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A DISTRIBUTIONAL STUDY OF THE GENUS POTAMOGETON IN MICHIGAN, INCLUDING SOME ECOLOGICAL NOTES ON OTHER AQUATIC GENERA

Thesis submitted to the faculty
of Michigan State College in partial
fulfillment of the requirements for the
M.S. degree

Henry Oosting

1927

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A Distributional Study of the Genus Potamogeton in Michigan, Including Some Ecological Notes on Other Aquatic Genera

Introduction

The genus Potamogeton forms one of the important elements of aquatic vegetation. No publication which concerns aquatics in general is complete without a discussion of the relationships of the genus with the other plants of aquatic habitat. All contributions to the vegetational conditions in marginal waters must recognize its importance because the genus constitutes a vegetational unit which makes up a large part of the inland aquatic vegetation.

The United States Department of Agriculture has done considerable investigation concerning its value as a game food. The starchy tubers and tuberous rootstocks are the favorite food of most ducks and the seeds and buds are eaten when available. The filiform types such as P. pectinatus are often eaten in their entirety. Methods of propagation and the conditions of growth are being studied so that the game preserves may be planted.

In its relationship to animals, the genus is as important as any aquatic group. Muskrats eat the plant tubers, while the larger fish feed on the tenderer forms. For every species of Potamogeton there are several species of insects whose larvae feed upon the plant or at least pass a period of their

lives upon it. These in turn may be related to the fish which feed upon them. Davis says, "plants furnish places of nesting, of refuge and of rest for fish, and a study of Walnut Lake records shows that the abundance of many fish and their permanence at any station was largely correlated with plant growth (17)".* It is evident that the relationships of aquatic plants to animals will bear considerable investigation and that results may be of economic importance.

As marl-forming agents, the various species of Potamogeton probably stand next to the Characeae in importance. In the great peat deposits of the state, borings invariably show the presence of some Potamogeton in the lakes of the past and in sufficient abundance to aid materially in the filling of the lakes and the building up of muck lands.

Considering the importance of the genus, it would seem that a survey of its distribution in a state so rich in conditions favoring its growth would be entirely justifiable.

To determine the distribution, the herbaria of the Michigan State College, the University of Michigan and the Field Columbian Museum of Chicago were studied, as well as the private collections of Cecil Billington of Detroit, C. W. Fallass of Petoskey, and Professor B. A. Walpole of East Lansing. In addition, the writer made extensive collections in several counties in western Michigan. All available publications

*Numbers in parentheses refer to bibliography.

were consulted to increase the distribution records, but because of the critical nature of the genus, only the reports which seemed most reliable and those of the commonest species were recorded.

Agnes Arber in her book on aquatic plants says "The Pondweeds are an exceedingly difficult group from the view point of the student of systematic botany, as the numerous species can, in many cases, only be discriminated as the result of much experience (2)". This difficulty of identification is due principally to the extreme variation of species, with the result that few specimens can be identified without careful investigation. Because of the critical nature of the genus, experienced students of aquatics have divided the group into hundreds of sub-species and varieties. This is particularly true of such authorities as Fryer, Bennett, and Hägstrom who have made the study of aquatics a life work. To consider even a part of their fine discriminations of species and sub-species would require far more study and investigation than this survey involves.

The nomenclature as found in Britton and Brown's "Illustrated Flora of the Northern States and Canada", 2nd edition, has been used throughout this work. For identifying the more difficult forms it was necessary to supplement the Britton and Brown key with several others and of these the key in Gray's"New Manual of Botany", 7th edition, and the key of Thomas Morong as found in his "Naiadaceae of North America"

were of most assistance. (Any further reference to Britton and Brown or to Gray's Manual applies to the above editions).

Environmental Relations

The aquatic habitat is so uniform and requires such definite characteristics for growth that the vegetation tends to be uniform in character. The submerged portions of all aquatics show tendencies toward simplification both in tissue structure and general form. The genus Potamogeton is no exception. Conducting tissues show no complexity, and other differentiation is reduced to a minimum. Most of the submerged leaves are but three cells in thickness. The two outer layers form the epidermis and the single layer between makes up the mesophyll. The epidermal cells are thin-walled, non-cutinized and often contain more chlorophyll than the mesophyll cells. This gives the leaves their characteristic deep green coloration. Further tendency toward simplicity can be seen in the form of the submerged leaves. All but a few are elongate, linear or ribbon-like and sessile on the stem. Species such as P.americanus and P. perfoliatus have leaves which are somewhat elongated and taper to short petioles.

This simplicity and uniformity makes identification difficult but to make matters worse, in the genus Potamogeton, the problem of variability in leaf form must also be contended with. The fruits develop characteristically for each species. Two species may often be distinguished by good mature fruits

only. The leaf venation, the type of stipule and manner of its attachment, may usually be considered as invariable, and these aid materially in identification.

An illustration of the forms difficult to identify is the amphibious type of floating-leaved species. These are dwarfed, coarse forms, usually lacking submerged leaves and often without fruits. They develop when the water drys up or recedes to lower levels, leaving the aquatic plant to die or adapt itself to the new conditions. Most water plants, unless highly specialized for aquatic life, are capable of producing such land forms when left in this condition. It is probable that the types having floating or aerial leaves are most successful because the least change is necessary for their establishment. In the genus Potamogeton the types with coriaceous, floating leaves are most commonly found in this condition. Fortunately, the leathery, floating leaves and the stipules retain their normal characteristics and they aid in identification. Occasionally fruits are produced, which simplifies matters somewhat, while comparison with forms in adjacent water may also aid. Forms collected which were growing in the amphibious or land condition are P. natans, P. americanus and P. heterophyllus. In this condition these lack their submerged leaves. The floating leaves are shorter and heavier than in the water forms and some were collected which were partially buried in the mud.

Although the general form of a given species may be extremely variable, there are certain characteristics which are

constant. The floating leaves are invariably coriaceous and unwettable, due to a peculiar, wax-like coating not present on submerged parts. Unlike terrestrial plants, these leaves can not yield when battered by heavy rains, nor can they escape the constant motion of the water on which they float. As a consequence these protective features are necessary to permit them to hold their positions successfully. In some submerged forms, the entire plant is flexible and moves as a whole with the fluctuating water. This is more true of the filiform and ribbon types which are often two or three times as long as the depth of the water in which they grow. Potamogeton natans has the stem-axis fixed in the ground at an angle and by one end only. From this the petioles arise at an angle from pliable points of attachment which permit the leaf to respond to every water movement without resistance.

Light passing through water is reflected at the surface, absorbed by the water, and retained by substances in solution and suspension to such an extent that all submerged aquatics are of the "shade plant" type. They invariably have delicate leaves, little palisade tissue, and contain chlorophyll in the epidermis. It is possible that the filamentous, linear forms are produced to increase the leaf surface for combating the diminished light in water.

It is known that darkness will cause elongation in some terrestrial plants (37). The writer is of the opinion that this effect may be observed in some species of Potamogeton and

that it may account for the variation in length of leaf in some cases. Potamogeton epihydrus, collected in Pigeon Lake, Ottawa County, has excessively long, submerged leaves. Other species found here in the deeper water have noticeably elongated submerged leaves. The water coming in is slow moving and drains from a boggy area which gives it a dark brown color. In Black Lake the water also has a dark color due to factory waste. Here the linear-leaved species, especially when growing in water of any depth with the resultant diminished light, tend to grow long and to float upon the surface, while the lower submerged part of the plant often reduces to the main stem only. Potamogeton compressus in particular was observed in this condition.

