipules strongly fibrous, becoming whitish
                        18. Leaves thin, 5–7-nerved, 1.5–3.5 mm. broad, obtuse or rounded and mucronate at tip; stipules 7–11 mm. long; peduncles flattened, 1.5–5 cm. long.....9. *P. Friesii.*
                        18. Leaves firm, often revolute, 3 (rarely 5)-nerved, 0.5–2.5 mm. broad, obtuse to sharply attenuate; stipules 0.8–2 cm. long; peduncles filiform, enlarged at tip, 1–9 cm. long
                            19. Leaves mostly rigid, obtuse or abruptly contracted to mucronate tips .....10. *P. strictifolius* var. *typicus.*
                            19. Leaves firm, scarcely rigid, very gradually tapering to a slender tip; stipules less strongly fibrous..10. *P. strictifolius* var. *rutiloides.*

17. Stipules soft, greenish, membraneous to subherbaceous
    20. Primary submersed leaves 0.1–0.5 mm. wide, without lacunae bordering midrib, the two lateral nerves visible only under high magnification; plants dimorphic; fruiting plants with upper floating dilated leaves elliptic or narrowly obovate; sterile plants with only linear-filiform submersed leaves.....14. *P. Vaseyi.*
    20. Primary submersed leaves 0.3–2.4 mm. wide, with one or more rows of lacunae bordering the midrib, except in *P. foliosus,* 1–3 nerves plainly visible; plants not dimorphic
        21. Leaf bases usually without glands; leaves without lacunae bordering the midrib, except sometimes near the base; sepaloid connectives 0.4–1.0 mm. long; fruit with rather coarse dentate sometimes prominent keels
            22. Stems 0.2–1 m. long, subsimple to loosely branched; leaves deep green to bronze; the primary leaves 4–10 cm. long, 1.4–2.8 mm. broad, 3–5 nerved....8. *P. foliosus* var. *genuinus.*
            22. Stems 0.6–6 dm. long, commonly bush-branched; leaves bright green, the primary leaves 1–8 cm. long, 0.3–1.5 mm. broad, 1–3 nerved.....8. *P. foliosus* var. *macellus.*
        21. Leaf bases commonly with a pair of glands; the leaves usually with 1–several rows of lacunae bordering the midrib; sepaloid connectives 1–2 mm. long; fruit rounded on the back or obscurely keeled
            23. Stipules connate, forming cylinders with margins united at least below the middle, in age rupturing and often shredded at tip; lacunae absent or nearly so in all but upper leaves; spikes interrupted, 6–12 mm. long with 3–5 whorls; winter buds both axillary and terminal.....11. *P. pusillus.*
            23. Stipules not connate, tending to be flat toward tip, convolute; lacunae bordering midrib well-developed; spike continuous, 2–8 mm. long, of 1–3 whorls; winter buds all at the tips of branches
                24. Leaf tips subacute to sharply pointed
                    25. Midrib of principal leaves (below the involucral leaves) bordered on each side by 1 or 2 rows of lacunae

26. Primary leaves of the principal stems 0.5–1.5 mm. wide, with well-defined lacunae often in rows each side of the midrib in the lower half of the leaf.....13. *P. Berchtoldi.*

26. Primary leaves 0.3–1 mm. wide, with a single row of frequently evanescent lacunae each side of the midrib..13. *P. Berchtoldi* var. *tenuissimus.*

25. Midrib of principal leaves bordered on each side by 3–5 bands of coarse lacunae.....13. *P. Berchtoldi* var. *lacunatus.*

24. Leaf tips mostly rounded or obtuse, midrib bordered on each side by 1 row (sometimes 2 at base) of lacunae; foliage mostly dark to light green

27. Principal leaves 3–7 cm. long. .....13. *P. Berchtoldi* var. *mucronatus.*

27. Principal leaves 0.8–2.5 cm. long. .....13. *P. Berchtoldi* var. *polyphyllus.*

12. Submersed leaves 1–10 mm. wide, delicate and ribbon-like, more or less distichous, the broad space between the inner nerves conspicuously cellular-reticulate

28. Submersed leaves 0.5–10 mm. wide, 7–13-nerved, not conspicuously distichous.....18. *P. epihydrus* var. *typicus.*

28. Submersed leaves 0.2–0.8 mm. wide, (3-) 5–7-nerved, strongly distichous and rather crowded on new shoots. .....18. *P. epihydrus* var. *Nuttallii.*

3. Submersed leaves lanceolate, elliptical to ovate

29. Floating leaves with 30–50 nerves, or rarely absent; submersed leaves arcuate, 0.8–2 dm. long and 2.5–7 cm. broad; petioles of submersed leaves 1–6 cm. long; endodermis of O-cells.....21. *P. amplifolius.*

