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AN ACCOUNT OF THE SPECIES OF *POTAMOGETON* L. (*POTAMOGETONACEAE*)

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Abstract: An account of the taxonomy of the genus *Potamogeton* L. with special reference to species description and delimitation is presented. A key to the species is given, based as far as possible on vegetative characters. Detailed descriptions are provided for a total of 69 species which are regarded as sufficiently well known. Special emphasis is laid both on a complete list of relevant characters as well as on the judgement of their respective diagnostic values. All important synonyms are listed allowing direct access to most of the relevant taxonomic and floristic *Potamogeton* literature. 50 confirmed hybrids are listed and assigned to their putative parent species. Questions with respect to the taxa listed are formulated in notes on each of the species. A more general view and questions on future *Potamogeton* research are summarized in the conclusions.

"It is to be regretted that we never arrive to the truth but through some mistake or another" (J.O. Hagström 1916)

INTRODUCTION

Since the days of GRAEBNER (1907) and HAGSTRÖM (1916) no comprehensive taxonomic treatment of the genus *Potamogeton* L. claiming worldwide validity has been carried out. The work of GRAEBNER (1907) was an attempt to compile all the known taxonomic and phytogeographic information about the genus, although P. Graebner himself never carried out important taxonomic work on the genus *Potamogeton*. In contrast, J.O. Hagström's treatment was based on 15 years of intensive anatomical and morphological studies of all specimens accessible to him. Hagström examined ca. 90% of the species known at that time. The comprehensiveness of his work is still unrivalled. Hagström's approach to infrageneric classification and species circumscription was acknowledged only recently both by WIEGLEB (1988) and LES & SHERIDAN & (1990b). Another early 20th century author, A. Bennett, had a worldwide knowledge of the genus, but he never produced a comprehensive treatment. His work is scattered in numerous, often contradictory, notes.

Since the time of Hagström's work a lot of new information has become available. Several papers deal with various aspects of the genus. Seed anatomy was treated by AALTO (1970), general morphology by TOMLINSON (1982), chromosome numbers by LES (1982) and HOLLINGSWORTH et al. (1998), pollen morphology by SORSA (1988), stem anatomy by WIEGLEB (1990c), and flavonoid chemistry by LES & SHERIDAN (1990a). However, the information on

species distribution and variation in different parts of the world is still quite inconsistent. Western and Central European *Potamogeton* taxonomy had reached a certain stability at the end of the 19th century. The work of PRESTON (1995) for the British Isles can be regarded as a culmination of this tradition in the degree of precision and completeness. In North America (FERNALD 1932, OGDEN 1943, HAYNES 1974, REZNICEK & BOBBETTE 1976) and Japan (MIKI 1937) a state of knowledge comparable to Europe has been reached. In Australia (ASTON 1973), South America (TUR 1982), South Africa (DANDY 1937, OBERMEYER 1966, SYMOENS et al. 1979), and Russia (YUZEPCHUK 1934, TZVELEV 1987, KASHINA 1988, VOLOBAEV 1993) a significant effort has been made without, however, solving important taxonomic and nomenclatural problems. Worldwide information on distribution and taxonomy is only available for five of the widespread species (HAYNES 1985, WIEGLEB 1990a,b).

The following treatment is regarded as a first step towards a worldwide monograph of the genus *Potamogeton*. The aims are to construct a key to all "sufficiently known species" and to give descriptions, as comprehensive as possible, for all those species according to the present state of knowledge. In addition questions are formulated as a basis for future research.

METHODS

Data base

An assessment of the validity of the taxa recognized below is based on the following work that has been conducted since 1985:

(1) Herbarium studies. Extensive herbarium studies were carried out in the course of the description and re-evaluation of several *Potamogeton* taxa (KADONO & WIEGLEB 1987, WIEGLEB 1990a,b, 1993), the work in connection with Flora Malesiana (WIEGLEB, unpubl.) and the work on the contribution of Bohemian botanists to *Potamogeton* taxonomy (KAPLAN 1997). Additional studies were carried out directly for the purpose of this paper. *Potamogeton* of B, BM, BREM, BRNM, BRNU, CTES, GLM, HBG, JE, K, L, M, MP, OLD, OLM, OP, PR, PRC, ROST, W, and WU were checked completely, and additional loans were made from A, AAU, ABD, BKF, BOL, BP, BRI, C, CANB, CGE, E, F, G, GAT, GOET, H, HAL, LAE, LD, MICH, MO, NH, NY, P, PERTH, PH, S, SING, TAA, TAI, TFC, TI, TUB, U, UC, UPS, WAG, WRSL, and ZT.

(2) Field surveys. The collection of specimens was carried out in various parts of the world (G. Wiegleb: the Atlantic Islands, Western, Central and Southern Europe, including Great Britain and the Mediterranean Islands, Japan, Argentina; Z. Kaplan: Western, Central, Southern and Eastern Europe, Siberia, Southwestern Asia). Specimens are deposited in the herbaria of the respective authors (G. Wiegleb: Museum für Naturkunde und Vorgeschichte, Oldenburg, Germany; Z. Kaplan: Institute of Botany, Průhonice, Czech Republic).

(3) Field ecological studies. The variation of various taxa (G. Wiegleb: *P. alpinus*, *P. natans*, *P. distinctus*, *P. wrightii*; Z. Kaplan: *P. pusillus*, *P. trichoides*, *P. pectinatus*) was studied, including also experimental studies (KAPLAN, unpubl. data).

(4) Study of stem anatomy. The stem anatomy of various taxa was studied in detail (WIEGLEB 1990c). The collection of slides with preserved cross sections is kept at the biological collection of the Brandenburgische Technische Universität, Cottbus.

(5) Literature survey. Based on the data bases accumulated independently by both authors in the course of this survey, more than 2000 names were checked for their validity, legitimity, correct spelling and exact citation (Z. Kaplan).

Taxonomic concepts

An open discussion on the respective taxonomic concepts at each level of the taxonomical hierarchy is regarded as crucial for a successful approach to *Potamogeton*.

Delimitation of the genus

In the present paper *Potamogeton* L. is regarded as one of two genera of the family *Potamogetonaceae*, the second one being the closely related genus *Groenlandia* J. GAY. *Groenlandia* differs from *Potamogeton* in the following aspects:

(1) Fruit type (having a drupe-like, instead of an achene-like, fruit in *Potamogeton*).

(2) Specialized type of hibernating structures (not found among the numerous types of winter buds in *Potamogeton*).

(3) Predominance of subopposite leaves throughout the stem (in *Potamogeton* occurring in the floral region only).

(4) Absence of stipule-like appendages (subsequently referred to as "stipules") on most of the leaves with lateral ones being produced only on the involucral leaves (*Potamogeton* has axillary or adnate stipules on all leaves).

(5) Spikes bearing regularly (1–)2(–4) flowers only (compared with the 4 to many-flowered spikes of *Potamogeton*).

(6) The unique basic chromosome number n=15 (compared with n=13 or rarely n=14 found in *Potamogeton*).

Classification into subgenera

Recently, several attempts have been made to introduce a third genus *Coleogeton* (RCHB.) LES et R.R. HAYNES (LES & HAYNES 1996), or more correctly *Stuckenia* BÖRNER (HOLUB 1997), based on a group of species formerly treated as subgenus *Coleogeton* (RCHB.) RAUNK. However, the reasons for separating this group from the genus *Potamogeton* are not regarded as convincing. Most of the characters claimed to be exclusive for *Stuckenia* occur also in *Potamogeton* s.str.:

(1) Stipular sheaths, mostly fused for more than half of their length. Stipular sheaths are constantly found in *P. spirillus* (in this species the fused portion is also longer than half of the length), *P. diversifolius*, *P. bicupulatus*, *P. robbinsii* and *P. maackianus*, also in young specimens of *P. alpinus*, *P. nodosus*, *P. distinctus*, *P. wrightii*, *P. gramineus* and *P. lucens*.

(2) Channelled leaves (phyllodial leaves sensu RAUNKIAER 1896). Such kinds of leaves are, however, regularly produced in *P. natans*, *P. oakesianus*, *P. diversifolius*, *P. bicupulatus*, *P. spirillus*, *P. octandrus*, *P. cristatus*, *P. vaseyi*, often also in *P. lucens*, *P. gramineus*, *P. thunbergii* and *P. illinoensis*. This holds even though "phyllodial leaves" cover a wide range of leaf shapes.

(3) "Hydrophilous pollination". Pollination in *Stuckenia*, as inferred from the elongated stigma, is claimed to be different from "anemophilous" pollination in *Potamogeton*. However, epihydrophily (including hydroautogamy; i. e. pollination by means of two dimensional pollen transfer restricted to the water/air interface, either at the water surface or on bubbles produced by submersed flowers during anthesis) occurs also in *P. acutifolius*, *P. pusillus*, *P. foliosus* and *P. lucens*, all of them being members of *Potamogeton* s. str.

(4) Higher ploidy level (particularly hexaploidy). The distinction in chromosome number is not so clear as is sometimes stated. Higher ploidy levels have also been reported for *P. crispus*, *P. illinoiensis* and *P. richardsonii*.

(5) Hybridization. It is said not to occur between *Stuckenia* and *Potamogeton*. The taxonomically unclear plant described as *P. nomotoensis* may be a hybrid between members of these respective taxa (*P. natans* and *P. pectinatus*), as it combines the typical characters of both groups.

We are aware that *Coleogeton* (*Stuckenia*) represents a compact monophyletic unit which differs from *Potamogeton* in several characters related to floral biology (endodermis of U-type in the flexible peduncle, elongated stigmas, specialized pollen type) and hibernation (forming a special type of rhizomatous turion). However, we draw attention to the fact that the endocarp type A is found in both taxa (AALTO 1970). As we consider the characters used by LES & HAYNES (1996) and HOLUB (1997) as insufficient for generic distinction, the traditional concept of treating *Coleogeton* at the rank of a subgenus is adopted here.

Infrageneric classification and arrangement of species

The arrangement of species in the descriptive part reflects their supposed systematic relation. It is based on cladistic analyses of all taxa based on the characters available so far (KAPLAN, unpubl.). Assumptions on the affinity of the species are generally outlined in the notes. No formal grouping is adopted.

We are aware of the fact that a taxonomic revision at the level of sections and subsections is also desirable. However, it cannot be carried out at present. Depending on the exact delimitation of these taxa, a complete check of the nomenclature has to be carried out. We assume that the genus *Potamogeton* may be furthermore divided into 5 sections, 1 in *Coleogeton* and 4 in *Potamogeton*, which form natural units. The approximate number of subsections is 22, 3 in *Coleogeton* and 19 in *Potamogeton*.

Species concept

A wide species concept is adopted in the following treatment. All *Potamogeton* species studied in more detail so far with respect to vegetative morphology and life history exhibit a wide range of phenotypic plasticity. It is presumed here that this holds also for the rest of the species. Therefore, the distinction of a species requires at least two independent characters which remain stable over a larger geographical area and over a wide range of environmental conditions.

Species with a limited geographical range differing by single characters from an otherwise variable species are generally not recognized. In some cases of broad-leaved species, taxa with a limited geographical area are recognized as they exhibit unique character combinations (e.g. the southern species *P. stenostachys*, *P. parmatus* and *P. papuanicus*). In total 69 species are recognized and described. Unfortunately the total range of plasticity of most species of the Southern Hemisphere is unknown.

Concepts of infraspecific units

A general concept of a taxonomic treatment of infraspecific classification has not yet been developed. Most varieties and forms recognized by older authors refer to obvious ecomorphoses and have no taxonomic value whatsoever. Exceptionally, they are important insofar as they contain basionyms for the modern treatment.

However, some of the taxonomic entities mentioned in the synonym list with a question mark, or in the notes which follow the descriptions, may be regarded in the future either as allopatric subspecies or as sympatric variants of the respective widespread taxon.

Hybrid concept

Hybridization is, under certain circumstances, a frequent event in *Potamogeton* and often leads to easily recognizable biological entities. Because of their frequency and ecological importance (WIEGLEB 1988) they have to be considered in any taxonomic treatment of the genus. Neglect could lead to misidentification of a number of specimens.

In total 50 hybrids are recognized here as being well established and distinguishable from the respective parent species. Approximately 20 further probable hybrids proposed in the literature cannot be recognized without further study, in particular by experimental crossing experiments. Many proposed hybrids, of which we were able to study the type specimen, proved to represent one of the parental species only.

The correct names of the hybrids are based on both putative parent species. Synonyms and notes are only given after the first-mentioned parent species. No description of the hybrids is given, as in most cases the hybrids are intermediate among the putative parents. We are aware of the fact that this is not true in all cases. Our list of "hybrids" contains three groups of taxa, which cannot be operationally distinguished:

(1) Confirmed hybrids, most probably of recent origin, which are usually sterile, forming no seeds, or at least no viable seeds (e.g. *P.* ×*nitens*), or only exceptionally producing well developed fruits (best known in *P.* ×*angustifolius*). We assume that this is the most frequent case.

(2) Fertile intermediates that may in the future be regarded as species in their own right, which are possibly of hybridogenous origin in the past. *P.* ×*ogdenii* is the only member that can be named at present. This case underlines the possible importance of hybridization for species formation in *Potamogeton*.

(3) Some special forms which are too rare to be judged finally, and which clearly do not deserve the rank of a species. The identity of these forms has to be clarified in the future. *P.* ×*nomotoensis*, *P.* ×*vaginans* and *P.* ×*faxonii* belong to this group.