Another factor which may produce elongation in aquatic plants is strain due to current. This was brought to my attention again and again in the field. Whenever a species of Potamogeton was found growing in a swiftly moving stream, it was elongated far beyond the depth of the water in which it grew. Experiment has proved that a plant subjected to a steady pull in the direction of growth will eventually grow longer than one not so treated (37). It seems reasonable to conclude that the extreme elongation of these specimens was due, at least in part, to the pull exerted by the stream flow.

In connection with stream flow, rheotropism should be mentioned. Arber says that plants growing in water which flows in a definite direction tend to grow in the direction of the current, regardless of the strength of that current. All

specimens of Potamogeton collected in streams illustrated this phenomenon conspicuously.

The factors influencing variation in leaf form are probably many. The problem has been studied from various angles by several botanists and the conclusions are still quite general. The concentration of the medium combined with nutrition probably forms an important factor. Transpiration has also been suggested as having some effect, as well as the type and fertility of the substratum (15).

Life Habits

The genus is so variable and adapts itself so easily to changing conditions that some species may be found in almost any body of water in Michigan. Stagnant or extremely filthy water, however, is not conducive to Potamogeton growth. Where the water is fresh and not too exposed or swift flowing, at depths varying from two decimeters to eight meters, some forms may almost invariably be found. Beyond this depth or in more open water it is almost impossible for the larger aquatics to establish or maintain themselves, with the results that the aquatic vegetation is somewhat concentrated along the margins of the water. Competition and the varying needs of the different types of vegetation have resulted in a definite arrangement of groups with relation to each other. These zones are almost invariable and are an outstanding characteristic of aquatic vegetation. But a comparatively few species can tolerate aquatic conditions and as these conditions are quite uniform everywhere,

aquatic floras are everywhere very similar. The few types adapted to aquatic life can endure certain conditions and no others, so that they are always found in definite habitats, always in the same zones, each zone dominated by a species or a group of species.

The relationships are ordinarily just as might be expected. Where there are large floating leaves, submerged types could hardly be expected to grow in the shaded waters beneath. These submerged forms usually form a zone by themselves. The semi-aquatics are found in shallow water near the shore.

The attached marginal vegetation may ordinarily be divided into four general zones. As conditions bearing on vegetation may vary, these zones must be modified for almost every lake when details are considered. First, along the shore in shallow water and to a depth of a meter, is a zone characterized by sedges and rushes. Along the outer margin of this zone a few of the larger leaved species of Potamogeton may be found, especially those with floating leaves. Of these P. natans is a common form. The second zone is made up almost entirely of plants with floating leaves such as Nymphaea, Nelumbo and Castalia. Because of their habit of covering the entire water surface with their large leaves, the submerged aquatics are forced to live outside the floating-leaved zone. In the deepest waters of the lake, vegetation is extremely sparse and is limited almost entirely to species of Naias and Chara. Between this deep-water zone and the floating-leaved zone, we find the genus

Potamogeton thriving as the dominant plant. Here, almost any or all of the species may be found. When the water lilies or large floating-leaved types are absent, Potamogeton may occupy all the area from deep water to the sedges.

The width of the zones varies with the slope of the bottom. A steep narrow shelf with a sudden drop to deep water, limits the width of the zones and the number of species which may take root there. Under such conditions the Potamogeton zone may not be present at all or only a few scattered forms may be found along the margin of the drop off. This condition is found in small deep lakes which are gradually disappearing. Then again, one part of a shore line may be in this steep condition while another in the same lake may have a wide shallow margin, gradually increasing in depth. The distribution of the genus here is obvious.

Associated with the genus Potamogeton are several other genera whose conditions for growth are practically the same. Elodea, Vallisneria, and Myriophyllum species are common while Brasenia is often found scattered through the two central zones. Their demands seem similar to those of the floating-leaved Potamogeton such as P. natans. Unattached species of Ceratophyllum and Utricularia are common also in almost any zone, and the small duckweeds such as Lemna and Wolffia may be found anywhere, although concentrated mostly in sheltered waters.

The genus Potamogeton is not limited to lake margins alone. In some shallow water bodies they may be scattered throughout.

However, if these be lakes of any size and unsheltered, permitting rough water, then floating-leaved types in particular are rare, and the open water will have few if any species. Potamogeton compressus, which is heavily veined and has linear leaves and stem, combines strength with a minimum resistance to wave action. Specimens were collected in the center of Black Lake, Ottawa county, where they were exposed to the most extreme weather conditions. More fragile types such as P. pusillus, probably would not survive in such locations, although having the same general form.

Collections of almost all species were also made in streams of widely varying character. The biological wealth of a stream varies inversely with its rate of flow, according to Pond (44). This statement is applicable to the genus Potamogeton, for whenever anything checks the flow of water, there conditions are more favorable for its development. Where the flow of the stream is checked, there is an accumulation of organic material and a deposition of rich alluvium, with the consequent increase of soil fertility and an increase in vegetation.

Some observations of habitat made in Black River, Ottawa county, are of interest. Almost without exception, the smaller filiform species were found in shallow water with sandy or gravelly bottom, while P. americanus was invariably found on clay bottom or next a clay bank. Species with linear or ribbon-like leaves seem best able to survive in shallow and swift moving streams. Several of these species were collected from

shallow, swift-flowing, sandy-bottomed streams at scattered stations. The water often was little more than a decimeter in depth while the plants were often a meter or more long and floating out on the surface.

The gelatinous or slimy sheath characteristic of so many water plants is conspicuously present in this genus. In some cases it is only about the seeds and in others the young leaves and growing points may be encased in it. Again, the entire plant may have a thin coating. It has been suggested (44) that this covering may protect amphibious forms and others too, from too rapid loss of water when exposed. Perhaps it is a protection for young buds and shoots against devouring animals. In submerged plants (2), the mucilage hinders the entry of water. Its true function has seemingly not been determined.

An incrustation is often found on the submerged leaves and stems of many of the Potamogeton species. This incrustation is a deposition of calcium carbonate. Several theories as to the reasons for its presence have been advanced but nothing very definite has as yet been determined (53). The commonest theory states that when the plants withdraw carbon dioxide from the water for food manufacture, the soluble bicarbonate of lime which is present in the water, is reduced to the insoluble neutral carbonate and deposited upon the plant surface.

$$CaH_2(CO_3)_2 \longrightarrow CaCO_3 + CO_2 + H_2O$$

Another theory considers the oxygen liberated by the plant as a

catalytic agent which acts on the bicarbonate to change it to a neutral carbonate. The most recent explanation rests upon the discovery that a soluble calcium salt of succinic acid is present in the cell sap of Chara. "The occurrence of this salt in the sap of other plants has not been determined, but as succinic acid is a very probable by-product in the ordinary processes of plant physiology, its wide distribution may reasonably be expected. As the calcium salt escapes from Chara by osmosis it is most likely decomposed with the formation of the insoluble carbonate." (44).

A considerable amount of careful work has been done on marl of late and investigation shows that, although the precipitation of calcium carbonate by plants is only one factor in the production of marl beds, still it is a factor which is great enough to be economically important.