29. Floating leaves with less than 30 nerves, or absent; submersed leaves smaller

30. Margins of leaves dentate.....5. *P. crispus.*

30. Margins of leaves entire

31. Base of leaf clasping stem; endocarp loop with cavity; leaves all submersed

32. Stipules whitish, inconspicuous, disintegrating to stringy fibers; endodermis of O-cells....28. *P. Richardsonii.*

32. Stipules whitish, conspicuous, persistent, rounded at tip; endodermis of U-cells.....27. *P. praelongus.*

31. Base of submersed leaf not clasping stem; endocarp loop solid; leaves both floating and submersed

33. Flowers on short pedicels 0.5–1 mm. long; apex of submersed leaves obtuse, never sharp-pointed, usually with 7 prominent nerves; endodermis of O-cells; floating leaves tapering to petioles 1–3 cm. long; stipules of submersed leaves thin and membranous, becoming shredded, although base is quite persistent; dorsal keel of fruit thin, well-developed upward, and lateral keel none or very low

34. Submersed leaves oblong-linear to linear-lanceolate, 7–25 cm. long, usually more than 8 times as long as broad, tapering to an obtuse or acutish apex .....19. *P. alpinus* var. *tenuifolius.*

34. Submersed leaves oblong to ovate-oblong, 4–10 cm. long, usually less than 8 times as long as broad, apex rounded and sometimes slightly cucullate .....19. *P. alpinus* var. *subellipticus.*

33. Flowers sessile; apex of submersed leaves usually acute, sharp-pointed to mucronate; bases of floating leaves rounded or cuneate; keel of fruit strongly prominent grey-green to olive-green

35. Stipules of submersed leaves firm, persistent; endodermis of U-cells

36. Petioles of floating leaves 2–9 cm. long, shorter than blade; submersed leaves 9–17-nerved, with lacunae in 2–5 rows along midrib.....25. *P. illinoensis.*

36. Petioles of floating leaves 2–10 (–15) cm. long, mostly longer than blade; submersed leaves with 3–9 nerves, with lacunae in 1–2 rows, mostly obscure

37. Principal submersed leaves narrowly elliptic to oblanceolate, (1–) 1.5–9 (–13) cm. long, 0.2–1 (–1.5) cm. wide, 5–10 times as long as broad, or if more than 10 times, then not less than 6 cm. long, sides not parallel; nerves (3–) 5–9

38. Principal submersed leaves (1–) 1.5–4.5 (6.5) cm. long, 0.2–0.6 (–0.8) cm. wide; 5–7-nerved.....26. *P. gramineus* var. *typicus.*

38. Principal submersed leaves (3–) 6–9 (–13) cm. long, 0.6–1 (–1.5) cm. wide; nerves 7–9 (–11).....26. *P. gramineus* var. *maximus.*

37. Principal submersed leaves linear, (1–) 1.5–3.5 (–5.5) cm. long, 0.1–0.25 (–0.3) cm. wide, 10–20 (–30) times as long as broad, sides essentially parallel for most of their length, tapering at apex to an acute tip; nerves 3 .....26. *P. gramineus* var. *myriophyllus.*

35. Stipules of submersed leaves decaying early, except sometimes semi-persistent in *P. nodosus;* endodermis of O-cells

39. Stem without conspicuous spots; floating leaves elliptical; submersed leaves 7–15-nerved, with lacunae of 2–5 rows along midrib, petioles 2–13 cm. long; stipules brown and linear.....22. *P. nodosus.*

39. Stem conspicuously spotted; floating leaves more rotund and ovate; submersed leaves (9–) 11–21-nerved with petioles up to 1.5 cm. long; stipules of floating leaves persistent, triangular..20. *P. pulcher.*

1. P. FILIFORMIS Pers. var. BOREALIS (Raf.) St. J. Map 1.

Collected in Wisconsin at only three stations always in very shallow water: near Oconomowoc in Waukesha County, Kangaroo Lake in Door County, and Trout Lake in Vilas County.

2. P. VAGINATUS Turcz. Map 2.

Collected in shallow water of Lake Mendota in University Bay and also in Marquette County near Montello.

3. P. PECTINATUS L. Map 3.

Widely distributed in southeastern, eastern central, and in the northwestern parts of the state, in shallow water of medium-hard and hard-water lakes and streams. Its abundant fruits form a valuable food for water-fowl.

4. P. ROBBINSII Oakes. Map 4, dots.

Abundant in the northern part of the state and occurring occasionally in the eastern half in either hard or soft water.

P. ROBBINSII Oakes. f. CULTELLATUS Fassett. Map 4, crosses.

Collected at only two points, in Douglas and Waukesha Counties. This form differs from *P. Robbinsii* in having non-serrate leaf margins. See Fassett, Rhodora 35 : 388–389. 1933.

5. P. CRISPUS L. Map 5.

Introduced from Europe, found only in Walworth, Dane, and Trempealeau counties in Wisconsin, collected first in 1905.