All hybrids of the second and third group are commented upon in a respective note.

The key

The account of the species is preceded by an analytical key to the species. The main purpose of the key is to elucidate the most important characters that are useful for distinguishing between the species. Thus, the key provides a kind of definition and delimitation of the species considered as valid in the framework of this treatment. The key is an artificial one. It is not intended to key out assumed subsections or related species groups in total before proceeding to the species themselves.

The key should enable the user to identify most of the species based on the typical variation shown by their individuals, provided that the necessary diagnostic characters are developed on a specimen examined. The key cannot be used to identify all extreme morphotypes, nor can it give access to incomplete and fragmentary herbarium specimens. As far as possible, it is based on characters of vegetative morphology, in particular shape, size, and venation of the submerged leaves. These are the characters that are available in most cases.

An account of the species

General arrangement of characters

The structure follows the general pattern as listed below:

(1) Name
(2) Citation
(3) Important synonyms
(4) Rhizome: shape, life cycle
(5) Stem: shape, life cycle
(6) Submerged leaves: lamina: shape, size, colour, venation and other special features; petiole
(7) Intermediate leaves (if developed); short characterization
(8) Floating leaves (if developed): lamina: shape, size, venation and other special features; petiole
(9) Stipules: shape, size and special features (if necessary separate for leaf types)
(10) Peduncles: size and shape
(11) Spikes: shape and size (if necessary separate for spike types)
(12) Flower number; number of carpels
(13) Fruits: size, special features
(14) Stem anatomy: stelar type, endodermis type, interlacunar bundles, subepidermal bundles, pseudo-hypodermis
(15) Distribution in outline
(16) Hybrids including their important synonyms
(17) Notes

The list of synonyms is restricted to those used in important floras or reference works as accepted by the respective authors. For example, most taxa treated at the species level in GRAEBNER (1907) and HAGSTRÖM (1916) can be assigned to species we recognize. Furthermore, names generally cited and names published in recent years are recognized. In order to save space, the list is confined only to "more important" names, mostly at the level of a species. Names of subspecies are sometimes included as they are generally neglected, but may become important for future infraspecific treatment. In the case of an uncertain assignment of a name a question mark is added.

The description of morphology and anatomy is carried out with special emphasis on vegetative diagnostic characters. The descriptive terms of morphology, population biology and anatomy are outlined below. The notes usually concentrate on two important questions: Does the respective taxon exist and which is the correct name? What information is lacking to answer these questions?

Information excluded

The following items were deliberately excluded from the account of the species:

(1) Information on typification and the deposition of type specimens. Types are often not designated, and in case of designation contradictory information is available in many cases. This implies a certain instability of nomenclature.

(2) Chromosome numbers. Overviews of published chromosome numbers can be found in LES (1982) and more recently in HOLLINGSWORTH et al. (1998). The data are excluded from the descriptions for several reasons. Only for ca. 30 species are two or more methodologically reliable counts available. All reliable counts originate from the Northern Hemisphere. Of at least 20% of the reliable counts we are not sure to which taxon of the present treatment they actually refer.

(3) Further information about several floral and generative characters, which have been regarded as important by earlier authors, e.g. information about sepaloid connectives or additional information about size, shape, and colour of fruits.

Descriptive terms of vegetative morphology

Descriptions of morphological characters and life histories in the taxonomic treatment of *Potamogeton* are often inexact. This is due to the fact that all *Potamogeton* species have a complex modular organization difficult to describe both in terms of classical and functional morphology. A fully satisfactory description of all morphological characters regarded as taxonomically important would be very space consuming. If possible, the nomenclature on branching, longevity of plant parts, overwintering structures, seasonality, etc. as proposed by BRUX et al. (1989), WIEGLEB & BRUX (1991), and WIEGLEB & KADONO (1989a,b) is adopted. As some simplifications were necessary, some explanations are given below.

Shoot types. In *Potamogeton* two different basic shoot types occur, namely "vertical shoots" [VS] ("erect shoot" sensu TOMLINSON 1982, including also the lateral "renewal shoots") and "horizontal shoots" (as lower and upper horizontal shoots [LHS, UHS]), which differ in leaf insertion and vegetative anatomy (TOMLINSON 1982). This differentiation is visible in all species, despite the fact that individual plants can change their growth pattern in an opportunistic way. Only for the sake of comparability with general *Potamogeton* literature do we use the term "rhizome" in the descriptions for the lower horizontal shoot, regardless whether it is actually stoloniferous, rhizomatous, or a complex of differently shaped parts. In the descriptions we also use the term "stem" characterizing the main axis of the vertical shoot. If necessary we use the terms "horizontal shoot" and "vertical shoot" to remain morphologically exact.

Branching pattern. A complete account on branching pattern cannot be given here, as even terms like "sympodial" and "monopodial" are not well-defined in *Potamogeton* and would require explanation at length. If we use expressions like "stem unbranched" we indicate that the species (e.g. *P. alpinus*) develops no renewal shoots below the pseudo-opposite involucral leaves. But it may produce turion-bearing upper horizontal shoots in some cases, in particular at the end of the growing season.

In principle, branching analysis is also important for a proper description of the inflorescence types. As the "inflorescence types" sensu HAGSTRÖM (1916) are not known for all species, we do not mention them. We use simple descriptive terms like "apical" or "lateral" to characterize the position of flowering parts, well knowing that these terms are imprecise without having identified the primary spike. In accordance with TOMLINSON (1982) we use the term "inflorescence" for the "spike-peduncle unit" as a whole. This contrasts with HAGSTRÖM's (1916) use of this term.

Longevity and hibernation. We avoid undifferentiated expressions like "annual" and "perennial". Terms relating to longevity always refer separately to below-ground or above-ground parts of an individual. Additionally, remarks on seasonality are given, if information is available. For example, in *P. lucens* the rhizomatous part of the LHS is at least biennial, mostly perennial, while the above ground vertical shoots are often short-lived and summer-green. The species has a seasonal development throughout its range. Unfortunately, such information is in most cases not available for Southern Hemisphere species.

We distinguish various types of "winterbuds" or "propagules" (see RAUNKIAER 1896), which in all cases serve several functions in the life cycle of an individual plant (hibernation,

drought resistance, short range dispersal, etc.). We distinguish between winterbuds on vertical and horizontal shoots:

(1) Winterbuds on VS are found as axillary or apical fusiform "turions", which are mostly dormant (e.g. in *P. pusillus*), as non-dormant axillary turions of varying shape (e.g. in *P. crispus*), or as unspecialized, non-dormant, axillary, short shoots (e.g in *P. natans* and *P. praelongus*).

(2) Winterbuds on LHS are found mostly as dormant apical turions on stoloniferous horizontal shoots (e.g. in *P. alpinus*, also on upper horizonatal shoots), as rhizomatous tubers (e.g. in *P. pectinatus*), and as turion-tuber complexes, mostly on rhizomatous lower horizontal shoots (e.g. in *P. lucens*). Also unspecialized leafy vertical shoots can be regarded as winterbuds in some species (e.g. in *P. amplifolius*).

Leaf description. Special emphasis is paid to the description of the leaves. Descriptive terms of leaf structure are always expressed in comparison to other aquatic plant leaves (and not terrestrial mesophyte leaves, as is often found in the literature). The fact that submerged leaves are membranous and translucent is taken for granted. The typical submerged leaf is found in the middle of the stem. The lower submerged leaves are often different in shape, which is acknowledged if they make up a significant portion of the leaves. The upper ones are often developed as "intermediate leaves". These leaves can be independently "intermediate" between submerged and floating leaf as to shape, structure, and petiolation. They may sometimes be present in the absence of true floating leaves. This fact usually results from a phenotypic reaction to varying water levels.

Descriptive terms of stem anatomy

We regard stem anatomical characters as useful information with respect to the taxonomic arrangement of the species, and also the identification of fragmentary herbarium specimens (see HAGSTRÖM 1916, TUR 1982, WIEGLEB 1990c). However, the anatomical characters have to be treated with great care. There is a lot of variation within species, often even within one individual specimen. Particularly in the study of herbarium specimens, when only those shoot types and parts available by chance can be studied, results of the study of a single cross section must not be overestimated.

The stem anatomical characters reported here refer to internodes on the upper parts of stems. The following characters are regarded as taxonomically important:

(1) Type of stele, distinguishing among the proto type (with more than 8, usually 10–14 free vascular bundles), the trio type (or eight bundles type, if necessary with additional information on the number of phloema, 1 or 2, in the trio bundle), the oblong type (with the 3 separated parts themselves containing 1–3 bundles), the four bundles type, and finally the circular type (or one bundle type). In a few cases additional characters like shape and sclerenchymatization of the stele are listed.

(2) Cell shape of the endodermis (which is either of U or O-type, or intermediate U-O-type). A further possible differentiation according to the strength of the cell walls is attributed to the developmental stage of the individual.

(3) Presence of interlacunar bundles, with additional information on number (including completeness of rings) and size.

(4) Presence of subepidermal bundles, including number and size.

(5) Presence of the pseudohypodermis, including number of cell layers.

KEY TO THE SPECIES

1a Stipules of submerged leaves adnate for most of their length to the leaf base, leaf lamina arising at the top of the stipular sheath which surrounds the stem above the node; submerged leaves always linear to broadly linear or rarely lanceolate 2

1b Stipules free from the leaf base or almost so, leaf lamina or petiole arising directly from the node; submerged leaves linear to broadly ovate 13

2a Leaves serrulate or denticulate at margins, 1.1–8.0 mm wide, 7–25 times as long as wide, auriculate to rounded at the base 3

2b Leaves entire at margins, 0.1–2.5(–5.0) mm wide, 15–600 times as long as wide, straight at the base . . 4

3a Submerged leaves lanceolate, gradually tapering to apex, stiffish; specialized axillary and apical dormant turions developing; scattered interlacunar bundles present . . . . . 36. *P. robbinsii*

3b Submerged leaves linear, with ± parallel margins, abruptly tapering at apex, ± lax; specialized dormant turions not developing; interlacunar bundles absent . . . . . 37. *P. maackianus*

4a Stipules fused with the leaves for 6–65(–140) mm; floating leaves always absent; inflorescences monomorphic; peduncles 20–200(–450) mm long; spikes long cylindrical, (13–)20–75 mm long in fruit; submerged leaves tubular with air channels bordering the midrib; fruits convex on sides, without lateral keels; endodermis of U-type, rarely of O-type 5

4b Stipules fused with the leaves for 0.3–6.0 mm; floating leaves often present; inflorescences dimorphic to trimorphic; peduncles 1–32 mm long; spikes subglobose to cylindrical, 2–28 mm long in fruit; submerged leaves ± flat with lacunae bordering the midrib; fruits concave on sides, with distinct lateral keels; endodermis of O-type 11

5a Stipules connate and tubular at the base when young, margins of the open portion brown; flower whorls in spike markedly remote at anthesis; leaves of the main stem obtuse at apex; mature fruits (1.9–)2.2–3.5 mm long 6

5b Stipules open and convolute along their entire length, margins of the open portion whitish; flower whorls in spike contiguous at anthesis, later remote; leaves of the main stem acute to obtuse or subretuse at apex; mature fruits mostly 3.0–4.7(–5.1) mm long 7

6a Leaves 0.3–1.2(–1.9) mm wide, (50–)100–300 times as long as wide, obtuse to subacute on side shoots; fruits (1.9–)2.2–2.8(–3.2) mm long; apex of ligule obtuse to rounded; stipular sheath of leaves on main stem not inflated . . . . . 66. *P. filiformis*

6b Leaves 1–3 mm wide, 20–50 times as long as wide, always broadly obtuse; fruits (2.8–)3.0–3.5 mm long; apex of ligule subretuse; stipular sheath of leaves on main stem often inflated . . . . . 67. *P. amblyphyllus*

7a Leaves always obtuse to subretuse; fruits without a distinct beak 8

7b Leaves mostly acute to acuminate; fruits with a distinct beak 10

8a Leaves strongly recurved at the top; peduncles short, 20–50 mm long . . . . . 65. *P. recurvatus*

8b Leaves not recurved at the top; peduncles 30–170(–200) mm long 9

9a Leaves obtuse at apex; peduncles 30–150 mm long; stipular sheath of leaves on main stem (especially the lower ones) very broad, up to 10 mm wide, 30–70 mm long; interlacunar bundles in (3–)4 circles . . . . . 63. *P. vaginatus*

9b At least some leaves clearly subretuse at apex; peduncles 100–170(–200) mm long; stipular sheath of leaves on main stem narrower, 1.5–4.0 mm wide, 20–30(–40) mm long; interlacunar bundles in 1 incomplete circle . . . . . 64. *P. subretusus*

10a Leaves of the main stem less than twice as wide as those on the branches; fruits with a beak up to 1.2 mm long, rhizomatous tubers mostly developing . . . . . 68. *P. pectinatus*

10b Leaves of the main stem more than twice as wide as those on the branches; fruits with a beak less than 0.5 mm long; rhizomatous tubers not developing . . . . . 69. *P. striatus*

11a (4) Adnate portion of the stipule mostly longer than free ligule, fused with the leaves for 1.5–6.0 mm; fruits with a dorsal keel and smoothly rounded sides, lateral keels absent ..... 60. *P. spirillus*
11b Adnate portion of the stipule mostly shorter than free ligule, fused with the leaves for 0.3–3.5(–4.0) mm; fruits usually with two lateral entire to dentate keels in addition to the dorsal keel 12