On some species of Potamogeton, the incrustation is almost invariably present while on others it is sometimes present. On the ribbon-leaved species of Potamogeton and such aquatics as Vallisneria, it seldom lodges, for their movements with the water probably set it free as soon as it is produced. In all cases the incrustation may easily be removed from the leaf. Its presence or absence does not seem to affect the life processes of the plant, as the most heavily incrusted specimens may be as large as those without a trace. So far as is known, the incrustation is a result of processes taking place within the plant and has no particular effect on the life processes

of the plant which precipitates it.

The genus Potamogeton includes in its vegetative reproduction every possibility or means employed by other aquatics. Some species propagate by vegetative fragments. Some have rhizomes and tuberous rootstocks to carry them through the winter. Still others produce vegetative winter buds - hibernacula, propagules or turions as they are variously called. These break off, drop to the bottom and start new plants in the spring. Although vegetative reproduction is possible in so many ways, sexual reproduction is also well developed. Wind is usually the pollen distributor and the spikes will be found protruding just above the water. In P. praelongus, the stem shortens after pollination and the spike is drawn under water where the seeds mature. Several of the completely submerged species are pollinated under water. In these, the pollen grains are filamentous structures that are as heavy or heavier than water and lack the thick exine characteristic of aerial pollen (15). Such pollen grains upon release float just beneath the surface and may come into contact with the long exserted stigmas.

Some members of the genus have almost completely ceased to produce seeds. Potamogeton robbinsii Oakes is the rarest of North American species to fruit with the exception of P. interruptus Kitaibel which bears floral spikes quite freely, but is not known to mature fruit in this country, though it does in Europe (28). Dr. Thomas Morong writes as follows in regard to the fruiting of P. robbinsii: "Very rarely, in years when

the waters are low, the flowering spikes rise above the surface and perfect a few fruits. Dr. Robbins saw but one fruit, collected in Oregon by Hall. Mr. Faxon collected a few fruiting specimens in Jamaica Pond, Massachusetts, in 1880. Besides these, I have never known another instance, although the plant is very prolific in the localities where it occurs."

Of the specimens of P. robbinsii I examined, none bore fruits. Specimens collected and observed in the field had spikes in various stages of maturity, and although a few appeared to have had fruits, none were collected or seen. P. interruptus was not collected, but of the specimens examined, None bore even a trace of a spike. Emmeline Moore says of P. robbinsii that in spite of the absence of fruits, propagation is readily effected. The branches, especially those with short internodes, become thickened and hardened through the storage of starch and when detached, function as propagative structures. As this enlargement and induration may take place at various points along the main axis, the final dismemberment of the whole plant provides enormous possibilities for the multiplication of the species.

P. pectinatus and P. filiformis are propagated by small tubers. These form at the ends of runner-like stems which spread in all directions from the main axis of the growing plant. P. perfoliatus and P. americanus grow in beds or small groups. All are connected by a network of underground runners or roots. Miss Moore explains these as non-tuberous underground

stems, rooting at the nodes and carrying the plant through the winter by the enlarged terminal portions which bear scaly buds. P. heterophyllus has its individuals connected in a series by an underground portion which is a series of short nodes and swollen internodes and Miss Moore calls this "propagation by tuberous rootstocks". This underground system of migration is very rapid in water plants, the soft mud of lake bottoms offering but little resistance to growth. Cowles says that a meter advance in a year is not uncommon.

It is quite generally agreed that temperature variation in water is considerably less, taken the year around, than on land. In spite of this, there is always a possibility of freezing. To overcome this possibility, species which grow the year around, like P. crispus, sink to the bottom in winter. Others withstand the most extreme cold by means of their seeds or winter buds.

These winter buds are formed by the tips of branches with a closely packed, overlapping mass of leaves and stipules. These form in the late summer, and in the fall they separate from the parent. Due to their compactness, they are heavier than water and so sink to the bottom where they rest through the winter. In the spring they resume growth like a simple vegetative branch.

P. compressus produces conspicuous winter buds and also plentiful fruits. P. friesii and P. pusillus, which are smaller forms, also commonly produce both buds and fruits. Miss Arber

has shown that bud formation, in these types particularly, can be directly connected with unfavorable growth conditions. To bear this out, I found that the smallest and weakest plants usually bore the most and the largest winter buds. These species bearing both buds and fruits have a general distribution and are very common forms. It is probable that this double method of reproduction helps to explain this distribution.

P. crispus forms a slightly different type of bud. Miss Moore calls it a bur. Morong groups both types together and speaks of them as propagating buds while Miss Arber calls them all turions. The P. crispus bud is merely a much shortened branch with reduced leaves and a concentration of starch within it. The entire bundle hardens and this hardness combined with the serrulate margins of the leaflets gives the feeling and appearance of a bur. Large numbers of these buds are formed and as nearly as I can learn, fruiting in P. crispus is quite uncommon. No fruits were found at the three stations where it was collected.

The advantage in carrying the plant through the winter by means of these buds is obvious. However, vegetative reproduction of this type has its disadvantages, chief of which is the limitation in rate of dispersal. The establishment of such species in distant habitats is almost impossible unless there are continuous waterways between and the result is a slow migration.

Distribution

Before attempting to draw any conclusions from the records of distribution, several factors should be considered which influence these records and which will modify the interpretation somewhat.

Potamogeton species are often found in almost inaccessible places. Usually they are covered with a slimy sheath which makes them difficult to handle and requires special pains in preserving specimens. After collecting, they decompose very quickly. Specimens in fruit are necessary for the identification of some species and fruiting specimens are often lacking. With these disadvantages it is obvious why collections of aquatic plants are limited.

Records for some species are very limited. Most of these bear close resemblance to more common species and can only be distinguished by careful study. The result is that the average collector does not recognize them in the field or after collection. In this class are P. oakesianus Robbins which is scarcely distinguishable from P. natans L. except in mature fruiting condition. Enough specimens of P. oakesianus were examined and collected to feel certain that it grows in the state and the wide separation of the points of collection would indicate that further search may reveal a general distribution. Several of the filiform species are even more difficult to recognize and identify.

Because of the variable character of the genus, the several

species are capable of adapting themselves to almost any condition of habitat with the result that most of the forms have a general distribution throughout the entire state. This is particularly true of the more prolific forms such as P. perfoliatus, P. heterophyllus, P. americanus and the type species P. natans.

There is one exception to this general distribution. An area including Otsego, Montmorency, Kalkaska, Crawford, Wexford and Missaukee counties has no record of any specimens whatsoever. This would seem to indicate that conditions here are unfavorable to the growth of the genus. However, a study of detailed county maps of this area shows that all have at least enough water to supply the conditions necessary for the growth of Potamogeton. Adjoining counties on all sides show general distribution for most species. The fact that the blank area is the same for every species leads to the conclusion that the area has probably not been sufficiently botanized.

Previous to the summer of 1926 the counties of Newaygo, Ottawa and Barry showed practically no records of Potamogeton collections. During that summer the writer botanized in these three counties with the result that practically all species found in the state were found there also. I conclude therefore, that the total absence of records in some regions, is due not to the absence of Potamogeton but to the absence of botanists.

Considering the species more in detail, we find several exceptions to the general conclusions. Several species have

not been collected or reported in the state. Others are so rare that the authenticity of reports may be doubted, especially where there is a close resemblance to some more common form. The greatest possible care was used in the identification of such forms. They were only recorded when the specimen had been thoroughly checked. Reports were not recorded at all in cases where there was room for doubt.