6. P. CONFERVOIDES Reichenb. Map 5, cross.

Collected once in Wisconsin, in Langlade County in a lake lying in drift of Fourth Wisconsin glaciation.[3] It occurs other-

[3] Fassett, N. C. Rhodora 36 : 349. 1934.

wise only in the area extending from Newfoundland south to New York, New Jersey and Pennsylvania. See Fernald, Rhodora 33 : 44–46. 1931, and Mem. Gray Herbarium 3 : 32–36, 1932.

7. P. ZOSTERIFORMIS Fern. Map 6.

Locally abundant in ponds and quiet streams of eastern and northern Wisconsin.

8. P. FOLIOSUS Raf. var. GENUINUS Fern. Map 7, crosses.

In medium hard, fresh or brackish water, occurring sparsely in eastern and northern Wisconsin.

P. FOLIOSUS Raf. var. MACELLUS Fern. Map 7, dots.

Chiefly in calcareous waters, abundant in the south-central area and sparsely in the north.

9. P. FRIESII Rupr. Map 8.

Fairly frequently found in calcareous or brackish water in southeastern Wisconsin; also collected in Brown and Door counties as well as northwestward in Forest and Douglas counties.

10. P. STRICTIFOLIUS Ar. Benn. var. TYPICUS Fern. Map 9, dots.

In calcareous waters; collected only once in each of Douglas, Bayfield and Door counties.

P. STRICTIFOLIUS Ar. Benn. var. RUTILOIDES Fern. Map 9, crosses.

Rare throughout southeastern and northeastern Wisconsin, mainly in alkaline waters.

11. P. PUSILLUS L. *P. panormitanus* Biv.; see Dandy and Taylor, Journ. Bot. 76 : 90–92. 1938. Map 10.

Prefers slightly alkaline waters; occurs occasionally in eastern and northern Wisconsin.

12. P. OBTUSIFOLIUS Mert. and Koch. Map 11, dots.

In cold streams and lakes of northeastern Wisconsin. Collected in Oneida, Sawyer, Douglas and Bayfield counties.

13. P. BERCHTOLDI Fieber. *P. pusillus* of authors; see Fernald. Rhodora 42 : 246. 1940. Map 13.

Occurs throughout northern Wisconsin, occasionally in hard-water lakes.

P. BERCHTOLDI var. TENUISSIMUS (Mert. and Koch) Fern. Map 14.

Grows in soft to hard water; occurs in Lake Mendota, Dane County, and occasionally northward through the middle of Wisconsin, also in the northwest.

P. BERCHTOLDI var. LACUNATUS (Hagström) Fern. Map 15.

Collected at three points in northern Wisconsin.

P. BERCHTOLDI var. MUCRONATUS Fieber. Map 16.

Fairly abundant in the northwestern area, collected once in Crawford County in the southwest.

P. BERCHTOLDI var. POLYPHYLLUS (Morong) Fern. Map 17.

Rare, collected only in Douglas, Washburn, Langlade and in Jefferson counties. These varieties of *P. Berchtoldi* have the essentially same range in Wisconsin and very similar general ranges.

14. P. VASEYI Robbins. Map 11, crosses.

Rare, along the Wisconsin River basin in lakes whose waters flow into that river or were at one time connected with it. A species closely related to *P. Vaseyi* occurs both in Michigan and in Minnesota but is not known in Wisconsin. This is *P. lateralis* Morong, differing from *P. Vaseyi* in having fruiting plants with linear submersed leaves and sterile (but often flowering) plants with floating leaves, the opposite of the case in *P. Vaseyi.* The leaves of *P. lateralis* are 0.4–1 mm. wide while the leaf width of *P. Vaseyi* varies from 0.3–0.5 mm. More detailed differences are given by Fernald in his monograph of linear-leaved species.

15. P. SPIRILLUS Tuckerm. Map 18, dots.

Along the Wisconsin River in Portage and Lincoln Counties and northwestward in shallow waters of ponds, lakes, and quiet streams.

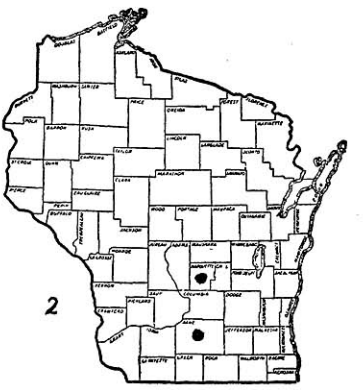
16. P. DIVERSIFOLIUS Raf. Map 18, crosses.

A southern species, found chiefly along the Mississippi and Chippewa rivers.