12a Submerged leaves from the middle part of stem (0.3–)0.5–1.5 mm wide, 20–180 times as long as wide, floating leaves (7–)13–40 mm long ..... 61. *P. diversifolius*
12b Submerged leaves from the middle part of stem 0.1–0.4(–0.5) mm wide, 190–500 times as long as wide; floating leaves 6–23(–28) mm long ..... 62. *P. bicupulatus*

13a (1) Leaf margins serrate, with teeth easily visible to the naked eye; fruits adnate at base; beak at least half as long as the rest of the fruit; submerged leaves (3–)5(–7)-veined; floating leaves always absent ..... 35. *P. crispus*
13b Leaf margins entire or minutely denticulate, with teeth not or scarcely visible to the naked eye; fruits free at base; beak mostly much less than half as long as the rest of the fruit; submerged leaves 1–41-veined; floating leaves absent or present 14

14a All leaves filiform to linear, with parallel sides, or sometimes linear-lanceolate, (13–)18–110 times as long as wide, mostly 0.1–6.0, rarely up to 9.0 mm wide, all sessile, submerged, entire at margins; stele of oblong or circular type (in *P. polygonus* of proto or reduced trio type) 15
14b Mostly all, but at least floating leaves narrowly elliptical to orbicular, with convex sides, 1–13 times as long as wide, 4–80 mm wide, sessile and/or petiolate, submerged and/or floating (or rarely emersed when semiterrestrial), entire and/or denticulate at margins; stele mostly of proto, trio or four bundles type, sometimes of oblong or circular type 33

15a Leaves with both lateral veins and many additional longitudinal sclerenchymatous strands; stem strongly compressed or flattened to terete; stele of oblong type, rarely (*P. polygonus*) of proto or reduced trio type 16
15b Leaves with 1–4 lateral veins on each side of the midrib without additional sclerenchymatous strands; stem terete or subterete to slightly compressed; stele mostly of circular type, sometimes of oblong type 24

16a Leaves (5–)7–9-veined, 3–6(–9) mm wide, with broad to very broad rows of lacunae bordering the midrib, acuminate at apex; strands in the leaf margins strongly sclerenchymatous, persisting as fibres ..... 38. *P. polygonus*
16b Leaves 3–5-veined (5–7(–9)-veined in *P. oxyphyllus*), mostly 1.2–5.0 mm wide, with narrow rows of lacunae bordering the midrib, acuminate or acute to obtuse, rounded or mucronate at apex; sclerenchymatous strands in the leaf margins almost of the same strength as the other leaf veins .. 17

17a Leaves (1.8–)2.0–5.4(–6.0) mm wide, with 16–34 sclerenchymatous strands (only (2–)8–16(–20) in *P. oxyphyllus*); fruits (2.8–)3.0–5.5 mm long 18
17b Leaves 1.2–2.5 mm wide, with 8–16(–20) sclerenchymatous strands; fruits 2.1–3.5 mm long 23

18a Stem terete, 0.3–0.6 mm in diameter throughout the shoot 19
18b Stem strongly compressed to flattened, (0.4–)0.6–3.4 mm wide (in *P. compressus* exceptionally up to 4.8 mm wide), distinctly broadened near the nodes 21

19a Leaves with (2–)8–16(–20) sclerenchymatous strands, 5–7(–9)-veined, linear to narrowly linear-lanceolate, acuminate at apex; pseudohypodermis absent ..... 46. *P. oxyphyllus*
19b Leaves with 20–32 sclerenchymatous strands, (3–)5-veined, linear, acute to obtuse at apex; pseudohypodermis 2–3-layered 20

20a Leaves 25–90(–130) mm long, obtuse at apex ..... 39. *P. ochreatus*
20b Leaves 85–200 mm long, acute at apex ..... 40. *P. furcatus*

21a Peduncles 3–15(–26) mm long; spikes almost globose, 4–8 mm long in fruit, with (1–)2(–3) whorls of flowers; stipules 10–21(–29) mm long; flowers with 1(–2) carpels ..... 41. *P. acutifolius*

21b Peduncles (19–)28–100 mm long; spikes cylindrical, 15–33 mm long in fruit, with 5–11 whorls of flowers; stipules (16–)20–55 mm long; flowers with (1–)2(–3) carpels 22

22a Fruits obliquely and narrowly obovate in outline, 3.4–4.0 mm long, beak recurved, leaves (3–)5-veined, stipules soon eroding to fibrous strands at the apex . . . . . 42. *P. compressus*
22b Fruits quadrately suborbicular, 4.0–5.0(–5.5) mm long, beak nearly erect, leaves 3-veined, stipules persistent and generally intact throughout the season . . . . . 43. *P. zosteriformis*

23a (17) Leaves 1.5–2.5 mm wide, acuminate; fruits 2.8–3.5 mm long; dorsal keel distinct . . . . . 44. *P. manchuriensis*
23b Leaves 1.2–2.0 mm wide, rounded and mucronate at the apex; fruits 2.1–3.0 mm long; dorsal keel indistinct . . . . . 45. *P. sibiricus*

24a (15) Rhizome long and creeping; inflorescence 1 or rarely 2 in terminal position; peduncles 15–240 mm long; leaves filiform, 0.1–0.5 mm wide . . . . . 59. *P. confervoides*
24b Rhizome short or absent; inflorescences usually more than 1 per shoot both in terminal and lateral position; peduncles 3–70(–80) mm long; leaves linear, rarely filiform, 0.3–6.0 mm wide 25

25a Leaves obtuse to rounded at apex, often very shortly mucronate, often with a reddish tinge; stem richly branched; internodes mostly much shorter than the adjacent leaves . . . . . 54. *P. obtusifolius*
25b Leaves acute, acuminate, mucronate at apex or gradually tapering to a fine, almost bristle-like point, reddish tinge present or mostly absent; internodes shorter or longer than the adjacent leaves 26

26a Leaves regularly 3–7(–9)-veined, (1.5–)2.0–6.0 mm wide; spikes 9–17 mm long 27
26b Leaves regularly 3-veined, rarely some 5-veined, mostly 0.3–2.0 mm wide; spikes 3–11(–13) mm long 28

27a Stipules split into two remnants, fused at base, almost entirely free at apex; leaves distinctly mucronate at the apex, with a faint marginal vein, 1.5–3.5 mm wide; flowers 4–8 in spike; fruits 2.4–3.0 mm long . . . . . 47. *P. friesii*
27b Stipules not split into two remnants, convolute (fused on the side towards to the leaf and free on the opposite side); leaves acute at apex, with marginal strands stronger, remaining as fibres, (2–)3–6 mm wide; flowers 5–12 in spike; fruits 4.3–4.6 mm long . . . . . 49. *P. gayi*

28a Leaf midrib occupying 1/3–3/5 of the leaf width near the base, with strongly convex lower side in cross-section, not bordered by rows of lacunae; flowers with 1(–3) carpels; leaves mostly 0.3–1.0 mm wide . . . . . 55. *P. trichoides*
28b Leaf midrib occupying up to 1/5 of the leaf width near the base, with slightly convex lower side in cross-section, mostly bordered by rows of lacunae; flowers with 4(–5) carpels; leaves 0.5–2.5(–3.1) mm wide 29

29a Fruits with a dorsal keel up to 0.4 mm high, often with 2 lateral keels; spikes 2–7 mm long in fruit 30
29b Fruits with dorsal side rounded, lateral keels always absent; spikes 3–14 mm long in fruit 31

30a Fruits convex on sides, 2.3–4.0 mm long, 3-keeled; dorsal keel ridge-like, to 0.2 mm high; peduncles 6–14 mm long . . . . . 53. *P. hillii*
30b Fruits concave on sides, 1.4–2.7 mm long, 1-keeled; dorsal keel wing-like and undulate, to 0.4 mm high; peduncles mostly 3–11 mm long . . . . . 52. *P. foliosus*

31a Stipules delicate, not fibrous, greenish, brown or greenish white, translucent when dry, connate or convolute; leaves flaccid, acute or acuminate at apex, not finely pointed . . . . . 48. *P. pusillus*
31b Stipules (especially those of turions) firm, coarsely fibrous, whitish, opaque when dry, connate; leaves rigid, gradually tapering to a fine, almost bristle-like point, or sometimes acute at apex 32

32a Leaves 0.5–1.1 mm wide; spikes 3–10 mm long; flower whorls contiguous . . . . . 50. *P. rutilus*
32b Leaves 0.6–2.0 mm wide; spikes 6–13 mm long; flower whorls remote . . . . . 51. *P. strictifolius*

33a (14) Submerged leaves narrowly linear, 0.1–1.0(–1.9) mm wide; lamina of floating leaves 3–11 mm wide 34
33b Submerged leaves broadly linear or ribbon-like to broadly ovate, more than 2.5 mm wide, or phyllodial, 0.2–3.5 mm wide; lamina of floating leaves, if present, more than (7–)11 mm wide 36

34a Fruits with dorsal keel strongly developed and cristate, beak conspicuous . . . . . 57. *P. cristatus*
34b Fruits with dorsal keel entire or obtusely dentate, beak short 35

35a Beak in ripe fruits straight; submerged leaves 0.5–1.2(–1.9) mm wide, 30–75 times as long as wide; floating leaves acute at apex, with petioles 0.2–1.1 times as long as the lamina . . . . . 56. *P. octandrus*
35b Beak in ripe fruits slightly recurved; submerged leaves 0.1–0.5 mm wide, 150–250 times as long as wide; floating leaves obtuse at apex, with petioles 0.7–2.0 times as long as the lamina . . . . 58. *P. vaseyi*

36a All submerged leaves consisting of narrowly linear phyllodes, with a convex lower side, 0.2–3.5 mm wide, 70–300 times as long as wide, lateral veins inconspicuous; floating leaves almost always present, with lamina oblong to broadly elliptical or broadly ovate; endodermis of U-type; interlacunar bundles always present 37
36b Most or all submerged leaves with well developed lamina, flat on both sides, 1–80 mm wide, 2–70 times as long as wide, lateral veins conspicuous; floating leaves absent or present, with lamina of various shape; endodermis mostly of O-type, sometimes of U-type; interlacunar bundles present or absent . . 38

37a Lamina of floating leaves 40–100(–140) mm long, (7–)20–45(–80) mm wide, 17–25(–35)-veined, usually subcordate at the base; submerged leaves 0.8–3.5 mm wide; fruits 3.8–5.0 mm long; pseudohypodermis present in 1–2 layers . . . . . 16. *P. natans*
37b Lamina of floating leaves (13–)22–40(–55) mm long, (5–)10–22(–29) mm wide, (7–)9–19(–23)-veined, cuneate to rounded at the base; submerged leaves 0.2–1.0 mm wide; fruits 2.5–3.5(–3.7) mm long; pseudohypodermis absent, rarely present in 1 layer . . . . . 17. *P. oakesianus*

38a Submerged leaves with relatively broad rows of lacunae bordering the midrib, linear to ribbon-like, delicate, flaccid, 1–11 mm wide, 14–70 times as long as wide, sessile except for the uppermost ones 39
38b Submerged leaves with relatively narrow rows of lacunae or completely without lacunae, lanceolate or narrowly elliptical to broadly ovate (lanceolate to ribbon-like in *P. solomonensis*), membranous, (2–)4–75 mm wide, 1.3–19.0(–21.0) times as long as wide, sessile or petiolate 41

39a Lamina of floating leaves 14–31 mm long, 6–9 mm wide, 5–9-veined; submerged leaves 1–4 mm wide, 3–7-veined; inflorescences regularly inserted in the axils of both floating and submerged leaves; peduncles 11–27 mm long . . . . . 30. *P. ulei*
39b Lamina of floating leaves 33–80 mm long, 7–25 mm wide, 9–21-veined; submerged leaves usually 3–11 mm wide, 5–9(–13)-veined; inflorescences inserted mostly in the axils of floating leaves; peduncles 23–100 mm long 40

40a Petioles of true floating leaves not flattened, 20–60(–90) mm long; submerged leaves persistent . . . . . 29. *P. epihydrus*
40b Petioles of floating leaves flattened, 40–115(–150) mm long; submerged leaves mostly decaying early . . . . . 31. *P. montevidensis*

41a Submerged leaves sessile, amplexicaul to semiamplexicaul at base, clasping the stem; floating leaves always absent 42
41b Submerged leaves petiolate or sessile with cuneate base, not clasping the stem; floating leaves present or absent 44

42a Leaves entire at margins, distinctly hooded at apex, 60–360 mm long; fruits 4.5–5.5 mm long; stele of proto type; endodermis of U-type, rarely O-type; interlacunar bundles present, strong . . . 28. *P. praelongus*
42b Leaves denticulate at margins, not or only scarcely hooded at apex, mostly 15–80 mm long; fruits 2.2–4.2 mm long; stele of specialized trio type; endodermis of O-type; interlacunar bundles absent 43

43a Stipules delicate, without fibres, decaying early; fruits 2.2–3.5 mm long ..... 26. *P. perfoliatus*
43b Stipules fibrous, persisting as fibres; fruits 2.7–4.2 mm long ..... 27. *P. richardsonii*

44a All true submerged leaves sessile or sometimes very shortly petiolate, with petioles less than 5 mm long, 0.00–0.05 times as long as the lamina, the uppermost submerged or intermediate leaves may have much longer petioles 45
44b Most or all submerged leaves petiolate, with most or all petioles at least (3–)5 mm long, (0.03–)0.05–5.00 times as long as the lamina 49