Of P. faxoni Morong. but two reputed specimens were examined. The one from Genesee County collected by D. Clark agrees entirely with descriptions obtainable. However, the specimen of S. H. Camp, from Jackson County is immature and also has many of the characteristics of P. americanus C.& S. Gray's Manual holds that P. faxoni Morong. is an infertile hybrid of P. alpinus Balbis and P. americanus C.& S. If this is true, and neither of these specimens had mature fruits, then the poor distribution is somewhat explained. Its close resemblance to these other forms may also explain the lack of specimens on record for the state.

In Britton and Brown's Illustrated Flora, P. varians Morong is spoken of as a hybrid of P. angustifolius Berch. & Presl. and P. heterophyllus Schreb. and it is limited to Mystic Pond, Medford, Massachusetts. Five good specimens were examined which were originally collected and identified by reliable botanists. The specimens were collected in widely scattered stations in the state and the evidence would seem to indicate its establishment in Michigan. The records may be limited because of its

close resemblance to P. heterophyllus Schreb.

P. crispus L. is a European species which has become established in the Atlantic coastal states and is gradually migrating inland. One specimen was examined which had been collected by Pennington in Van Buren county and during the summer, the writer found P. crispus growing prolifically at three distinct stations in Ottawa county. The manuals limit the range of P. crispus to the eastern states. In 1913, E. D. Hull wrote a short article on the advance of the species and showed it had but recently established itself in Illinois and Indiana and that the points of establishment were along connected bodies of water. Because of its means of dispersal, previously mentioned, this seems entirely within reason. These water bodies mentioned by Hull are connected with Lake Michigan and so migration to other nearby water bodies connected with it could well be expected. The collections made in Michigan were in the southwestern part of the state, in small lakes connected with Lake Michigan and it seems reasonably possible that the species could have migrated to these points from Illinois and Indiana where it was already established in 1913. I have found no other record of its growth in the state, and in the several counties I worked I found no evidence of its presence.

Of the thirty five species as listed in the Illustrated Flora of Britton and Brown, seven have not been found in the state. P. pulcher Tuckerm seems to be limited almost entirely to the Atlantic coastal states and the south. P. mysticus

Morong, a depauperate form of P. perfoliatus L., is a local species found in a few stations in Massachusetts. P. confervoides Reichb., a delicate, filiform species, is restricted more to cold streams or mountain ponds and is common in the New England states, particularly Maine and New Hampshire. It is possible that further investigation may show its presence in the Upper Peninsula of Michigan. P. gemmiparus Morong is a local species found in the Atlantic states only. The range as given in Gray's Manual and the Illustrated Flora of Britton and Brown for P. diversifolius Raf. and P. dimorphus Raf. includes Michigan but no specimens were collected or located for examination.

Key to the Species of the genus Potamogeton in Michigan.

1a. Plants with both floating and submerged leaves.

2a. Submerged leaves bladeless, reduced to phyllodes.

3a. Nutlets pitted, 4-6 mm. long, 3 mm. wide --
1. P. natans.

3b. Nutlets not pitted, 3 mm. long, 2 mm. wide -------- 2. P. oakesianus.

2b. Submerged leaves with a proper blade.

4a. Submerged leaves capillary to linear.

5a. Submerged leaves capillary to linear-setaceous, 0.1-0.5 mm. wide, 1-nerved - 22. P. vaseyi.

5b. Submerged leaves linear, broader than 5a, several-nerved.

6a. Leaves ribbon-like, obtusely pointed, coarsely cellular-reticulated each side of midrib -- 4. P. epihydrus.

6b. Leaves broader at base, acute; no cellular-reticulation --- 8. P. heterophyllus.

4b. Submerged leaves lanceolate to ovate.

7a. Submerged leaves not of same type at upper and lower part of stem.

8a. Upper submerged leaves oval or elliptic, lower lanceolate, not pellucid; plant green ---------- 3. P. amplifolius.

8b. Upper submerged leaves petioled, lowest sessile; semi-pellucid; plant

reddish-tinged throughout ---- 5. P. alpinus.

7b. Submerged leaves all of same type.

9a. Submerged leaves petioled.

10a. Floating leaves elliptic.

11a. Floating leaves broadly elliptic, rounded or subcordate at base -- 10. P. illinoensis.

11b. Floating leaves narrowly elliptic, tapering at base -- 6. P. americanus.

10b. Floating leaves obovate or oblanceolate, tapering at base ---- 7. P. faxoni.

9b. Submerged leaves sessile or subsessile.

12a. Fruit only 2 mm. long, obscurely 3-keeled ---------- 9. P. varians.

12b. Fruit 3 mm. long, distinctly 3- keeled ---------- 11. P. angustifolius.

1b. Plants with submerged leaves only.

13a. Stipules free from petioles.

14a. Leaf-blades rather broad, 6 mm. to 4 cm. wide, lanceolate or oblanceolate to ovate, several- to many-nerved.

15a. Leaves sessile or short-petioled, not clasping.

16a. Fruit 3-keeled, 2.5-4 mm. long; spikes 2.5-5 cm. long --------- 11. P. angustifolius.

16b. Fruit scarcely keeled, 3 mm. long; spikes 5-7.5 cm. long --------- 12. P. lucens.

15b. Leaves clasping or half-clasping.

17a. Leaves half-clasping, elongate with rounded cucullate tips; stipules conspicuous; fruit sharply keeled ---------- 13. P. praelongus.

17b. Leaves cordate-clasping, if elongate the tips plane tapering; stipules inconspicuous or soon reduced to shreds; fruit rounded or scarcely keeled ---------- 14. P. perfoliatus.

14b. Leaf-blades narrower than 6 mm. (except P. crispus), linear to oblong-linear; 1-7 nerved.

18a. Leaves glandless at base.

19a. Leaves linear, 3-5 nerved (except 16); 1-6 mm. wide.

20a. Leaves delicate, 1-2 mm. wide, obscurely 3-5 nerved ---------- 18. P. foliosus.

20b. Leaves coarser, 2-6 mm. wide, two ranked.

21a. Leaves 5-nerved, coarsely cellular-reticulate along midrib, ribbon-like -4. P. epihydrus.

21b. Leaves with 3 principal and many fine nerves -- 16. P. compressus.

19b. Leaves variable in shape, linear, oblong-linear, or linear-lanceolate, 3-7 nerved, 2-16 mm. wide.

22a. Leaves crisped, oblong-linear, serrulate, 3-7 nerved ---------- 15. P. crispus.

22b. Leaves not crisped, entire, pellucid, upper

often petioled, lower sessile.

23a. Entire plant suffused with red; leaves obtuse, or rarely acute, narrowed at base; fruit 3-keeled, middle keel sharp -5. P. alpinus.

23b. Plant green, leaves acuminate or cuspidate; fruit indistinctly 3-keeled - 8. P. heterophyllus.

18b. Leaves 2-glandular at base.

24a. Leaves 3-nerved; spikes capitate.

25a. Leaves acute, cuspidate, 1-1.5 mm. wide; fruit 5 mm. long ---------- 17. P. hillii.

25b. Leaves obtuse, mucronate, 1 mm. wide; fruit 2 mm. long ---------- 23. P. pusillus.

24b. Leaves 3-7 nerved, spikes not capitate.