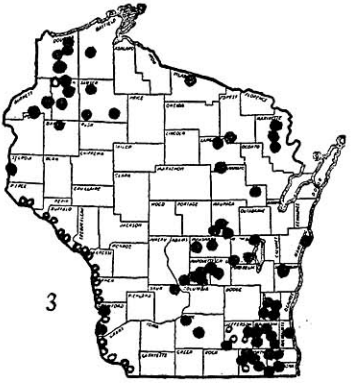
17. P. CAPILLACEOUS Poir. Map 12.

A coastal plain, shallow-water species. Rare in Wisconsin, found occasionally in soft water lakes of Adams, Juneau, Jackson and Sawyer counties.

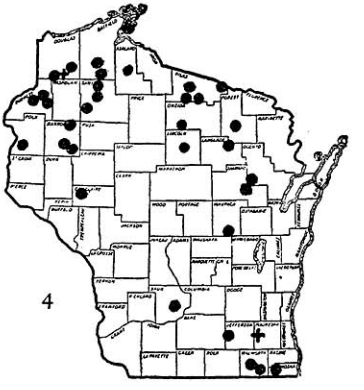
Potamogeton filiformis var. borealis



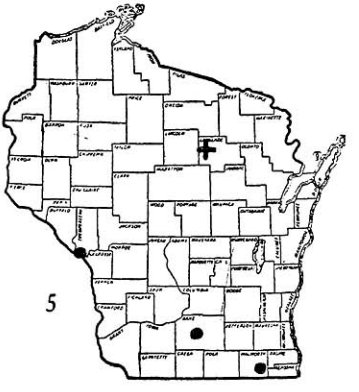
Potamogeton vaginatus



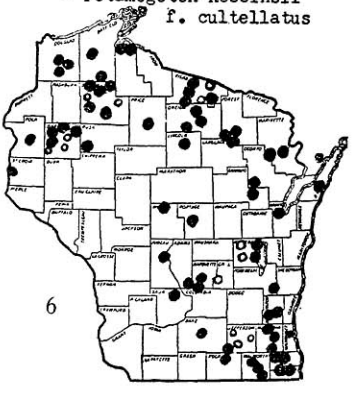
Potamogeton pectinatus



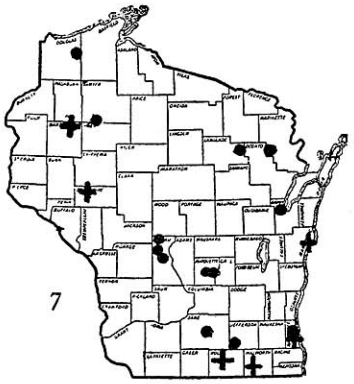
● Potamogeton Robbinsii
✚ Potamogeton Robbinsii f. cultellatus



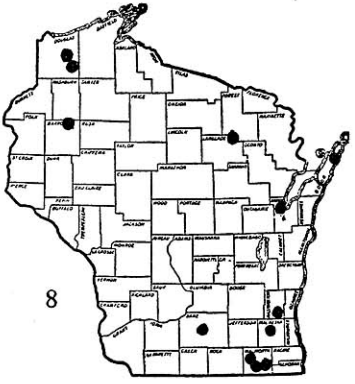
● Potamogeton crispus
✚ Potamogeton confervoides



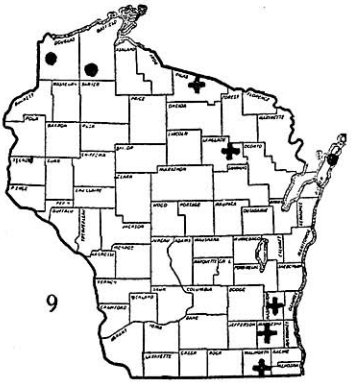
Potamogeton zosteriformis



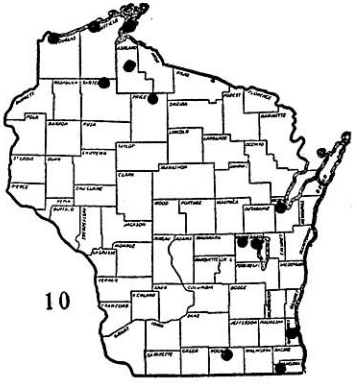
✚ Potamogeton foliosus var. geminus
● Potamogeton foliosus var. macellus



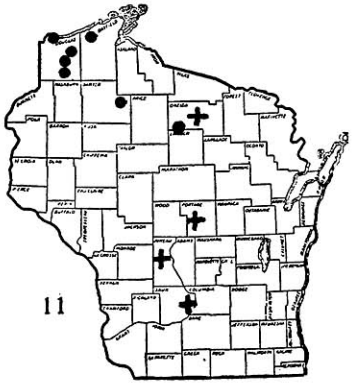
Potamogeton Friesii



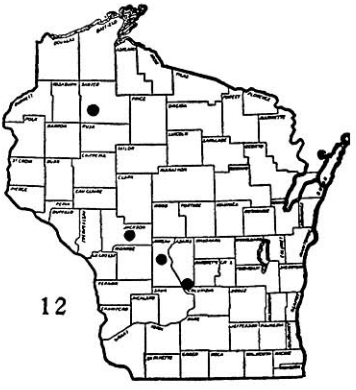
● Potamogeton strictifolius var. typicus
✚ Potamogeton strictifolius var. rutiloides