45a Submerged leaves obtuse to narrowly obtuse and slightly hooded at apex, 9–15-veined; stem unbranched; petioles of floating leaves 0.1–0.8 times as long as the lamina; both submerged and floating leaves with a strong reddish to brownish tinge, especially when dried; interlacunar bundles absent ..... 13. *P. alpinus*
45b Submerged leaves acute to mucronate and flat at apex, usually 3–11-veined (up to 17-veined in *P. illinoensis*); stem unbranched to richly branched; petioles of floating leaves mostly 0.8–4.0 times as long as the lamina; leaves green or rarely only with a slight brownish tinge; interlacunar bundles present or absent 46

46a Submerged leaves denticulate at margins; stem usually richly branched (unbranched or sparingly branched in *P. illinoensis*); peduncles as thick as or up to much thicker than the stem; fruits 2.4–3.9 mm long; stele of proto or trio to oblong type; endodermis of U-type 47
46b Submerged leaves entire at margins; stem unbranched or sparingly branched; peduncles as thick as the stem; fruits 1.7–2.6 mm long; stele of four bundles type, rarely of proto or trio type; endodermis of O-type 48

47a Submerged leaves linear-oblong to oblong or oblanceolate, mostly 5–12 mm wide; stipules usually 6–25 mm long; fruits 2.4–3.1 mm long ..... 25. *P. gramineus*
47b Submerged leaves narrowly lanceolate or oblong to elliptical, mostly 12–53 mm wide; stipules 20–80 mm long; fruits 2.7-3.9 mm long 53

48a Submerged leaves narrowly linear-lanceolate to narrowly elliptical; fruiting spikes 10–25 mm long, 6–7 mm wide; fruits 2.0–2.6 mm long; stipules usually 25–35 mm long; subepidermal bundles present, mostly strongly developed ..... 33. *P. cheesemanii*
48b Submerged leaves narrowly oblong to broadly ovate; fruiting spikes 7–22 mm long, ± 5 mm wide; fruits 1.7–2.0(–2.5) mm long; stipules 16–25 mm long; subepidermal bundles absent ..... 32. *P. drummondii*

49a (44) Lamina of submerged leaves sometimes sagittate at base, 105–160 mm long; petioles of floating leaves 115–185 mm long; peduncles considerably thicker than the stem, 130–180 mm long; pseudohypodermis absent ..... 18. *P. papuanicus*
49b Lamina of submerged leaves cuneate to cordate at base, never sagittate, 30–310 mm long; petioles of floating leaves 5–260(–390) mm long; peduncles as thick as or thicker than the stem, 10–350 mm long; pseudohypodermis absent or mostly present 50

50a Mature submerged leaves mucronate at the apex, denticulate at margins (at least in young leaves), near the base of the stem often partly reduced to phyllodes; petioles of submerged leaves (0–)2–70(–140) mm long; interlacunar bundles always well developed; endodermis of U-type, exceptionally of O-type 51
50b Submerged leaves either obtuse or acute at the apex, entire or minutely denticulate at margins, phyllodes near the base of the stem almost always absent; petioles of submerged leaves 1–200(–250) mm long; interlacunar bundles present or absent; endodermis of O-type, exceptionally of U-type 54

51a Petioles of submerged leaves 30–70(–140) mm long; submerged leaves oblong, with parallel margins; fruits 2.0–3.3 mm long; peduncles slightly thicker than the stem; stele of trio type, rarely of proto type ..... 21. *P. wrightii*
51b Petioles of submerged leaves usually (0–)2–40 mm long; submerged leaves elliptical or lanceolate, with convex margins; fruits 2.7–4.5 mm long; peduncles distinctly thicker than the stem; stele mostly of oblong type in typical shoots 52

52a Submerged leaves mostly elliptical, 25–65 mm wide, conspicuously denticulate; petiole length relatively constant, ranging between 2–7(–15) mm; floating leaves always absent; stele mostly of oblong type . . . . . 24. *P. lucens*

52b Submerged leaves narrowly lanceolate to elliptical, mostly 5–40 mm wide, often only inconspicuously denticulate; petiole length variable, ranging between 0–40(–65) mm long; floating leaves present or absent; stele more variable, ranging from proto to oblong type 53

53a Submerged leaves mostly 15–40 mm wide, 9–17-veined, mostly 4–6 times as long as wide; lamina of floating leaves mostly 25–65 mm wide . . . . . 22. *P. illinoensis*

53b Submerged leaves (3–)7–28 mm wide, 7–11-veined, mostly 6–17 times as long as wide; lamina of floating leaves 12–30 mm wide . . . . . 23. *P. schweinfurthii*

54a (50) Stem conspicuously black-spotted; submerged leaves undulate along the margins; interlacunar bundles absent . . . . . 7. *P. pulcher*

54b Stem not conspicuously black-spotted, sometimes reddish-spotted or mostly without conspicuous spots; submerged leaves ± flat along the margins (undulate in *P. australiensis*); interlacunar bundles absent or present 55

55a Floating leaves translucent, membranous, with conspicuous secondary veins; fruits 1.3–2.5 mm long; petioles of floating leaves 5–50 mm long; interlacunar bundles absent; subepidermal bundles always present; pseudohypodermis present 56

55b Floating leaves opaque, coriaceous, with inconspicuous secondary veins (in *P. tepperi* secondary veins conspicuous); fruits 1.8–5.2(–5.7) mm long; petioles of floating leaves 20–260(–390) mm long; interlacunar bundles absent or mostly present; subepidermal bundles present or absent; pseudohypodermis present or absent 57

56a Fruits 1.3–1.9 mm long; lamina of floating leaves 13–21-veined, 2–10 times as long as the petiole; peduncles not thicker than stem . . . . . 3. *P. coloratus*

56b Fruits 2.0–2.5 mm long; lamina of floating leaves 9–15-veined, 0.5–5.0 times as long as the petiole; peduncles thicker than stem . . . . . 4. *P. australiensis*

57a Whole plants strongly reddish brown, especially when dried; submerged leaves decaying early; pseudohypodermis always present . . . . . 11. *P. ferrugineus*

57b Plants pale green to olive-green, locally also with a brownish tinge; submerged leaves decaying or mostly persistent; pseudohypodermis absent or present 58

58a Submerged leaves (21–)25–37(–41)-veined, with petioles (2–)6–80 mm long; floating leaves (21–)25–51-veined, often cordate to rounded at base 59

58b Submerged leaves 3–21-veined, with petioles mostly 30–250 mm long (in *P. solomonensis* and *P. fryeri* only (1–)5–50 mm long); floating leaves 9–25-veined (up to 35-veined in *P. fryeri*), mostly cuneate, sometimes also rounded to subcordate at base 60

59a Submerged leaves (at least the uppermost) folded and strongly arcuate; fruits 3.9–5.2(–5.7) mm long, not tricarinate, with an indistinct, smooth dorsal keel only; stem indistinctly sclerenchymatous; pseudohypodermis present . . . . . 10. *P. amplifolius*

59b Submerged leaves ± flat; fruits (2.7–)3.0–4.1 mm long, distinctly tricarinate, with strongly sculptured dorsal and lateral keels; stem strongly sclerenchymatous, with persistent fibres visible to the naked eye; pseudohypodermis absent . . . . . 6. *P. sulcatus*

60a Unrolled stipules 6–15 mm wide, with hyaline margins, persistent; submerged leaves elliptical to oblong or lanceolate, mostly 1.6–2.8 times as long as wide, obtuse at apex; petioles of submerged leaves (2–)10–35 mm long; lamina of floating leaves ovate or elliptical to obovate, 1.6–2.8 times as long as wide; petiole of floating leaves almost always with a discoloured section at the junction with the lamina; pseudohypodermis present in 2–3(–4) layers . . . . . 9. *P. linguatus*

60b Unrolled stipules mostly 3–10 mm wide, without hyaline margins, persistent to decaying early; submerged leaves lanceolate or ribbon-like to narrowly oblong or oblong, mostly 2.3–19.0 times as long as wide, acute to narrowly obtuse at apex; petioles of submerged leaves mostly 25–250 mm long (in *P. solomonensis*

and *P. fryeri* only (1–)5–50 mm long); lamina of floating leaves narrowly elliptical to lanceolate or linear-oblong, 1.5–6.0 times as long as wide; petiole of floating leaves with or mostly without a discoloured section at the junction with the lamina; pseudohypodermis absent or present in 1(–2) layers 61

61a Lamina of submerged leaves lanceolate to ribbon-like, 5–8(–15) mm wide, 8–19 times as long as wide; floating leaves 9–11-veined; spikes dimorphic, cylindrical or subglobose; stele of reduced trio or four bundles type . . . . . 34. *P. solomonensis*

61b Lamina of submerged leaves narrowly oblong or oblong to lanceolate, (5–)8–38 mm wide, (1.9–)2.3–11.0(–15.0) times as long as wide; floating leaves 11–35-veined; spikes monomorphic, cylindrical; stele of proto or trio type 62

62a Petiole of floating and uppermost submerged leaves often flattened and winged, with undulate margins; lamina of floating leaves 21–35-veined; lower submerged leaves sessile to subsessile, the upper ones petiolate, the petioles 0–40 mm long, 0.0–0.3 times as long as the lamina; peduncles 70–150 mm long; fruits 4.5–5.0 mm long; interlacunar bundles present . . . . . 8. *P. fryeri*

62b Petiole of both floating and submerged leaves terete; lamina of floating leaves 11–25-veined; all submerged leaves (long) petiolate, the petioles (12–)30–250 mm long, (0.2–)0.5–5.0 times as long as the lamina; peduncles mostly 25–120 mm long; fruits 1.8–4.8 mm long; interlacunar bundles present or mostly absent 63

63a Fruits 2.7–4.8 mm long; submerged leaves (5–)9–21-veined, minutely denticulate or entire at margins, with petioles 30–250 mm long; endodermis of O-type or U-type 64

63b Fruits 1.8–2.6 mm long (up to 3.0 mm long in *P. tepperi*); submerged leaves (3–)5–15-veined, entire at margins, with petioles mostly 15–90 mm long; endodermis of O-type 67

64a Flowers with 1–2(–3) carpels; petioles of floating leaves (50–)80–260(–390) mm long . . 19. *P. distinctus*

64b Flowers with (3–)4(–5) carpels; petioles of floating leaves 18–210(–280) mm long 65

65a Submerged leaves persistent, (11–)22–38 mm wide; floating leaves mostly 60–130 mm long; interlacunar bundles absent, rarely a few present; endodermis mostly of O-type, rarely of O-U-type . . . 20. *P. nodosus*

65b Submerged leaves decaying early, 6–27 mm wide; floating leaves mostly 30–80 mm long; interlacunar bundles present; endodermis of U-type, rarely of O-type 66

66a Petioles of floating leaves 18–110(–195) mm long, 0.3–3.0 times as long as the lamina; lamina mostly 20–41 mm wide; stele of trio type; interlacunar bundles present in 2–3 circles; subepidermal bundles present . . . . . 14. *P. thunbergii*

66b Petioles of floating leaves usually 75–170(–280) mm long, 1.8–6.0 times as long as the lamina; lamina 7–26 mm wide; stele of proto or trio type; interlacunar bundles present in 1 circle; subepidermal bundles absent or a few present . . . . . 15. *P. parmatus*

67a (63) Submerged leaves decaying early, 5–9(–11)-veined; peduncles 0.8–3.0 times as long as the fruiting spike, slightly thinner than the stem; stele of trio type; interlacunar bundles present . . . . 12. *P. stenostachys*

67b Submerged leaves persistent or decaying, (3–)5–17-veined; peduncles 2.5–6.0 times as long as the fruiting spike, as thick as the stem; stele of proto to trio type; interlacunar bundles absent 68

68a Submerged leaves decaying early, linear-lanceolate to ovate-lanceolate; fruits (2.0–)2.5–3.0 mm long; floating leaves 15–23-veined; stele of proto to trio type; subepidermal bundles absent . . . . . 5. *P. tepperi*

68b Submerged leaves persistent, linear-oblong to oblong or narrowly elliptical; fruits 1.8–2.6 mm long; floating leaves mostly 11–19-veined (up to 25-veined in *P. polygonifolius*); stele of proto type; subepidermal bundles present 69

69a Submerged leaves 5–15 times as long as wide; fruits 1.9–2.6 mm long . . . . . 1. *P. polygonifolius*

69b Submerged leaves 1.9–5.0 times as long as wide; fruits 1.8–2.3 mm long . . . . . 2. *P. suboblongus*

AN ACCOUNT OF THE SPECIES

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= *P. anglicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 180. 1916, pro hybr. *P. coloratus* × *P. polygonifolius*.

Description

Rhizome filiform to slender, terete, perennial, sometimes with apical scaly turions. Stem unbranched or sparingly branched, filiform to slender, terete, annual to perennial, wintergreen, continuing to grow after flowering; specialized dormant turions not developing. Submerged leaves usually present, absent in landforms and shallow water forms, petiolate; lamina linear-oblong to narrowly elliptical, 50–130(–220) mm long, 3–25(–55) mm wide, 5–15 times as long as wide, yellow-green to bright green, often with a reddish tinge, (3–)5–15-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, narrowly obtuse at apex; petiole 15–80(–240) mm long, 0.5–5.0 times as long as the lamina. Intermediate leaves sometimes present, petiolate, oblong. Floating leaves petiolate; lamina oblong or elliptical to ovate, (10–)25–75(–105) mm long, (5–)10–65 mm wide, 1.5–4.0 times as long as wide, opaque, coriaceous, bright green to brownish green, often with a reddish tinge, 11–19(–25)-veined, cuneate to rounded or subcordate at base, acute to obtuse at apex; petiole (13–)25–150(–300) mm long, 0.5–6.0 times as long as the lamina. Stipules axillary, convolute, 10–65 mm long, translucent, persistent. Peduncles 25–100(–185) mm long, 2.5–5.0 times as long as the fruiting spike, as thick as the stem, inserted in the axils of floating leaves. Spikes cylindrical, 10–42 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 1.9–2.6 mm long, dorsal keel indistinct.