26a. Leaves strict and revolute, 3-5-nerved, acuminate ---------- 21. P. rutilus.

26b. Leaves not as above, 3-7 nerved, obtuse, mucronate or cuspidate.

27a. Spikes ovoid, 6-9 mm. long; peduncles slender, erect ---------- 19. P. obtusifolius.

27b. Spikes interrupted, 7-12 mm. long, peduncles thicker than stem, sometimes thickening upward -------- 20. P. friesii.

13b. Stipules adnate to leaves or petioles.

28a. Leaves very narrowly linear, less than 2 mm. wide, capillary to setaceous, 1-nerved or nerveless.

29a. Free part of stipule shorter than sheath; stigma broad and sessile.

30a. Sheath of stipule less than 8 mm. long ---------- 24. P. filiformis.

30b. Sheath of stipule more than 14 mm. long ---------- 25. P. interior.

29b. Free part of stipule equal to sheath; stigma capitate; style apparent - 26. P. pectinatus.

28b. Leaves linear, 2-6 mm. wide, nerves 3 to many.

31a. Leaves entire, 3-5 nerved -------27. P. interruptus.

31b. Leaves minutely serrulate, finely many-nerved ---------- 28. P. robbinsii.

1. POTAMOGETON NATANS L. (floating).

Very common. Distribution general thruout. Ponds and slow moving streams, depths varying from 1/2 - 2 meters. Often found in exposed water. This is the type species of the genus and is large and conspicuous. Submerged leaves reduced to phyllodes. Heavy, brownish-tinged, floating leaves attached at right angles to petioles. Fruiting July and August.

Specimens examined: Berrien Co. (H.T. Darlington, 1917); Lenawee Co. (C. Billington, 1914); Monroe Co. (B.F. Chandler,1913); Van Buren Co. (H.S. Pepoon,1904); Kalamazoo Co. (E.B. Mains,1913); Jackson Co. (S.H. & D.R. Camp, 1897); Washtenaw Co. (J. Dawson); Wayne Co. (C. Billington, 1915); Barry Co. (H. Oosting,1926); Ingham Co. (C.F. Wheeler,1900); Livingston Co. (F.L. Stearns,1920); Oakland Co. (B.A. Walpole,1919); Macomb Co. (Cooley,1840); Ottawa Co. (H. Oosting,1926); Montcalm Co. (C.F. Wheeler,1900); Kent Co. (A.J. Pieters,1897); St. Clair Co. (C.K. Dodge, 1904); Muskegon Co. (C.D. McLouth,1899); Newaygo Co. (H. Oosting,1926); Emmet Co. (C.W. Fallas,1897); Iosco Co. (H.T. Darlington,1918); Oscoda Co. (H.T. Darlington,1918); Cheboygan Co. (F.C. Gates,1911); Gogebic Co. (E.A. Bessey, 1920); Marquette Co. (A. Dachnowski, 1906).

Reported from: Cass Co. (H.S. Pepoon,1907); Calhoun Co. (C.E. Barr,1908); Allegan Co. (F.A. Loew,1913); Lapeer Co. (W.A. Brotherton,1921); Tuscola Co. (C.K. Dodge,1921); Huron Co. (C.A. Davis); Bay to Cheboygan Co. (Occassional C.K. Dodge,1921); Chippewa Co. (C.K. Dodge,1921); Schoolcraft Co. (C.K. Dodge,1921).

2. POTAMOGETON OAKESIANUS Robbins. (named for Oakes).

Infrequent. Distribution probably general. Habitat same as P. natans which it closely resembles except in size. Seeds desirable for identification. Fruiting July, August.

Specimens examined: Kalamazoo Co. (H. Oosting,1926); Ingham Co. (H. Oosting,1926); Clinton Co. (H.T. Darlington, 1918); Iosco Co. (H.T. Darlington,1918); Gogebic Co. (H.T. Darlington).

3. POTAMOGETON AMPLIFOLIUS Tuckerm. (large-leaved).

General thruout. Frequent. Mostly in lakes, depths up
up to 2 1/2 meters. Often without floating leaves. Largest submerged leaves in the genus, usually incrusted with lime. Fruiting July, August.

Specimens examined: Berrien Co. (C.K. Dodge & H.T. Darlington,1917); Lenawee Co. (H. Stocking); Kalamazoo Co. (E.B. Mains,1913); Jackson Co. (S.H. Camp,1897); Washtenaw Co. (F.L. Stearns,1920); Wayne Co. (C. Billington, 1915); Ingham Co. (C.F. Wheeler,1900); Ottawa Co. (H. Oosting,1926); Kent Co. (C.W. Fallas, 1881); St. Clair Co. (C.K. Dodge,1895); Montcalm Co. (C.F. Wheeler,1900); Gratiot Co. (C.A. Davis,1893); Newaygo Co. (H. Oosting, 1926); Oceana Co. (D. Cooley,1850); Arenac Co. (?); Iosco Co. (C.F. Wheeler,1888); Roscommon Co. (E.A. Bessey, 1925); Charlevoix Co. (C.F. Wheeler,1894); Gogebic Co. (H.T. Darlington,1919).

Reported from: Calhoun Co. (C.E. Barr,1908); Macomb Co. (E.J. Hill); Muskegon Co. (V.O. Graham,1921); Huron Co. (C.A. Davis,1907); Mason Co. (E.J. Hill); Cheboygan Co. (Gates & Ehlers); Schoolcraft Co. (C.K. Dodge,1921); Marquette Co. (C.K. Dodge).

4. POTAMOGETON EPIHYDRUS Raf. (living on the water) or (upon the water).

P. claytonii Tuckerm.
P. pennsylvanicus Willd.
P. nuttallii C. & S.

Frequent thruout. Lakes and streams. Commonly without floating leaves in running water. In swiftly flowing streams submerged leaves much elongated. In quiet water

submerged leaves have characteristic fan-like arrangement.

Fruiting July, August.

Specimens examined: Kalamazoo Co. (H. Oosting,1926); Macomb Co. (D. Cooley,1840); St. Clair Co. (Miss N.P. Whiting,1894); Ottawa Co. (H. Oosting,1926); Muskegon Co. (C.D. McLouth,1899); Montcalm Co. (H.T. Darlington,1919); Newaygo Co. (H. Oosting,1926); Roscommon Co. (E.A. Bessey, 1916); Iosco Co. (H.T. Darlington,1918); Alpena Co. (H.T. Darlington,1918); Luce Co. (C.K. Dodge,1915); Alger Co. (C.F. Wheeler,1895); Marquette Co. (C.F. Wheeler,1892); Gogebic Co. (H.T. Darlington,1918); Keweenaw Co. (O.A. Farwell,1888).

Reported from: Oakland Co. (C.A. Davis,1907); Tuscola Co. (C.K. Dodge,1921); Chippewa Co. (C.K. Dodge,1921); Schoolcraft Co. (C.K. Dodge,1921).

5. POTAMOGETON ALPINUS Balbis. (alpine).

Infrequent. Distribution general. Entire plant suffused with reddish tinge. Fruiting July, August, September.