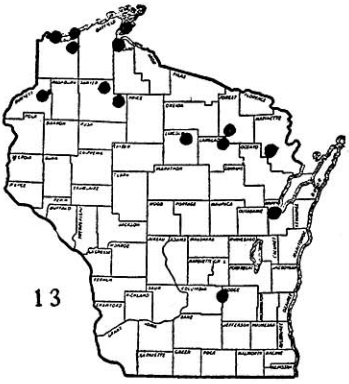
Potamogeton pusillus



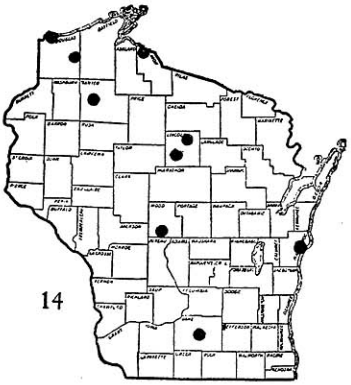
● Potamogeton obtusifolius
✚ Potamogeton Vaseyi



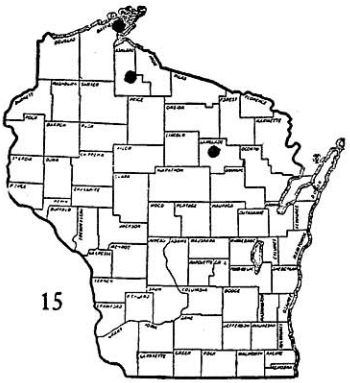
Potamogeton capillaceus



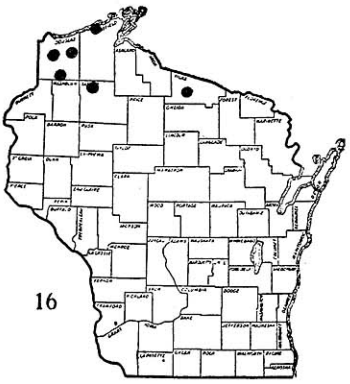
Potamogeton Berchtoldi



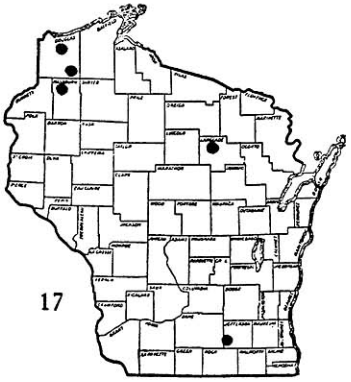
Potamogeton Berchtoldi
var. tenuissimus



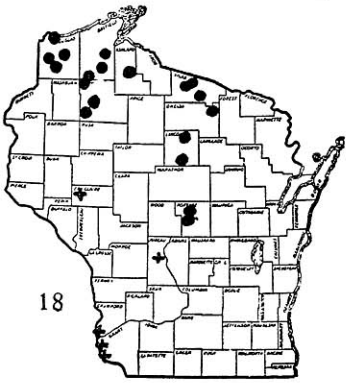
Potamogeton Berchtoldi
var. lacunatus



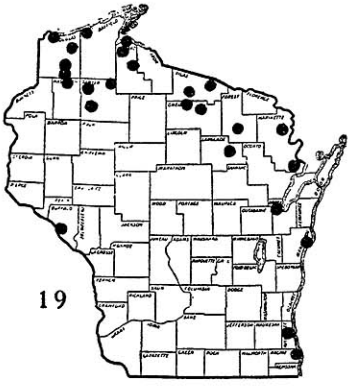
Potamogeton Berchtoldi
var. mucronatus



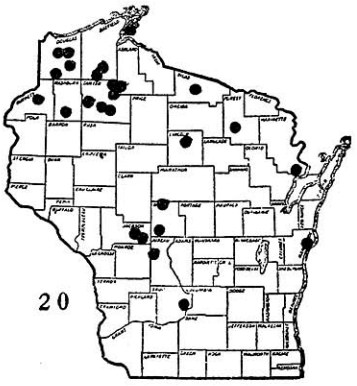
Potamogeton Berchtoldi
var. polyphyllus



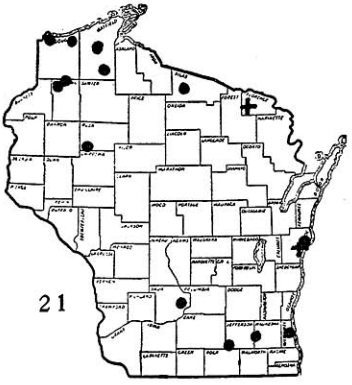
+ Potamogeton diversifolius
● Potamogeton Spirillus