Stem anatomy

Stele of proto type, endodermis mostly of O-type, sometimes O-U-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis present, 1–2-layered.

Distribution

W, N, C and S Europe, the Azores, Madeira, N Africa, E North America.

Hybrids

13 × 1. *P.* ×*spathulatus* SCHRAD. ex W.D.J. KOCH et ZIZ, Cat. Pl. Palatinat. 5: 18. 1814, pro sp. ("spathulatum")
[= *P. alpinus* × *P. polygonifolius*]
≡ *P. kochii* F.W. SCHULTZ, Arch. Fl. France Allem. 1: 61 et 72. 1844, nom. illeg. ("Kochii")
≡ *P. oblongo-rufescens* F.W. SCHULTZ, Flora 32(15): 230. 1849, nom. illeg.
≡ *P. rufescenti-natans* F.W. SCHULTZ, Archives de Flore 1(4): 55. 1855, nom. illeg.
≡ *P. alpino-natans* F.W. SCHULTZ, Jahresber. Pollichia 20–21: 228. 1863, nom. illeg.
≡ *P. alpinus* subsp. *spathulatus* (SCHRAD. ex W.D.J. KOCH et ZIZ) MAGNIN, Bull. Soc. Bot. France 43: 441. 1896.

16 × 1. *P.* ×*gessnacensis* G. FISCH., Mitt. Bayer. Bot. Ges. 1(37): 472. 1905. ("Geßnacensis")
[= *P. natans* × *P. polygonifolius*]

25 × 1. *P.* ×*lanceolatifolius* (TISELIUS) C.D. PRESTON, Watsonia 16: 437. 1987.
[= *P. gramineus* × *P. polygonifolius*]

≡ *P. gramineus* f. *lanceolatifolius* TISELIUS, Potamog. Suec. Exs., fasc. 3: [sched.] no. 139, notulae p. 6. 1897.

≡ *P. gramineus* proles *heterophyllus* var. *stagnalis* subvar. *lanceolatifolius* (TISELIUS) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 88. 1907.

≡ *P.* ×*seemenii* nothof. *lanceolatifolius* (TISELIUS) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 231. 1916. ("form")

1 × 48. *P.* ×*rivularis* GILLOT in MAGNIER, Scrin. Fl. Select. 6: 118. 1887

[= *P. polygonifolius* × *P. pusillus*]

≡ *P. lanceolatus* var. *rivularis* (GILLOT) FRYER, J. Bot. 32: 338. 1894.

≡ *P. lanceolatus* subsp. *rivularis* (GILLOT) MAGNIN, Bull. Soc. Bot. France 43: 441. 1896.

= *P.* ×*miguelensis* DANDY, Bol. Soc. Brot., ser. 2, 44: 5. 1970.

Notes

(1) *P. polygonifolius* is closely related to *P. coloratus* and *P. suboblongus*.

(2) The assumed eastward distribution of *P. polygonifolius* in Asia can be attributed to confusion with *P. distinctus*. The assumed Southern Hemisphere distribution is due to confusion with southern species like *P. suboblongus*, *P. cheesemanii*, *P. parmatus*, and *P. stenostachys*. The occurrence in these areas has not yet been proved.

2. *Potamogeton suboblongus* HAGSTRÖM, Kungl. Svenska Vetenskapsakad. Handl. 55(5): 182. 1916

Description

Rhizome slender, terete, perennial, continously growing, turions or winterbuds not seen. Stem unbranched or rarely sparingly branched, slender, terete, perennial, not much differentiated from the horizontal shoot; specialized dormant turions not developing. Differentiation of submerged and floating leaves indistinct. Submerged leaves, if present, petiolate; lamina subcoriaceous, narrowly elliptical to oblong, 30–90 mm long, 8–17(–38) mm wide, 1.9–5.0 times as long as wide, yellow-green to bright green, sometimes with a reddish tinge, 7–15-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, narrowly obtuse at apex; petiole 20–60 mm long, 1.2–1.8 times as long as the lamina. Floating leaves petiolate; lamina oblong to broadly elliptical or ovate, (20–)30–60(–75) mm long, 8–35 mm wide, 1.6–4.0 times as long as wide, opaque, coriaceous, bright green to brownish green, 11–15(–21)-veined, cuneate to truncate or subcordate at base, subacute to rounded at apex; petiole 18–55 mm long, 0.6–1.8 times as long as the lamina. Stipules axillary, convolute, 9–35 mm long, conspicuous, persistent or partly decaying. Peduncles (34–)45–130 mm long, 2.5–4.0(–5.5) times as long as the fruiting spike, as thick as the stem, mostly terminal in the axils of floating leaves. Spikes cylindrical, 10–30 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 1.8–2.3 mm long, dorsal keel indistinct.

Stem anatomy

Stele of proto type, rarely reduced to trio (2) type or complex four bundles type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, in one incomplete ring, pseudohypodermis present, 1-layered.

Distribution

New Zealand, Tasmania?

Note

(1) *P. suboblongus* is a distinct species of the flora of New Zealand. It is closely related to *P. polygonifolius* from the Northern Hemisphere.

3. *Potamogeton coloratus* HORNEMANN, Fl. Dan. 9(25): 2, tab. 1449. 1813. ("coloratum")

≡ *P. hornemannii* G. MEY., Chloris Han. 521. 1836, nom. illeg. ("Hornemanni")

≡ *P. natans* var. δ. *coloratus* (HORNEM.) FIORI, Fl. Anal. Ital. 1: 154. 1896.

= *P. plantagineus* DUCROS ex ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 504. 1818.

≡ *P. natans* subsp. *plantagineus* (DUCROS ex ROEM. et SCHULT.) HOOK. f., Stud. Fl. Brit. Isl. 371. 1870.

= *P. helodes* DUMORT., Fl. Belg. 163. 1827.

= *P. siculus* TINEO ex GUSS., Fl. Sicul. Syn. 2(2): 790. 1845, nom. illeg., non J. PRESL 1821.

= *P. subflavus* H. LORET et BARRANDON, Fl. Montpellier 2: 671. 1876.
≡ *P. alpinus* subsp. *subflavus* (H. LORET et BARRANDON) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 74. 1907.
≡ *P. coloratus* f. *subflavus* (H. LORET et BARRANDON) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 179. 1916.

Description

Rhizome slender, terete, perennial, overwintering with short leafy shoots, rarely with apical scaly turions. Stem unbranched or very sparingly branched, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate or sometimes subsessile; lamina narrowly elliptical to oblong, (27–)70–175 mm long, 11–44(–65) mm wide, (2.0–)3.5–8.5 times as long as wide, bright green, sometimes with a reddish tinge, 9–17-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, acute at apex; petiole (3–)15–65 mm long, 0.05–0.40 times as long as the lamina. Floating leaves present or rarely absent, shortly petiolate; lamina broadly elliptical or broadly ovate to suborbicular, (15–)25–85 mm long, 15–55 mm wide, 1.1–2.0 times as long as wide, translucent, membranous to subcoriaceous, bright green, often with a reddish or brownish tinge, 13–21-veined, truncate to cordate at base, acute to obtuse at apex; petiole 5–45 mm long, 0.1–0.5 times as long as the lamina. Stipules axillary, convolute, 20–65 mm long, translucent, persistent. Peduncles (18–)30–180 mm long, 1.3–4.0(–6.1) times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 14–45 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 1.3–1.9 mm long, dorsal keel indistinct.

Stem anatomy

Stele of proto type, distinctly lobed, endodermis mostly of O-type, rarely O-U-type, interlacunar bundles mostly absent, subepidermal bundles present, pseudohypodermis usually present, 1–2-layered.

Distribution

W, C and S Europe, N Africa, SW Asia (Turkey).

Hybrids

3 × 25. *P.* ×*billupsii* FRYER, J. Bot. 31: 353, t. 337 et 338. 1893. ("Billupsii")
[= *P. coloratus* × *P. gramineus*]

3 × 48. *P.* ×*lanceolatus* SM. in SOWERBY, ENGL. Bot. 28: t. 1985. 1809, pro sp. ("lanceolatum")
[= *P. coloratus* × *P. pusillus*]
= *P. lanceolatus* var. *hibernicus* A. BENN. in PRAEGER, Irish Naturalist 5: 243. 1896.
– *P. perpygmaeus* HAGSTR. ex DRUCE, Bot. Soc. Exch. Club Brit. Isles 6 (1922): 630. 1923, nom. nud.
= *P.* ×*perpygmaeus* HAGSTR. ex DRUCE, List Brit. Pl. ed 2. 116. 1928.

4. *Potamogeton australiensis* A. BENNETT, J. Bot. 48: 149. 1910.

= ? *P. membranaceus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 157. 1916.

Description

Rhizome slender, terete, perennial, turions or winterbuds not seen. Stem unbranched or sparingly branched, slender to robust, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate to subsessile; lamina narrowly elliptical to lanceolate, 30–50(–90) mm long, 8–24 mm wide, 2–4 times as long as wide, bright green, 7–13-veined, with narrow rows of lacunae bordering the midrib, entire but becoming undulate at margins when dried, cuneate or truncate at base, subacute at apex; petiole (2–)10–15(–40) mm long, 0.05–0.50 times as long as the lamina. Floating leaves present or absent, shortly petiolate; lamina broadly elliptical to ovate, 15–35 mm long, 12–16 mm wide, 1.2–3.0 times as long as wide, translucent, membranous, bright green, 9–15-veined, truncate or subcordate at base, rounded at the apex; petiole 10–50 mm long, 0.2–1.2 times as long as the lamina. Stipules axillary, convolute, 15–26 mm long, translucent, persistent. Peduncles 55–95 mm long, 2.5–6.0 times as long as the fruiting spike, usually thicker than the stem, inserted in the axils of submerged or rarely floating leaves. Spikes cylindrical, 15–25 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 2.0–2.5 mm long, dorsal keel indistinct.

Stem anatomy

Stele of proto or trio (1) type, lobed, endodermis of O-type, interlacunar bundles absent or scattered ones present in the outer circle, subepidermal bundles present, pseudohypodermis present, 1–3-layered.

Distribution
Tasmania, SE Australia (exact distribution unknown).

Note
(1) *P. australiensis* is a distinct species of the flora of Tasmania and Australia. The exact delimitation is still unclear, as confusion with *P. cheesemanii*, *P. sulcatus*, and *P. suboblongus* has occurred. The present description is based on the authentic specimens collected by Wilson from Merrigang Creek, Victoria, sent by Maiden to A. Bennett and preserved at BM. Only one recent specimen (Morris *258 713*, Tasmania, OLD) is included. In their treatment of *Potamogeton* submitted to Flora of Australia, Papassotiriou, Jacobs and Hellquist include also a form with true floating leaves into their concept of *P. australiensis* which has not yet been described in the literature. These plants have roundish floating leaves up to 65 mm in length, 55 mm in width and 32 veins. As they also differ in some other characters from the plants known so far (e.g. the larger fruits) they are not included in the present treatment. Cultivation experiments are necessary to test the identity of the divergent morphotypes.

5. *Potamogeton tepperi* A. BENNETT, J. Bot. 25: 178. 1887. ("Tepperi")

– *P. tricarinatus* F. MUELL. ex A. BENN., J. Bot. 25: 177. 1887, nom. nud.

Description
Rhizome slender, terete, perennial, winterbuds not seen. Stem unbranched, slender, terete, annual; winterbuds as axillary leafy shoots, specialized dormant turions not developing. Submerged leaves petiolate, decaying early; lamina linear-lanceolate to ovate-lanceolate, 40–60(–104) mm long, 10–20 mm wide, 2.5–6.0 times as long as wide, pale green, 11–15-veined, with narrow bands of lacunae bordering the midrib, entire at margins, cuneate at base, subacute at apex; petiole 32–65 mm long, 0.5–1.5 times as long as the lamina. Intermediate leaves sometimes present, petiolate. Floating leaves present, petiolate; lamina ovate-lanceolate to ovate, 40–60(–80) mm long, 20–30(–40) mm wide, 1.5–2.5 times as long as wide, coriaceous, bright green, 15–23-veined, with conspicuous secondary veins, subcordate at base, rounded to subacute at apex; petiole 40–80(–100) mm long, 0.8–1.5 times as long as the lamina. Stipules axillary, convolute, 25–40 mm long, decaying early. Peduncle 40–75(–90) mm long, 2.0–6.0 times as long as the fruiting spike, as thick as the stem, inserted in the axils of floating leaves. Spike cylindrical, 15–35 mm long in fruit, contiguous. Flowers 12 to numerous, with 4 carpels. Fruits (2.0–)2.5–3.0 mm long, dorsal and lateral keels distinct, but not tuberculate.

Stem anatomy
Stele of proto or trio type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles usually absent, pseudohypodermis present, 1-layered.

Distribution
E and SE Australia (exact distribution unknown).