Specimens examined: Macomb Co. (A.J. Pieters,1893); Kent Co. (C.W. Fallas,1897); Charlevoix Co. (C.W. Fallas, 1918); Emmet Co. (J.H. Ehlers,1922); Bois Blanc Island, (S.H. Camp,1894); Alger Co. (C.F. Wheeler,1900); Marquette Co. (C.F. Wheeler,1892); Gogebic Co. (E.A. Bessey,1919); Keweenaw Co. (O.A. Farwell,1888); Isle Royale. (A.E. Foote,1868);

Reported from: Wayne Co. (O.A. Farwell,1900); Cheboygan Co. (Gates & Ehlers).

6. POTAMOGETON AMERICANUS C. & S.

P. lonchites Tuckerm.
P. fluitans Roth.

Common. Distribution general. Slow streams and also lakes and ponds. Depths up to 3 meters. Often without floating leaves and sometimes with floating leaves only, the large, delicate submerged leaves being broken up by

the water movements. Calcium incrustation common.

Fruiting July, August.

Specimens examined: Berrien Co. (H.T. Darlington, 1919); Cass Co. (H.S. Pepoon,1904); Lenawee Co. (C. Billington,1914); Monroe Co. (B.A. Walpole,1920); Kalamazoo Co. (E.B. Mains,1913); Calhoun Co. (W.J. Beal, 1898); Jackson Co. (S.H. & D.R. Camp,1893); Washtenaw Co. (F.L. Stearns,1920); Barry Co. (H. Oosting,1926); Livingston Co. (F.L. Stearns,1920); Macomb Co. (C.F. Wheeler,1900); Ottawa Co. (H. Oosting,1926); Shiawasee Co. (G.H. Hicks,1890); Montcalm Co. (C.F. Wheeler,1900); Newaygo Co. (H. Oosting,1926); Huron Co. (C.A. Davis).

Reported from: Wayne Co. (O.A. Farwell); St. Clair Co. (A.J. Pieters,1894); Muskegon Co. (O.A. Graham,1921); Bay to Cheboygan Co.,frequent thruout,(C.K. Dodge,1921); Manistee Co. (F.P. Daniels); Keewenaw Co. (O.A. Farwell, 1904).

7. POTAMOGETON FAXONI Morong. (named for C.E. Faxon).

Gray's Manual, 7th edition, - infertile hybrid of P. alpinus. Previously discussed. Status doubtful.

Specimens examined: Jackson Co. (S.H. Camp,1897); Genesee Co. (D. Clark).

8. POTAMOGETON HETEROPHYLLUS Schreb. (variously leaved).

Distribution general. Very Common. Extremely variable. Without floating leaves in rough water. Ordinarily the plants are found growing in a series Connected by the rootstock. Fruiting July, August, September.

Specimens examined: Van Buren Co. (H.S. Pepoon, 1906); Kalamazoo Co. (H. OOsting,1926); Jackson Co. (S.H. Camp,1897); Washtenaw Co. (F.L. Stearns,1920); Ingham Co.; Livingston Co. (F.L. Stearns,1920); Oakland Co. (C. Billingtcn,1916); Macomb Co. (A.J. Pieters,1893); Ottawa Co. (H. Oosting,1926); Kent Co. (L891); Clinton Co. (H.T. Darlington,1918); St. Clair Co. (C.K. Dodge,1904); Montcalm Co. (C.F. Wheeler,1900); Newaygo Co. (H. Oosting, 1926); Lake Co. (W.J. Beal,1890); Huron Co. (C.A. Davis, 1896); Missaukee Co. (E.A. Bessey,1916); Iosco Co. (C.F. Wheeler,1888); Grand Travers Co. (L888);

Alcona Co. (1888); Charlevoix Co. (C.F. Wheeler,1892); Cheboygan Co. (F.C. Gates,1911); Emmet Co. (C.W. Pallas, 1897); St. James Island, (C.W. Wheeler, 1900); Alger Co. (C. Billington,1916); Marquette Co. (A. Dachnowski,1906); Gogebic Co. (H.T. Darlington,1919); Ontonagon Co. (E.A. Bessey,1923); Keweenaw Co. (O.A. Farwell,1888); Isle Royale, (A.E. Foote,1868).

Reported from: Cass Co. (H.S. Pepoon,1907); Wayne Co. (O.A. Farwell,1900); Tuscola Co. (C.K. Dodge,1921); Muskegon Co. (V.O. Graham,1921); Chippewa Co. (C.K. Dodge, 1921); Schoolcraft Co. (C.K. Dodge,1921).

9. POTAMOGETON VARIANS Morong. (variable).

Infrequent. Distribution probably general, previously discussed. Closely resembles P. heterophyllus and has characteristics of several other species. Fruits July, August.

Specimens examined: Macomb Co. (A.J. Pieters,1893); Ottawa Co. (H. Oosting,1926); Montcalm Co. (C.F. Wheeler, 1900); Cheboygan Co. (H.C. Beardslee,1890); Mackinaw Co. (S.H. & D.R. Camp,1824); Keweenaw Co. (O.A. Farwell,1888).

10. POTAMOGETON ILLINOENSIS Morong.

Two specimens collected and identified by McLouth and Walpole are doubtful. Both are immature and lack fruits. No other record or collections found in the state.

Specimens examined: Muskegon Co. (C.D. McLouth,1894); Allegan Co. (B.A. Walpole,1923).

11. POTAMOGETON ANGUSTIFOLIUS Berch. & Presl. (narrow-leaved).

P. zizii Roth.

Distribution general. No specimens or records from Upper Peninsula. Common. Very prolific in some areas. Fruiting July, August.

Specimens examined: Berrien Co. (H.T. Darlington, 1917); Kalamazoo Co.(H. Oosting,1926); Washtenaw Co.(1838); Ingham Co. (Wheeler & Hicks,1893); Livingston Co. (F.L. Stearns,1920); Macomb Co. (A.J. Pieters,1893); Clinton Co. (1884); Kent Co. (A.J. Pieters,1897); Muskegon Co. (C.D. McLouth,1890); Montcalm Co. (C.F. Wheeler,1900); Huron Co. (C.K. Dodge,1908); Iosco Co. (H.T. Darlington,1918); Charlevoix Co. (C.F. Wheeler,1892); Cheboygan Co. (C.F. Wheeler,1890); Emmet Co. (J.H. Ehlers,1921); Bois Blanc Island (1894).

Reported from: Manistee Co. (E.J. Hill); Wayne Co. (D.H. Campbell); St. Clair Co. (A.J. Pieters,1893).

12. POTAMOGETON LUCENS L. (shining).

Distribution general. Common in lakes and ponds. Usually may be distinguished by its large shining leaves. Fruiting July, August.

Specimens examined: Cass Co. (H.S. Pepoon,1904); Van Buren Co. (L.H. Pennington,1910); Kalamazoo Co. (H. Oosting,1926); Washtenaw Co. (Miss G. Williamson,1901); Ingham Co. (C.F. Wheeler,1900); Livingston Co. (F.L. Stearns,1900); Oakland Co. (B.A. Walpole,1920); Macomb Co. (A.J. Pieters,1893); Clinton Co. (H.T. Darlington,1918); Kent Co. (A.J. Pieters,1897); Ottawa Co. (H. Oosting,1926); Newaygo Co. (H. Oosting,1926); Iosco Co. (H.T. Darlington, 1918); Cheboygan Co. (F.C. Gates,1911); Emmet Co. (C.W. Fallas,1897); St. James Island (C.F. Wheeler,1900).