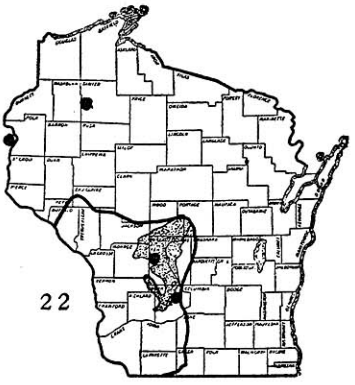


Potamogeton epihydrus var. typicus



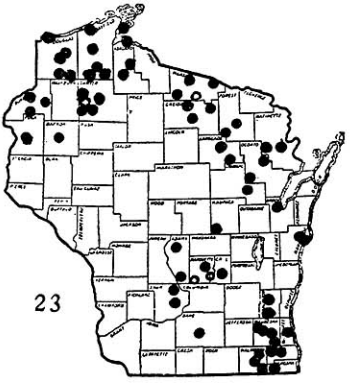
Potamogeton epihydrus var. Nutallii



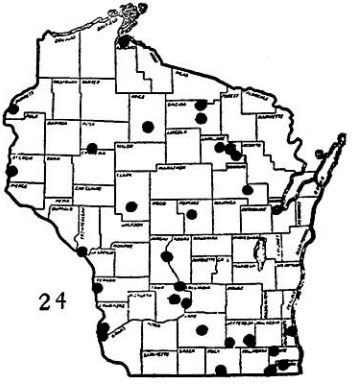


● Potamogeton alpinus var. tenuifolius
✚ Potamogeton alpinus var. subellipticus

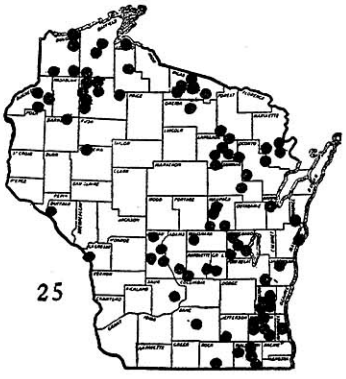
Potamogeton pulcher



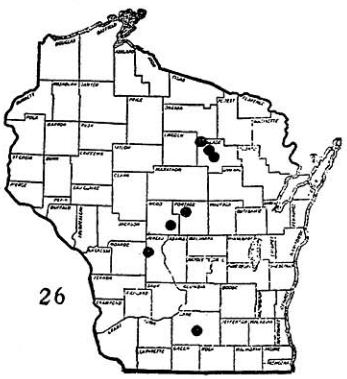
Potamogeton amplifolius



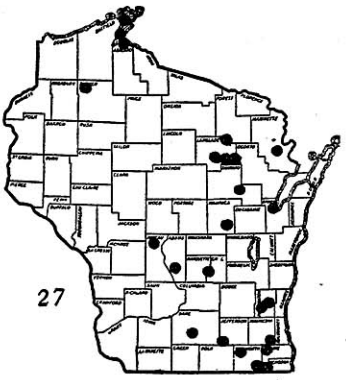
Potamogeton nodosus



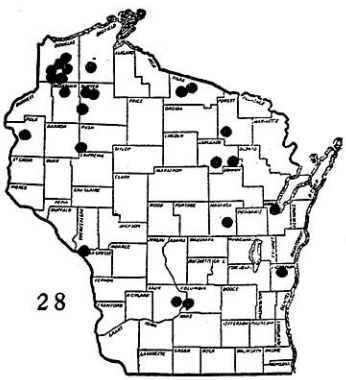
Potamogeton natans



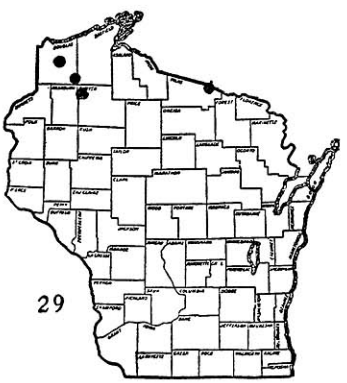
Potamogeton Oakesianus



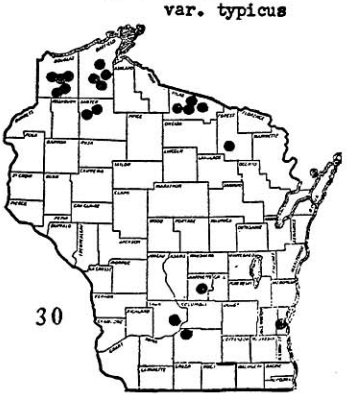
Potamogeton illinoensis



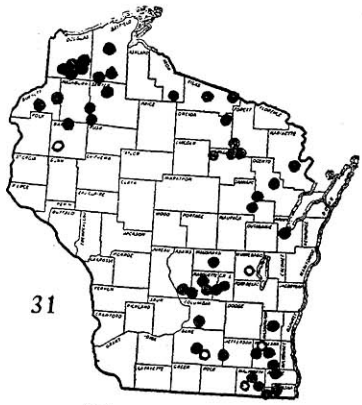
Potamogeton gramineus
var. typicus



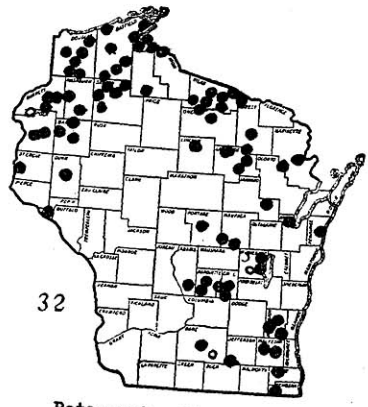
Potamogeton gramineus
var. maximus



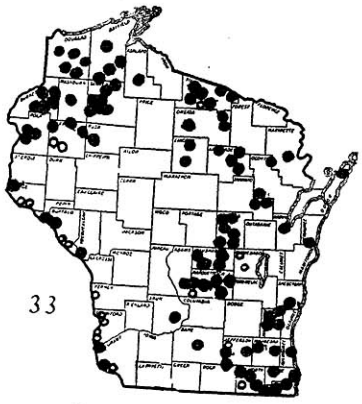
Potamogeton gramineus
var. myriophyllus



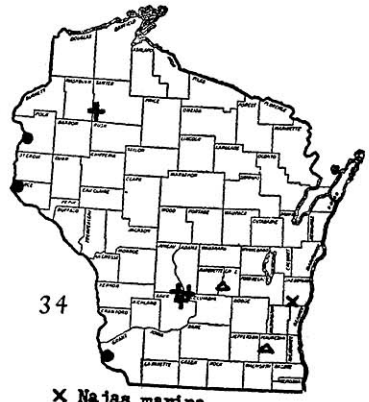
Potamogeton praelongus



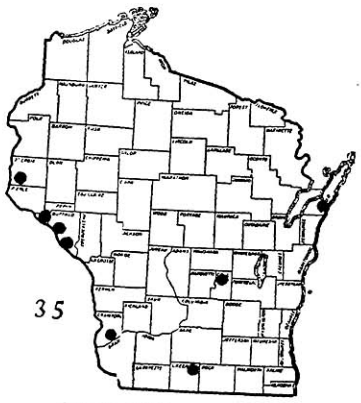
Potamogeton Richardsonii



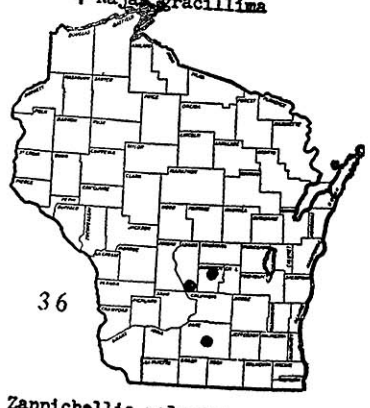
Najas flexilis



× Najas marina
△ Najas olivacea
● Najas guadalupensis
+ Najas gracillima



Zannichellia palustris



Zannichellia palustris var.major

18. P. EPIHYDRUS Raf. var. TYPICUS Fern. Map 19.

Common in the north and occasionally in the east near the Lake Michigan shore, also collected in Sauk and Buffalo counties. This species grows both in soft and hard water lakes.