Note
(1) At present not enough information is available on the exact delimitation of *P. tepperi*. This taxon is not identical with the widespread *P. sulcatus*, as it lacks the tricarinate fruits. It is similar to *P. suboblongus* but differs in the smaller fruit size and the distinct differentiation of submerged and floating leaves. We only recognize the specimens originally collected by Bailey and similar plants collected later along the east cost of Australia. Outside Australia, frequent misapplication of the name *P. tepperi* to *P. nodosus* and *P. distinctus* has occurred, but the taxon is not identical with these species. It is differentiated by the presence of a pseudohypodermis, the absence of dentation of submerged leaves, and the smaller fruit size. Nevertheless *P. nodosus* occurs on the Australian continent.

6. *Potamogeton sulcatus* A. BENNETT, Ann. K. K. Naturhist. Hofmus. Wien 7: 294. 1892.

= *P. muricatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 165. 1916.

Description
Rhizome slender to robust, terete, perennial, winter buds not seen. Stem unbranched, slender to robust, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate; lamina oblong-lanceolate to oblong or elliptical, 50–120(–200) mm long, 10–40(–65) mm wide, 2.2–7.0 times as long as wide, pale green, 27–35 veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate to rounded at base, rounded to subacute at apex; petiole (6–)20–80 mm long, 0.1–0.6 times as long as the lamina. Intermediate

leaves sometimes present, petiolate; petiole up to 140 mm long. Floating leaves present or sometimes absent, petiolate; lamina broadly elliptical to suborbicular, 30–150 mm long, 10–70 mm wide, 1.3–2.7 times as long as wide, opaque, coriaceous, bright green, 25–35(–39)-veined, cordate at base, rounded at apex; petiole 30–60 mm long, 0.5–2.0 times as long as the lamina. Stipules axillary, convolute, 25–40(–50) mm long, translucent, decaying or persistent. Peduncles 40–80(–180) mm long, 0.8–2.3 times as long as the fruiting spike, as thick as or slightly thicker than the stem, inserted in the axils of floating and submerged leaves. Spikes cylidrical, 30–80 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits (2.7–)3.0–4.1 mm long, dorsal keel distinct, tuberculate, strong lateral keels distinct.

Stem anatomy

Stele of proto or trio (2) type, with strong sclerenchymatic bundle sheaths and a cambium-like structure below the endodermis, endodermis of O-type, interlacunar bundles present in 1–3 circles, subepidermal bundles present or absent, pseudohypodermis absent.

Distribution

E and S Australia.

Note

(1) We choose *P. sulcatus* as the appropriate name of the frequently collected Australian taxon with the fibrous stem. However, the simple equation "*P. sulcatus* = *P. tricarinatus*" does not hold. *P. sulcatus* seems to be restricted to E and S Australia (Murray river catchment). For *P. tricarinatus* see below (under *P. cheesemanii*).

7. *Potamogeton pulcher* TUCKERMAN, Amer. J. Sci. Arts, ser. 1, 45: 38. 1843.

≡ *Spirillus pulcher* (TUCK.) NIEUWL., Amer. Midl. Naturalist 3: 16. 1913.

= *P. pulcher* f. *amphibius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 153. 1916.

Description

Rhizome slender, terete, perennial. Stem unbranched, slender, terete, annual, usually conspicuously black-spotted especially near the base; specialized dormant turions not developing. Submerged leaves petiolate to subsessile; lamina long lanceolate or narrowly oblong to oblong, 80–140(–215) mm long, 10–25(–35) mm wide, 3–10 times as long as wide, yellow-green to bright green, (9–)11–21-veined, with narrow rows of lacunae bordering the midrib, entire and usually strongly undulate at margins, narrowly to broadly cuneate at base, acute at apex; petiole 1–15(–18) mm long, 0.01–0.20 times as long as the lamina. Intermediate leaves sometimes present. Floating leaves petiolate; lamina broadly oblong or elliptical to broadly ovate, 20–75(–108) mm long, 15–60(–85) mm wide, 1.2–2.5 times as long as wide, opaque, coriaceous, bright green to brownish green, often with a reddish tinge, (19–)21–29(–41)-veined, rounded to subcordate at base, acute to rounded at apex; petiole 36–180 mm long, 0.7–2.5 times as long as the lamina, rarely with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 20–50 mm long, translucent, decaying early to persistent. Peduncles 50–80(–110) mm long, 2.0–3.5 times as long as the fruiting spike, as thick as or slightly thinner than the stem. Spikes cylindrical, 20–45 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 3.1–4.1(–4.7) mm long, dorsal keel distinct.

Stem anatomy

Stele of proto type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis present, 1-layered.

Distribution

C and E North America.

8. *Potamogeton fryeri* A. BENNETT, J. Bot. 45: 234. 1907. ("Fryeri")

= *P. subsessilifolius* A. CAMUS in LECOMTE, Not. Syst. 1: 86. 1909.

– *P. sessilifolius* A. CAMUS in LECOMTE, Not. Syst. 1: 87. 1909, nom. nud.

= *P. torquatus* KOIDZ., Bot. Mag. (Tokyo) 43: 397. 1929.

Description

Rhizome slender to robust, terete, perennial, of aseasonal growth, with wintergreen shoots; winterbuds not developing or as non-dormant scaly turions. Stem unbranched or sparingly branched in autumn, slender to robust, terete, annual or perennial; specialized dormant turions not developing. Submerged leaves usually present, absent in landforms, lower ones sessile to subsessile, the upper ones petiolate; lamina linear-lanceolate

to oblong, sometimes that of the lowest leaves partly reduced to phyllodes, 105–150 mm long, 12–16 mm wide, 6–11(–14) as long as wide, yellow-green to bright green, 5–9-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, acute at apex; petiole 0–40 mm long, 0.0–0.3 times as long as the lamina, mostly flattened and winged, with undulate margins. Intermediate leaves sometimes present, petiolate; petiole up to 115 mm long. Floating leaves usually present, petiolate; lamina lanceolate or oblanceolate to elliptic, 65–120(–150) mm long, 18–40(–75) mm wide, 1.3–5.5 times as long as wide, opaque, coriaceous, bright green to olive green, 21–35-veined, rounded to broadly cuneate at base and narrowed into the petiole, acute at apex; petiole (65–)80–210 mm long, 0.9–2.5 times as long as the lamina, often conspicuously winged towards the lamina, rarely with a discoloured section at the junction with the lamina. Stipules axillary, convolute, (30–)50–100 cm long, opaque, fibrous, whitish, persistent. Peduncles 70–150 mm long, 2–6 times as long as the fruiting spike, as thick as the stem, thinner directly below the spike, inserted in the axils of floating leaves. Spikes cylindrical, 20–30(–50) mm long in fruit, contiguous. Flowers numerous, with (3–)4 carpels. Fruits 4.5–5.0 mm long, dorsal keel distinct.

Stem anatomy

Stele of proto type, lobed, endodermis of O-type, interlacunar bundles present in 2–3(–4) circles, strong, multicellular, scattered subepidermal bundles present, pseudohypodermis present, 1–2-layered.

Distribution

East Asia (Korea, Japan, Russian Far East, China?).

9. *Potamogeton linguatus* HAGSTRÖM in DUSÉN, Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 4: 259. 1901.

= ? *P. montanus* C. PRESL, Reliq. Haenk. 1(2): 85. 1827.
= *P. badioviridis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 161. 1916.

Description

Rhizome slender to robust, terete, perennial, winterbuds not seen. Stem unbranched or sparingly branched, slender to robust, terete or subterete, annual; specialized dormant turions not developing. Submerged leaves short petiolate to subsessile; lamina elliptical to oblong or lanceolate, 40–60(–110) mm long, (5–)15–34 mm wide, 1.6–2.8(–8.0) as long as wide, yellow-green to bright green, 13–19-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, obtuse at the apex; petiole (2–)10–35 mm long, (0.1–)0.2–0.7 times as long as the lamina. Floating leaves present or sometimes absent, petiolate; lamina ovate or elliptical to obovate, (30–)55–83 mm long, (15–)21–35(–50) mm wide, 1.6–2.5 times as long as wide, opaque, coriaceous, bright green to olive green, 11–21-veined, cordate to rounded or broadly cuneate at base, acute to rounded at apex; petiole 30–150 mm long, (0.8–)1.7–4.5 times as long as the lamina, sometimes slightly winged towards the lamina, almost always with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 40–60(–80) mm long, unrolled up to 15 mm wide, translucent, with hyaline margins, persistent. Peduncles 45–80(–200) mm long, 2–5 times as long as the fruiting spike, as thick as the stem, inserted in the axils of floating and submerged leaves, rarely subopposite to submerged leaves. Spikes cylindrical, 15–40 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits (3.5–)3.7–4.5 mm long, rugose when dried, dorsal keel indistinct.

Stem anatomy

Stele of proto type, lobed, endodermis of O-type, interlacunar bundles present in 1 circle or absent, subepidermal bundles present in 1 incomplete ring, pseudohypodermis present, 2–3(–4) layered.

Distribution

South America south of 38° S (Argentine, Chile, Falkland Islands).

Note

(1) The morphological variation and distribution of *P. linguatus* is insufficiently known. Nevertheless, we assume that it forms a natural group with *P. fryeri* and *P. amplifolius*.

10. *Potamogeton amplifolius* TUCKERMAN, Amer. J. Sci. Arts, ser. 2, 6: 225. 1848.

≡ *Spirillus amplifolius* (TUCK.) NIEUWL., Amer. Midl. Naturalist 3: 16. 1913.
= *P. subobtusus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 147. 1916, pro hybr. *P. alpinus* × *P. nodosus*.

= *P. amplifolius* f. *homophyllus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 163. 1916.
= ? *P. scoliophyllus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 164. 1916, pro hybr. *P. amplifolius* × *P. illinoensis*.

Description

Rhizome slender to robust, terete, perennial. Stem unbranched or sparingly branched, slender to robust, terete, annual to perennial, overwintering as shortened shoots; specialized dormant turions not developing. Submerged leaves petiolate to subsessile; lamina lanceolate to ovate or broadly elliptical, folded and strongly arcuate, 80–170(–210) mm long, 25–75 mm wide, (1.3–)2.0–3.8(–5.4) times as long as wide, bright green or yellow-green to dark green, sometimes with a brownish tinge, (21–)25–37(–41)-veined, without rows of lacunae bordering the midrib, entire at margins, narrowly to broadly cuneate at base, obtuse to acute at apex; petiole (2–)6–60 mm long, 0.02–0.30 times as long as the lamina. Intermediate leaves sometimes present. Floating leaves petiolate; lamina broadly oblong or elliptical to ovate, 45–105 mm long, 22–50 mm wide, 1.8–2.9 times as long as wide, opaque, coriaceous, bright green to olive green, sometimes with a reddish tinge, (21–)29–41(–51)-veined, cuneate to rounded or subcordate at base, acute to rounded or mucronate at apex; petiole (45–)80–200 mm long, (0.7–)1.1–2.3 times as long as the lamina, rarely with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 35–110(–185) mm long, translucent, decaying early to persistent. Peduncles 50–85(–110) mm long, 1.0–2.5(–4.0) times as long as the fruiting spike, as thick as or thicker than the stem. Spikes cylindrical, 25–50 mm long in fruit, contiguous. Flowers numerous, with (2–)4 carpels. Fruits 3.9–5.2(–5.7) mm long, dorsal keel indistinct.

Stem anatomy

Stele of proto type, lobed, endodermis of O-type, interlacunar bundles present, multicellular, subepidermal bundles absent, pseudohypodermis present, 1(–2)-layered.

Distribution

W, C and E North America.

11. *Potamogeton ferrugineus* HAGSTRÖM, Kungl. Svenska Vetenskapsakad. Handl. 55(5): 161. 1916.

= *P. apicalis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 156. 1916.
= ? *P. spoliatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 168. 1916.

Description

Rhizome slender to robust, terete, perennial, winterbuds not seen. Stem unbranched, slender to robust, terete, annual, dark-spotted near the base; specialized dormant turions not developing. Submerged leaves petiolate; lamina broadly lanceolate, decaying early, (80–)150–240 mm long, (18–)25–40 mm wide, 1.8–6.5 times as long as wide, green, with a reddish or brownish tinge, especially when dried, 13–23-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, acute at apex; petiole (10–)40–140 mm long, 0.05–0.45 times as long as the lamina. Floating leaves petiolate; lamina broadly lanceolate to ovate or elliptical, 50–85(–120 mm) long, 15–38 mm wide, 1.8–3.5 times as long as wide, green, with a reddish or brownish tinge, strongly reddish brown when dried, 15–23-veined, cuneate at base, obtuse to acute at apex; petiole 40–80(–140) mm long, 0.8–1.5 times as long as the lamina. Stipules axillary, convolute, 35–65 mm long, translucent, persistent, 2–keeled at base. Peduncles 40–90 mm long, 1.5–4.1 times as long as the fruiting spike, as thick as or slightly thicker than the stem. Spikes cylindrical, 17–40(–60) mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 3.5–4.5(–5.0) mm long, dorsal keel distinct.

Stem anatomy

Stele of proto or trio (2) type, endodermis of O-type, rarely faint U-type, interlacunar bundles absent or 1 circle present, scattered subepidermal bundles present or absent, pseudohypodermis present, (1–)2(–3) layered.

Distribution

South America (Argentina, Uruguay, Brazil).

Note

(1) The description of *P. ferrugineus* has until recently been obscured by confusion with *P. illinoensis*. Despite our investigations some uncertainties with respect to distribution and taxonomic relation of the species remain. In particular, plants described as *P. spoliatus* show some deviating characters.