Reported from: Wayne Co.(D.H. Campbell); Muskegon Co. (C.D. McLouth); Chippewa Co. (C.K. Dodge,1921).

13. POTAMOGETON PRAELONGUS Wulf. (very long).

Distribution general. Common in deeper ponds and lakes, depths of 2 to 4 meters. Flowers at surface. Stem contracts drawing fruits to deep water where they mature. Large and coarse, can be recognized by the white stems and the large white stipules. Fruiting July, August.

Specimens examined: Cass Co. (H.S. Pepoon,1906); Van Buren Co.(F. Gates,1906); Kalamazoo Co.(E.B. Mains, 1913); Jackson Co.(S.H. Camp,1897); Washtenaw Co. (F.L. Stearns,1920); Ingham Co. (C.F. Wheeler,1900); Clinton Co.(H.T. Darlington,1900); Ottawa Co. (H. Oosting,1926); Gratiot Co. (C.A. Davis,1895); Montcalm Co. (C.F. Wheeler,1900); Newaygo Co. (H. Oosting,1926); Iosco Co. (H.T. Darlington,1918); Cheboygan Co. (F.C. Gates,1911); Gogebic Co. (H.T. Darlington,1919); Ontonagon Co. (H.T. Darlington,,E.A. Bessey,1923).

Reported from: Oakland Co. (C.A. Davis,1907); Kent Co. (Emma J. Cole,1901); Emmet Co. (Fallas and Swift, 1918).

14. POTAMOGETON PERFOLIATUS L. (thru the leaf, or clasping).

P. richardsonii Rydb.

Distribution general. Very common. Water upt to a meter in depth. Prolific. Leaves variable, orbicular to linear-lanceolate. May be distinguished from small specimens of P. praelongus by absence of white stipules and by the perfoliate base. Fruiting July, August.

Specimens examined: Berrien Co. (H.T. Darlington, 1917); Kalamazoo Co. (H. Oosting,1926); Monroe Co. (B.F. Chandler,1914); Washtenaw Co. (Miss H.W. Thompson,1903); Wayne Co. (C.F. Wheeler,1892); Barry Co. (H. Oosting, 1926); Ingham Co. (C.F. Wheeler,1900); Oakland Co. (C. Billington,1915); Macomb Co. (A.J. Pieters,1893); St. Clair Co. (A.J. Pieters,1893); Ottawa Co. (H. Oosting, 1926); Muskegon Co. (C.D. McLouth,1894); Montcalm Co. (H.T. Darlington,1917); Gratiot Co. (C.A. Davis,1893); Newaygo Co. (H. Oosting,1926); Huron Co. (C.K. Dodge, 1908); Iosco Co. (W.J. Beal & C.F. Wheeler,1888); Antrim Co. (C.W. Fallas,1920); Charlevoix Co. (H.D. Thompson, 1894); Cheboygan Co. (F.C. Gates,1911); Emmet Co. (J.H. Ehlers,1921); Alger Co. (C.F. Wheeler,1900); Marquette Co. (A. Dachnowski,1906); Gogebic Co. (H.T. Darlington, 1919); Isle Royale (A.E. Foote,1861); Kent Co. (J. Shadduck,1896).

Reported from: Cass Co. (H.S. Pepoon,1907); Van Buren Co. (H.S. Pepoon,1907); Bay Co. (G.M. Bradford); Schoolcraft Co. (C.K. Dodge,1921).

15. POTAMOGETON CRISPUS L. (curly).

Three stations in Ottawa Co., one in Van Buren Co. A European species, established on the coast and migrating west along the watercourses. Leaves crisp and have margins crimped. Grows the year around. Not collected in fruit but winter buds usually present.

Specimens examined: Van Buren Co. (L.H. Pennington, 1910); Ottawa Co. (H. Oosting,1926).

16. POTAMOGETON COMPRESSUS L. (flattened stem).

P. zosteraefolius Schum.

Very Common. Distribution general thruout. Streams, ponds and lakes. In running or exposed water or in standing water. Collected at all depths up to 2 or 3 meters. Fruiting July and August.

Specimens examined: Berrien Co. (H.T. Darlington, 1917); Van Buren Co. (D.A. Pelton,1880); Kalamazoo Co. (H. Oosting,1926); Lenawee Co.(C.H. Stocking,1861); Washtenaw Co. (W.H. Rush,1891); Barry Co. (H. Oosting, 1926); Ingham Co. (C.F. Wheeler,1892); Livingston Co. (F.L. Stearns,1920); Oakland Co. (B.A. Walpole,1919); Macomb Co. (A.J. Pieters,1893); St. Clair Co. (C.K. Dodge,1904); Ottawa Co. (H. Oosting,1926); Kent Co. (A.J. Pieters,1897); Clinton Co. (H.T. Darlington,1918); Gratiot Co. (C.A. Davis,1898); Montcalm Co. (C.F. Wheeler, 1900); Newaygo Co. (H. Oosting,1926); Iosco Co. (W.J. Beal, & C.F. Wheeler,1888); Oscoda Co. (H.T. Darlington,1918); Cheboygan Co. (F.C. Gates,1911); Gogebic Co. (H.T. Darlington,& E.A. Bessey,1918).

Reported from: Cass Co. (H.S. Pepoon,1907); Wayne Co. (D.A. Farwell,1900); Muskegon Co. (C.D. McLouth,1896); Emmet Co. (Gates & Ehlers); Marquette Co. (C.K. Dodge, 1918).

17. POTAMOGETON HILLII Morong. (named for Hill).

Probably general. At least in the Southern Peninsula. Infrequent. Sometimes found without glands at leaf bases but is easily recognized by the characteristic fruits. Fruiting July and August.

Specimens examined: Kalamazoo Co. (H. Oosting,1926); Ottawa Co. (H. Oosting,1926); Kent Co. (A.J. Pieters,1897); St. Clair Co. (C.K. Dodge,1896); Newaygo Co. (H. Oosting, 1926); Manistee Co. (D.A. Pellton,1884).

18. POTAMOGETON FOLIOSUS Raf. (leafy).

Occasional. Distribution general. In shallow water, lakes and streams. In fruit it can be identified at once by the irregular characteristic keel on the back. Fruiting July, August.

Specimens examined: Berrien Co. (C.K. Dodge, H.T. Darlington,1917); Cass Co. (H.S. Pepoon,1904); Van Buren Co. (L.H. Pennington,1910); Kalamazoo Co. (S.E.Wolff, 1924); Washtenaw Co. (F.L. Stearns,1920); Ingham Co. (H.T. Darlington,1918); Ottawa Co. (H. Oosting,1926); Ionia Co. (C.F. Wheeler,1881); Genesee Co. (D. Clark); Montcalm Co. (C.F. Wheeler,1900); Iosco Co. (W.J. Beal & C.F. Wheeler,1888); Manistee Co. (E.J. Hill,1880); Marquette Co. (A. Dachnowski,1906); Keweenaw Co. (O.A. Farwell,1886).

19. POTAMOGETON FRIESII Ruprecht. (named for E. Fries).

P. mucronatus Mann.

Distribution general. Frequent. Upper Peninsula distribution doubtful. Collected commonly in shallow, quiet water with mucky bottom. Fruiting July, August.