P. EPIHYDRUS Raf. var. NUTALLII (C. and S.) Fern. Map 20.

Common in north and occasionally in central Wisconsin.

19. P. ALPINUS var. TENUIFOLIUS Raf. Map 21, dots.

Sparsely distributed in northwestern and southeastern parts of the state.

P. ALPINUS var. SUBELLIPTICUS (Fern.) Ogden. Map 21, crosses.

Collected only in Florence and Manitowoc counties.

20. P. PULCHER Tuckerm. Map 22.

This species is not cited from Wisconsin by Ogden, Rhodora 45 : 121–122. 1943, although the dot on Map 6 of his paper (page 127) representing Taylors Falls, Minnesota, appears as if in Wisconsin. This station is indicated on our Map 22 just east of Polk County.

The range of *P. pulcher* in Wisconsin (and in eastern Minnesota) appears to be related in some way to preglacial and early post glacial history. Its occurrence in company with other uncommon species in Holly Lake, Sawyer County has already been discussed.[4] It occurs in Sauk County in the bed of Glacial Lake Wisconsin, in a stream in Baxter's Hollow, in the unglaciated portion of the Baraboo Hills. In Juneau County it is found in the bed of Glacial Lake Wisconsin, in reservoirs maintained for cranberry culture.[5] The possibility of its introduction with cranberry stock from the east appears remote in light of the rest of its distribution in Wisconsin.