12. *Potamogeton stenostachys* K. SCHUMANN in MARTIUS, Fl. Bras. 3(3): 687, t. 119, fig. 1. 1894.

Description

Rhizome slender to robust, terete, perennial, winterbuds not seen. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate; lamina lanceolate, decaying early, 60–105 mm long, 12–20 mm wide, 3.0–7.5 times as long as wide, bright green to dark green, 5–9(–11)-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, acute at apex; petiole 65–90 mm long, 0.7–1.5 times as long as the lamina. Floating leaves petiolate; lamina elliptical to ovate, 30–90 mm long, 13–35 mm wide, 1.7–3.0 times as long as wide, bright green, often with a brownish or reddish tinge, 15–23-veined, cuneate to rounded at base, obtuse to subacute at apex; petiole 27–65(–120) mm long, 0.7–4.0 times as long as the lamina. Stipules axillary, convolute, 30–72 mm long, opaque, persistent, whitish. Peduncles 25–140 mm long, 0.8–3.0 times as long as the fruiting spike, slightly thinner than the stem. Spikes cylindrical, 25–45 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 1.8–2.5, dorsal keel indistinct.

Stem anatomy

Stele of trio type (2), endodermis of O-type, interlacunar bundles present in 2 circles, subepidermal bundles absent, pseudohypodermis present, 1–2-layered.

Distribution

South America (Brazil).

Note

(1) *P. stenostachys* is insufficiently known, even though it is clearly distinct from other South American taxa. The present description is based on the type specimen Riedel *834* and the herbarium collections Ule *1308* and Ule *6942*.

13. *Potamogeton alpinus* BALBIS, Mém. Acad. Sci. Turin, Sci. Phys. Math. 1, 10–11 (1802–1803): 329. 1804. ("alpinum")

≡ *P. lucens* var. β. *alpinus* (BALB.) FIORI, Fl. Anal. Ital. 1: 154. 1896. ("alpina")
= *P. annulatus* BELLARDI, Mém. Acad. Sci. Turin, Sci. Phys. Math. 1, 10–11 (1802–1803): 447, t. 1, fig. 2. 1804.
= *P. tenuifolius* RAF., Med. Repos., Hexade 3, 2: 409. 1811. ("tenuifolium")
≡ *P. alpinus* subsp. *tenuifolius* (RAF.) HULTÉN, Fl. Aleut. Isl. 65. 1937.
= *P. semipellucidus* W.D.J. KOCH et ZIZ, Cat. Pl. Palatinat. 5: 18. 1814. ("semipellucidum")
= *P. rufescens* SCHRAD. ex CHAM., Adnot. Fl. Berol. 5. 1815.
= *P. obscurus* DC. in LAM. et DC., Fl. Franç. ed. 3, 6: 311. 1815. ("obscurum")
= *P. purpurascens* SEIDL ex J. PRESL et C. PRESL, Fl. Čech. 37. 1819.
= *P. microstachys* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 360. 1827.
= *P. obrutus* A.W. WOOD, Class-book Bot. 176. 1845.
= *P. casparyi* KOHTS, Oesterr. Bot. Z. 20: 289. 1870. ("Casparyi")
≡ *P. alpinus* proles *casparyi* (KOHTS) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 74. 1907. ("Casparyi")
– *P. thomasii* A. BENN., Ann. K. K. Naturhist. Hofmus. Wien 7: 288. 1892, pro syn. ("Thomasii")
= *P. stylatus* HAGSTR., Bot. Not. 1908: 98. 1908.
= *P. montanensis* GAND., Bull. Soc. Bot. France 66: 304. 1919. ("montanense")
– *P. palmerii* DRUCE, List Brit. Pl. ed 2. 116. 1928, nom. nud. ("Palmeri")

Description

Rhizome slender, terete, perennial, with scaly apical turions. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves present, absent in landforms, sessile, lanceolate to oblong, (51–)70–180(–380) mm long, (7–)10–25(–33) mm wide, 4–10(–14) times as long as wide, yellow-green to bright green, often with a reddish tinge, especially strong when dried, (7–)9–15-veined, with broad rows of lacunae bordering the midrib, entire at margins, cuneate at base, obtuse to narrowly obtuse and slightly hooded at apex. Intermediate leaves sometimes present. Floating leaves present or absent, petiolate; lamina oblong or oblanceolate to obovate, (24–)42–90 mm long, 8–25 mm wide, 2–6 times as long as wide, opaque, subcoriaceous to coriaceous, yellow-green, usually with a reddish or brownish tinge, especially when dried, 9–19-veined, cuneate to attenuate at base, obtuse at apex; petiole 10–35 mm long, 0.1–0.8 times as long as the lamina. Stipules axillary, convolute, (12–)18–35(–50) mm long, translucent, decaying early. Peduncles

30–150(–310) mm long, 2–5(–9) times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 15–40 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 2.6–3.7 mm long, dorsal keel distinct.

Stem anatomy

Stele of trio (2) type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis absent, rarely 1-layered.

Distribution

Circumboreal, throughout the Northern Hemisphere.

Hybrids

13 × 1. *P.* ×*spathulatus* SCHRAD. ex W.D.J. KOCH et ZIZ, Cat. Pl. Palatinat. 5: 18. 1814, pro sp. ("spathulatum")

[= *P. alpinus* × *P. polygonifolius*]

13 × 24. *P.* ×*nerviger* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 359. 1827, pro sp.

[= *P. alpinus* × *P. lucens*]

≡ *P. rufescens* var. b) *nerviger* (WOLFG.) K. RICHT., Pl. Eur. 1: 12. 1890.

≡ *P. alpinus* var. *purpurascens* subvar. *nerviger* (WOLFG.) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 311. 1897.

≡ *P. alpinus* var. *nerviger* (WOLFG.) G. FISCH., Mitt. Bayer. Bot. Ges. 4(10): 153. 1930.

= *P. nervigerus* WOLFG., Herb. Eichw. Skizze 125. 1830. [non vidimus]

13 × 25. *P.* ×*nericius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 145. 1916.

[= *P. alpinus* × *P. gramineus*]

13 × 26. *P.* ×*prussicus* HAGSTR., Bot. Not. 1908: 103. 1908.

[= *P. alpinus* × *P. perfoliatus*]

= *P. johannis* HESL.-HARR., Occas. Notes Dept. Bot., King's Coll., Newcastle upon Tyne 2: 3. 1941.

13 × 28. *P.* ×*griffithii* A. BENN., J. Bot. 21: 65, t. 235. 1883. ("Griffithii")

[= *P. alpinus* × *P. praelongus*]

= *P. macvicarii* A. BENN., Ann. Scott. Nat. Hist. 62: 106. 1907. ("Macvicarii")

13 × 35. *P.* ×*olivaceus* BAAGÖE ex G. FISCH., Ber. Bayer. Bot. Ges. 11: 33. 1907.

[= *P. alpinus* × *P. crispus*]

– *P.* ×*venustus* BAAGÖE, Actes 1. Congr. Intern. Bot. Paris 516. 1900, nom. nud.

= *P.* ×*venustus* BAAGÖE ex A. BENN., J. Bot. 45: 375. 1907.

– ? *P. baagoei* A. BENN. [apud GRAEBN.] in ENGL., Pflanzenr. 31 (IV.11): 132. 1907, nom. nud. ("Baagoei")

= *P.* ×*venustus* BAAGÖE ex HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 144. 1916, nom. illeg.

Note

(1) *P. alpinus* might be sometimes confused with other similar plants. However, it is a taxonomically well defined species. It shows an extreme regional and ecological polymorphism.

14. *Potamogeton thunbergii* CHAMISSO et SCHLECHTENDAL, Linnaea 2(2): 221, t. 6, f. 21. 1827. ("Thunbergii")

≡ *P. americanus* var. *thunbergii* (CHAM. et SCHLTDL.) A. BENN. in DYER, Fl. Capens. 7: 46. 1897. ("Thunbergii")

≡ *P. fluitans* proles *thunbergii* (CHAM. et SCHLTDL.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 61. 1907.

= *P. natans* var. *angustatus* b) *capensis* CHAM. ex KUNTH, Enum. Pl. 3: 128. 1841.

= *P. richardii* SOLMS in SCHWEINF., Beitr. Fl. Aethiop. 194. 1867. ("Richardi")

≡ *P. americanus* var. *richardii* (SOLMS) SOLMS ex SCHWEINF., Bull. Herb. Boissier 2, App. 2: 8. 1894. ("Richardi")

= *P. natans* var. *capensis* T. DURAND et SCHINZ, Consp. Fl. Afric. 5: 494. 1894.

= *P. fibrosus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 160. 1916.

Description

Rhizome slender to robust, terete, perennial, with apical scaly turions. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate; lamina lanceolate to oblong, decaying early, sometimes the lower ones reduced to phyllodes, 80–200 mm long, 5–27 mm wide, 5–13 times as long

as wide, bright green to dark green, 9–17-veined, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute at apex; petiole (10–)45–180 mm long, 0.2–1.8 times as long as the lamina. Intermediate leaves often present. Floating leaves petiolate; lamina elliptical to oblong-ovate, 30–80(–124) mm long, (11–)20–40(–48) mm wide, 1.6–3.5(–5.0) times as long as wide, opaque, coriaceous, olive green to dark green, 11–25-veined, broadly cuneate to rounded at base, broadly acute at apex; petiole 18–110(–195) mm long, (0.3–)0.6–3.0 times as long as the lamina, almost always with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 25–40(–60) mm long, translucent, persistent to decaying early. Peduncles 50–100 mm long, 2.0–3.5 times as long as the fruiting spike, as thick as the stem, inserted in the axils of floating leaves. Spikes cylindrical, 30–50 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 3.2–4.8 mm long, dorsal keel distinct.

Stem anatomy

Stele of trio (2) type, endodermis of U-type, interlacunar bundles present in 2–3 circles, subepidemal bundles present, pseudohypodermis present, 1-layered.

Distribution

Africa (in particular South and East Africa), Madagascar, Mascarene Islands?

Notes

(1) *P. thunbergii* is superficially morphologically similar to *P. nodosus*. However, according to its stem anatomy and some morphological characters like the presence of phyllodial leaves and the discoloured joint at the top of the petiole, it is more closely related to *P. natans*.

(2) The exact identity of *P.* ×*bunyonyiensis* DENNY et LYE, Kew Bull. 28(1): 120. 1973, introduced as a hybrid *P. schweinfurthii* × *P. thunbergii*, is still under consideration and cannot be listed with certainty among confirmed hybrids.

15. *Potamogeton parmatus* HAGSTRÖM, Bot. Not. 1908: 97. 1908.

Description

Rhizome slender, terete, perennial, winterbuds not seen. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate; lamina lanceolate to oblong, decaying early, 40–75 mm long, 6–16(–23) mm wide, 2.3–3.8 times as long as wide, green, (5–)7–13-veined, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute at apex; petiole 70–195 mm long, 1.6–3.3 times as long as the lamina. Floating leaves petiolate; lamina oblong or oblanceolate to obovate, 45–63 mm long, 7–26 mm wide, 2.1–4.2 times as long as wide, opaque, coriaceous, olive green to dark green, sometimes with a brownish tinge, (9–)11–19-veined, broadly cuneate at base, acute at apex; petiole 75–170(–280) mm long, 1.8–6.0 times as long as the lamina. Stipules axillary, convolute, 30–45 mm long, translucent, decaying early. Peduncles 50–120 mm long, 2–6 times as long as the flowering spike, as thick as the stem, inserted in the axils of floating leaves. Spikes cylindrical, 14–20 mm long in flower, contiguous. Flowers numerous, with 4 carpels. Fruits not seen.

Stem anatomy

Stele of proto or trio (2) type, endodermis of U-type, interlacunar bundles present in 1 circle, subepidermal bundles absent or a few present, pseudohypodermis absent or 1-layered.

Distribution

Madagascar, E Africa?

Note

(1) *P. parmatus* has been recorded only from a restricted geographical area. It has never been re-collected since its first formal description (HAGSTRÖM 1908). Because of the unique character combination, however, we are inclined to maintain it as a separate species, being closely related to both *P. thunbergii* and *P. schweinfurthii*. It may prove to be a hybrid or an extreme morphotype of one of these species (cf. *P.* ×*bunyonyiensis*, DENNY & LYE 1983).

16. *Potamogeton natans* Linnaeus, Sp. Pl. 126. 1753.

≡ *Spirillus natans* (L.) NIEUWL., Amer. Midl. Naturalist 3: 16. 1913.

– *P. natans* [subsp.] α. *vulgaris* SCHÜBL. et G. MARTENS, Fl. Württemb. 109. 1834, nom. inval.

– *P. natans* [subsp.] a) *vulgaris* ČELAK., Analyt. Květ. Čech, Mor. a Rak. Slezska ed. 3. 45. 1897, nom. inval.
– *P. serotinus* SCHRAD. ex SCHULT. et SCHULT. f., Mant. 3: 351. 1827, pro syn. ("serotinum")
= *P. natans* var. β. *ovalifolius* FIEBER in BERCHT. et FIEBER, Potam. Böhmens 23. 1838; FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 260. 1838.
– *P. paludosus* BOENN. ex STEUD., Nomencl. Bot. ed. 2. 2: 384. 1841, pro syn.
= *P. natans* var. β. *prolixus* W.D.J. KOCH, Syn. Fl. Germ. Helv. ed. 2. 775. 1844.
≡ *P. natans* var. b. *angustifolius* G. MEY., Fl. Hanov. Exscurs. 537. 1849, nom. illeg.
= *P. morongii* A. BENN., J. Bot. 39: 145. 1902. ("Morongii")
= ? *P. floridanus* SMALL, Fl. Southeast. Unit. St. 37. 1903.
= *P. gessnacensis* var. *richtsfeldii* f. *hibernicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 192. 1916.
≡ *P. hibernicus* (HAGSTR.) DRUCE, List Brit. Pl. ed 2. 116. 1928.