Specimens examined: Kalamazoo Co. (H. Oosting,1926); Jackson Co. (C.F. Wheeler,1898); Washtenaw Co. (C.H. Kaufman,1923); Ingham Co. (C.F. Wheeler,1900); St. Clair Co. (W.S. Cooper,1901); Ottawa Co. (H. Oosting,1926); Montcalm Co. (C.F. Wheeler,1900); Newaygo Co. (H. Oosting, 1926); Mason Co. (C.E. Barr,1909); Manistee Co.(E.J. Hill, 1880); Arenac Co. (C.F. Wheeler,1900); Iosco Co. (W.J. Beal & C.F. Wheeler,1888); Antrim Co. (C.W. Fallas,1920); Emmet Co. (C.W. Fallas,1921).

Reported from; Wayne Co. (O.A. Farwell); Oscoda Co. (E.J. Hill); Cheboygan Co. (E.J. HIll).

20. POTAMOGETON OBTUSIFOLIUS Mert. & Koch. (blunt-leaved).

One station only, but specimen agrees perfectly with available descriptions. Fruiting August.

Specimen examined: St. Clair Co. (C.K. Dodge,1904).

21. POTAMOGETON RUTILUS Wolfg. (reddish-yellow).

Distribution general in south and probably thruout. Occasional. Propagating buds often absent. Fruiting July and August.

Specimens examined: Van Buren Co. (H.S. Pepoon, 1904); Jackson Co. (S.H. Camp,1896); Monroe Co. (B.A. Walpole,1920); Wayne Co. (C.F. Wheeler,1892); Oakland Co. (B.F. Chandler,1916); Kent Co. (W.E. Mulliken,1896); Marquette Co. (A. Dachnoski, 1906).

22. POTAMOGETON VASEYI Robbins. (named for Vasey).

One station only. Probably no more because the species is not recognized. Commonly grows without floating leaves and fruits rarely. August.

Specimen examined: St. Clair Co.(C.K. Dodge,1896).

23. POTAMOGETON PUSILLUS L. (very small).

Very common. General thruout. Ponds and shallow, slow streams at depths from 1/2 to 2 meters. Variable in general form but glands, buds and fruits invariable. This is one of the commonest species. Fruiting July and August.

Specimens examined: Cass Co. (H.S. Pepoon,1904); Kalamazoo Co. (H. Oosting,1926); Washtenaw Co. (W.H. Rush,1891); Ingham Co. (C.F. Wheeler,1892); Oakland Co. (B.A. Walpole,1920); Macomb Co. (A.J. Pieters,1892); ST. Clair Co. (W.S. Cooper,1903); Ottawa Co. (H. Oosting, 1926); Kent Co. (W.E. Mulliken,1896); Newaygo Co. (H. Oosting,1926); Iosco Co. (H.T. Darlington,1918); Alpena Co. (C.F. Wheeler,1895); Cheboygan Co. (J.H. Ehlers, 1921); Emmet Co. (C.W. Fallas,1918); Marquette Co. (C.K. Dodge,1916); Gogebic Co. (H.T. Darlington,1918);

Reported from: Van Buren Co. (H.S. Pepoon,1907); Wayne Co. (D.H. Campbell); Muskegon Co. (E.A. Bessey, 1920); Manistee Co. (E.J. Hill); Chippewa Co. (C.K. Dodge,1921); Schoolcraft Co. (C.K. Dodge,1921).

24. POTAMOGETON FILIFORMIS Pers. (thread-like).

Distribution general. Frequent. Shallow, quiet water. This is one of the most delicate species and can be recognized in the field by its filiform structure. Fruiting July, August.

Specimens examined: Kalamazoo Co. (E.B. Mains); Macomb Co. (A.J. Pieters,1893); St. Clair Co. (C.K. Dodge,1904); Ottawa Co. (H. Oosting,1926); Montcalm Co. (C.F. Wheeler,1900); Huron Co. (C.A. Davis,1896); Iosco Co.(H.T. Darlington,1918); Missaukee Co.(C.W. Fallas, 1897); Charlevoix Co. (H.S. Jennings,1894); Cheboygan Co. (J.H. Ehlers,1921); Chippewa Co. (D.A. Pellton,1881); Gogebic Co. (H.T. Darlington,1919).

Reported from; Wayne Co. (O.A. Farwell); Emmet Co. (Gates & Ehlers).

25. POTAMOGETON INTERIOR Rydb. (inland).

Common. Distribution general. Shallow, warm water. Should be collected in fruit to distinguish it from (26). Fruiting July, August, September.

Specimens examined: Kalamazoo Co. (H. Oosting,1926); Jackson Co. (S.H. Camp,1897); Barry Co. (H. Oosting, 1926); Macomb Co. (A.J. Pieters,1893); Ottawa Co. (H. Oosting,1926); Newaygo Co. (H. Oosting,1926); Antrim Co. (C.W. Fallas,1920); Charlevoix Co. (C.F. Wheeler,1892); Emmet Co. (J.H. Ehlers,1922); Gogebic Co. (H.T. Darlington, 1918).

26. POTAMOGETON PECTINATUS L. (comb-like).

Very common. General thruout. Shallow, warm water, ponds and lakes. Is commonly a little smaller than (25). and has the appearance of a fan-like comb in the water. Fruiting July, August and September.

Specimens examined: Berrien Co. (C.K. Dodge & H.T. Darlington,1917); Cass Co. (H.S. Pepoon,1904); Kalamazoo Co. (H. Oosting,1926); Jackson Co. (S.H. & D.R. Camp); Lenawee Co. (D. Cooley,1838); Washtenaw Co. (W.H. Rush, 1891); Wayne Co. (C. Billington,1915); Macomb Co. (A.J. Pieters,1893); Oakland Co. (C. Billington,1915); Macomb Co.; Livingston Co. (F.L. Stearns,1920); Ingham Co. (C.F. Wheeler,1892); Barry Co. (H. Oosting,1926); Ottawa Co. (H. Oosting,1926); Kent Co. (A.J. Pieters,1897); Clinton Co. (H.T. Darlington,1918); Genesee Co. (D. Clark); St. Clair Co. (C.K. Dodge,1904); Muskegon Co. (C.D. McLouth, 1904); Newaygo Co. (H. Oosting,1926); Midland Co. (R.R. Driesbach,1918); Bay Co. (W.J. Beal & C.F. Wheeler,1888); Roscommon Co. (H.T. Darlington,1916); Manistee Co. (E.J. Hill,1872); Cheboygan Co. (F.C. Gates,1911).

27. POTAMOGETON INTERRUPTUS Kitaibel. (interrupted, referring to the mode of growth).

Rare but distribution general. Stations in the North, East and West. Rarely found in fruit.

Specimens examined: St. Clair Co. (C.K. Dodge,1893); Cheboygan Co. (C.F. Wheeler,1880); Manistee Co. (E.J. Hill).

28. POTAMOGETON ROBBINSII Oakes. (named for Robbins).

Four stations in Southern Peninsula and one in the Upper Peninsula. Probably more general but not recognized. If P. epihydrus is without floating leaves, the two are very similar in the water because of the opposite branching, forming a fan. P. epihydrus has longer leaves and does not send a long fruiting stem up to the surface. It also lacks the serrate margins of the leaves.

Specimens examined: Washtenaw Co. (F.L. Stearns, 1920); Ingham Co. (C.F. Wheeler,1891); Ottawa Co. (H. Oosting, 1926); Muskegon Co. (E.J. Hill, 1899); Marquette Co. (A. Dachnowski, 1906).

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