21. P. AMPLIFOLIUS Tuckerm. Map 23.

Usually in deep, hard water, common and abundant in eastern and northern Wisconsin.

22. P. NODOSUS Poir. Map 24.

Also known as *P. americanus* C. and S. Usually in flowing water; common along the Mississippi and Wisconsin Rivers and occasionally elsewhere throughout the state.

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[4] Fassett, N. C. Rhodora 36 : 350–351. 1934.

[5] Catenhusen, John. Trans. Wis. Acad. 36 : 165. 1944.

23. P. NATANS L. Map 25.

Tolerant of waters with a large range of pH; abundant in shallow waters of lakes and streams throughout eastern and northern Wisconsin, also at two points near the Mississippi, at La Crosse and near the mouth of the Chippewa River. Because of its tendency to fruit freely it is one of the primary foods for water-fowl.

24. P. OAKESIANUS Robbins. Map 26.

Not widely distributed, found in shallow water of stream near Madison, Dane County and at one point in each of Wood, Juneau, Portage and Langlade counties.

25. P. ILLINOENSIS Morong. Map 27.

Including *P. lucens* and *P. angustifolia* of American authors. Sparsely scattered throughout eastern and northern Wisconsin.

26. P. GRAMINEUS L. var. TYPICUS Ogden. Map 28.

Fairly abundant in the north but very rare elsewhere.

P. GRAMINEUS var. MAXIMUS Robbins. Map 29.

Very rare in northern Wisconsin.

P. GRAMINEUS var. MYRIOPHYLLUS Robbins. Map 30.

Moderately abundant in some areas in the north but found only at one station in each of Marquette, Sauk, Dane and Ozaukee counties in the south.

27. P. PRAELONGUS Wulfen. Map 31.

Usually in medium-hard water; fairly common in eastern and northern Wisconsin.

28. P. RICHARDSONII Ar. Benn. Map 32.

Commonly found in medium-hard-water lakes in eastern and northern Wisconsin. *P. bupleuroides* was reported from northern Wisconsin by Fassett, Rhodora 29 : 228. 1927, but the material seems rather to belong with *P. Richardsonii.*

NAJAS

1. Leaves coarsely toothed, the teeth visible to the naked eye; backs of leaves often spiny; fruits 4–5 mm. long.....*N. marina.*
1. Leaves with fine teeth, usually visible only under a lens; backs of leaves not spiny; fruits 2–3.5 (–4.5) mm. long
   2. Widenings of leaf bases tapered

3. Style 1 mm. or more long; seed very finely and obscurely marked with 30–40 rows of pits across the middle, usually shining
   4. Leaves 1.5–4 cm. long, 0.5–1 mm. wide at base above the lobes, gradually tapered to the tip; seed shining.....*N. flexilis.*
   4. Leaves 9–18 mm. long, 1.2–2 mm. wide, abruptly pointed; seed dull.....*N. olivacea.*
3. Style 0.5 mm. or less long; seed dull, coarsely and deeply pitted with 10–20 rows of pits across the middle...*N. guadalupensis.*

2. Widenings of leaf bases lobe-like, wedge-shaped and coarsely jagged, leaf blades thread-like, finely toothed.....*N. gracillima.*

1. N. MARINA L. Map 34, X.

Collected at one station in Wisconsin, Random Lake, Sheboygan County.

2. N. FLEXILIS (Willd.) Rostk. and Schmidt. Map 33.

Common in the shallows of medium to hard water lakes in the eastern and northern areas of Wisconsin.

3. N. OLIVACEA Rosendahl and Butters. Map 34.

Two collections in Wisconsin have been identified by Professor Rosendahl as probably belonging to this species. Since mature fruit is not present, identification could not be made with certainty.

4. N. GUADALUPENSIS (Spreng.) Morong. Map 34, dots.

In Wisconsin this species has been collected at only three stations along the Mississippi River. These are either in the shallows or in adjacent lakes.

5. N. GRACILLIMA (A. Br.) Morong. Map 34, crosses.

Collected near Wisconsin Dells and once in Sawyer County. See Fassett, Rhodora 38 : 348–350. 1934.

ZANNICHELLIA

1. Z. PALUSTRIS L. Map 35.

Stems numerous and thread-like, from extensively creeping root-stocks; fruits in bunches of 2–5, scarcely stalked, the body 2–2.5 mm. long. Hard to brackish water; along the Mississippi and Wisconsin river basins, not common.

2. Z. PALUSTRIS var. MAJOR (Boenn.) Koch. Map 36.

Fruit longer stalked, the body 2.5–3 mm. long. Though found chiefly along the Atlantic Coast, it has been collected in Adams, Marquette, and Dane counties in Wisconsin.