Description

Rhizome slender to robust, rarely filiform, terete, perennial, overwintering with phyllodial shoots. Stem unbranched or sparingly to richly branched, slender to robust, terete, annual to perennial, wintergreen, dark-spotted near the base; winterbuds as axillary, short, leafy shoots, specialized dormant turions not developing. Submerged leaves sessile; lamina reduced to linear phyllodes, 100–450(–610) mm long, 0.8–3.5 mm wide, 70–200(–300) times as long as wide, dark green, 1–3-veined, lateral veins inconspicuous, entire at margins, straight at base, narrowly obtuse to acuminate at apex. Intermediate leaves rarely present, narrowly lanceolate, long petiolate. Floating leaves petiolate; lamina oblong to broadly elliptical or broadly ovate, 40–100(–140) mm long, (7–)20–45(–80) mm wide, 1.5–3.5(–5.2) times as long as wide, opaque, coriaceous, brown-green or yellow-green to olive green or dark green, sometimes with a brownish tinge, 17–31(–35)-veined, cuneate to rounded or subcordate at base, acute to obtuse at apex; petiole 50–150(–300) mm long, 0.7–5.0 times as long as the lamina, almost always with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 40–170 mm long, translucent, persistent. Peduncles 35–90(–125) mm long, 1.2–3.0 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 20–60 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 3.8–5.0 mm long, dorsal keel indistinct to distinct.

Stem anatomy

Stele of eight bundles or complex oblong type, endodermis of U-type, interlacunar bundles present in 3–4 circles, multicellular, subepidermal bundles present, pseudohypodermis present, 1–2-layered.

Distribution

Circumpolar, boreal and temperate regions of the Northern Hemisphere.

Hybrids

16 × 1. *P.* ×*gessnacensis* G. FISCH., Mitt. Bayer. Bot. Ges. 1(37): 472. 1905. ("Geßnacensis")
[= *P. natans* × *P. polygonifolius*]

16 × 20. *P.* ×*schreberi* G. FISCH., Mitt. Bayer. Bot. Ges. 1(37): 471. 1905. ("Schreberi")
[= *P. natans* × *P. nodosus*]

24 × 16. *P.* ×*fluitans* ROTH, Tent. Fl. Germ. 1: 72. 1788, pro sp.
[= *P. lucens* × *P. natans*]
≡ *P. natans* [var.] β. *fluitans* (ROTH) CHAM., Adnot. Fl. Berol. 4. 1815.
≡ *P. natans* [subsp.] γ. *fluitans* (ROTH) SCHÜBL. et G. MARTENS, Fl. Württemb. 109. 1834.
≡ *P. oblongus* [var.] ("spielart") a. *fluitans* (ROTH) G. MEY., Chloris Han. 520. 1836.
– *P. rothii* A. BENN. ex G. FISCH., Mitt. Bayer. Bot. Ges. 1(31): 362. 1904, nom. inval. ("Rothii")
= *P.* ×*crassifolius* FRYER, J. Bot. 28: 321, t. 299. 1890.
– *P.* ×*olivaceus* BAAGÖE, Actes 1. Congr. Intern. Bot. Paris 516. 1900, nom. nud.
= *P.* ×*noltei* G. FISCH., Mitt. Bayer. Bot. Ges. 37: 472. 1905, nom. illeg. ("Noltei"), non A. BENN. 1890.
– *P. noltei* ser. *harzii* G. FISCH., Ber. Bayer. Bot. Ges. 11: 57 et 145. 1907, nom. inval. ("Harzii")
– *P. noltei* var. β. *harzii* G. FISCH. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 137. 1907, nom. inval. ("Harzii")
≡ *P. harzii* G. FISCH., Mitt. Bayer. Bot. Ges. 3(5): 104. 1914. ("Harzii")
≡ *P. fluitans* proles *raunkiaeri* G. FISCH., Mitt. Bayer. Bot. Ges. 3(5): 103. 1914. ("Raunkiaeri")
– *P. fluitans* ser. *raunkiaeri* (G. FISCH.) G. FISCH., Mitt. Bayer. Bot. Ges. 4(10): 154. 1930, nom. inval.

= *P.* ×*sterilis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 238. 1916.
= *P.* ×*subrufus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 241. 1916.

25 × 16. *P.* ×*sparganiifolius* LAEST. ex FR., Novit. Fl. Suec. Mant. 1: 9. 1832. ("sparganifolius")
[= *P. gramineus* × *P. natans*]
≡ *P. natans* proles *sparganiifolius* (LAEST. ex FR.) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 304. 1897.
≡ *P. natans* subsp. *sparganiifolius* (LAEST. ex FR.) SCHINZ et THELL., Fl. Schweiz ed. 3. 2: 15. 1914.
= *P. natans* subsp. *kirkii* SYME ex HOOK. f., Stud. Fl. Brit. Isl. 371. 1870. ("Kirkii")
– *P. kirkii* SYME, ENGL. Bot. ed. 3. 9: 31. 1869, pro syn. ("Kirkii")
≡ *P. kirkii* (SYME ex HOOK f.) SYME ex HOOK f., Stud. Fl. Br. Isl. ed. 3. 435. 1884.
= *P.* ×*tiselii* K. RICHT., Pl. Eur. 1: 13. 1890. ("Tiselii")
= *P. dubius* TISELIUS, Potamog. Suec. Exs., fasc. 1: [sched.] no. 19, notulae p. 5. 1894.

25 × 48. *P.* ×*variifolius* THORE, Essai Chloris 47. 1803, pro sp. ("variifolius")
[= *P. natans* × *P. pusillus*]
≡ *P. gramineus* subsp. *variifolius* (THORE) NYMAN, Consp. Fl. Eur. 4: 682. 1882.
≡ *P. javanicus* subsp. *variifolius* (THORE) P. FOURNIER, Quatre Fl. Fr. 140. 1935.

25 × 56. *P.* ×*yamagataensis* KADONO et WIEGLEB, J. Jap. Bot. 62(3): 73. 1987.
[= *P. natans* × *P. octandrus*]
= *P. pleiophyllus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 159. 1916, p. p.

? 25 × 68. *P.* ×*nomotoensis* KADONO et T. NOGUCHI, Acta Phytotax. Geobot. 42(2): 175. 1991, pro sp.
[= ? *P. natans* × *P. pectinatus*]

Notes

(1) *P. floridanus* is a unique plant collected from a restricted area. Morphologically it is similar to a juvenile *P. natans*. It differs from the type in its completely different shoot anatomy. Anatomical characters point to hybridization with *P. illinoensis* or *P. gramineus*. Both its identity with *P. natans* or a hybrid of this species have been rejected in the past for phytogeographical reasons.
(2) The authentic collection of *P. pleiophyllus* includes both *P.* ×*yamagataensis* and *P. nodosus*. Further specimens are listed in its protologue including also *P. distinctus* and maybe even *P. natans*. A lectotype specimen has to be selected in the future to elucidate the identity with *P.* ×*yamagataensis*.
(3) *P.* ×*nomotoensis* displays a unique character combination of a broad-leaved species with long adnate stipules. It could represent a hybrid, a hybridogenous species or an extreme deviation of a broad-leaved species like *P. natans* (for an analogous case of the last possibility see HELLQUIST 1978). Further research is necessary.
(4) The name "*P. fluitans*" has been misapplied to almost all broad-leaved species with floating leaves. Most of specimens named as such relate to *P. nodosus*, but by no means all records of "*P. fluitans*" can be explained in this way. Despite the lack of type specimens we adopt the name for the hybrid *P. natans* × *P. lucens*, being aware of the fact that this hybrid still grows not far from the type locality in the same river.

17. *Potamogeton oakesianus* J.W. ROBBINS in GRAY, Manual Bot. North. U. S. ed. 5. 485. 1867. ("Oakesianus")

Description

Rhizome slender, terete, perennial. Stem unbranched or sparingly branched, slender, terete, annual to perennial, overwintering as shortened shoots; specialized dormant turions not developing. Submerged leaves sessile; lamina reduced to linear phyllodes, 50–160 mm long, (0.2–)0.3–1.0 mm wide, 120–300 times as long as wide, dark green, 1–3-veined, lateral veins inconspicuous, entire at margins, straight at base, narrowly obtuse to acuminate at apex. Floating leaves petiolate; lamina oblong to elliptical or broadly ovate, (13–)22–40(–55) mm long, (5–)10–22(–29) mm wide, 1.5–2.7 times as long as wide, opaque, coriaceous, bright green to olive green, sometimes with a brownish tinge, (7–)9–19(–23)-veined, cuneate to rounded at base, broadly acute to obtuse at apex; petiole 25–70(–100) mm long, 1.0–2.5 times as long as the lamina, often with a discoloured section at the junction with the lamina. Stipules axillary, convolute, 10–40(–55) mm long, translucent, persistent. Peduncles 25–60 mm long, 1.5–2.5 times as long as the fruiting spike, usually thicker than the stem. Spikes cylindrical, 15–30 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 2.5–3.5(–3.7) mm long, dorsal keel distinct.

Stem anatomy
Stele of trio type, endodermis of U-type, interlacunar bundles in 1–2 circles present, subepidermal bundles present, pseudohypodermis absent or present, 1-layered.

Distribution
C and E North America.

Note
(1) *P. oakesianus* is closely related to *P. natans*. It comprises morphotypes with a special character pattern distributed within a limited geographical area.

18. *Potamogeton papuanicus* WIEGLEB, Blumea 37: 379. 1993.

Description
Rhizome slender, terete, perennial. Stem unbranched or very sparingly branched, slender, terete, annual or perennial, continuing growth after flowering; specialized dormant turions not developing. Submerged leaves petiolate or sometimes subsessile; lamina narrowly oblong to oblong-lanceolate, 105–160 mm long, 12–30 mm wide, 4–9 times as long as wide, bright green, sometimes with a reddish tinge, 7–13-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate to slightly cordate or sagittate at base, acute at apex; petiole 5–45 mm long, 0.1–0.5 times as long as the lamina. Floating leaves petiolate; lamina oblong-lanceolate to elliptical, 65–115 mm long, 18–30 mm wide, 2–5 times as long as wide, translucent, membranous to subcoriaceous, bright green, sometimes with a reddish or brownish tinge, 9–15-veined, cuneate at base, acute at apex; petiole 115–185 mm long, 0.5–3.0 times as long as the lamina. Stipules axillary, convolute, 20–60 mm long, translucent, persistent. Peduncles 130–180 mm long, 5–7 times as long as the flowering spike, thicker than the stem, inserted in the axils of floating and submerged leaves. Spikes cylindrical, 21–28 mm long in flower, contiguous. Flowers numerous, with 4 carpels. Fruits not seen.

Stem anatomy
Stele of proto or trio (2) type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis absent.

Distribution
Papua-New Guinea, Lesser Sunda Isles?

Note
(1) Both morphology and distribution of *P. papuanicus* are still insufficiently known. The species is related to *P. distinctus* and *P. nodosus*.

19. *Potamogeton distinctus* A. BENNETT, J. Bot. 42: 72. 1904.

– *P. digynus* WALLICH, Numer. List 181, no. 5177. 1832, nom. nud.
= *P. natans* f. *indicus* MIQ., Fl. Ind. Batav., Suppl. 1 [= Fl. Ned. Ind., Eerste Bijv.], 2: 259, 3: 597. 1861. ("indica")
= *P. malaianus* var. *tenuior* MIQ., Ill. Fl. Archipel Ind. 1: 47. 1870.
= *P. franchetii* A. BENN. et BAAGÖE ex A. BENN., J. Bot. 45: 234. 1907. ("Franchetii")
= *P. tepperi* var. α. *attenuatus* A. CAMUS in LECOMTE, Not. Syst. 1: 85. 1909.
= *P. tepperi* var. β. *subcordatus* A. CAMUS in LECOMTE, Not. Syst. 1: 85. 1909.
= *P. longipetiolatus* A. CAMUS in LECOMTE, Not. Syst. 1: 88. 1909.
= *P. perversus* A. BENN., Philipp. J. Sci. 9: 343. 1914.
= *P. alatus* KOIDZ., Bot. Mag. (Tokyo) 43: 397. 1929.
= *P. fontigenus* Y.H. GUO, X.Z. SUN et H.Q. WANG, Bull. Bot. Res. North.-East. Forest. Inst. 5(2): 133. 1985; Y.H. GUO, H.Q. WANG et X.Z. SUN, Acta Bot. Bor.-Occid. Sin. 5(4): 301. 1985.

Description
Rhizome slender, terete, perennial, with apical winter buds. Stem unbranched or sparingly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves mostly present, petiolate; lamina oblong to lanceolate, decaying early, sometimes that of the lowest leaves reduced to phyllodes, 45–140 mm long, (5–)10–23 mm wide, 4–7 times as long as wide, bright green to dark green, 9–17-veined, with narrow rows of lacunae bordering the midrib, minutely denticulate at margins, cuneate at base, acute at apex; petiole 30–190(–230) mm long, 0.5–5.0 times as long as the lamina. Intermediate leaves sometimes present. Floating

leaves petiolate; lamina oblong to broadly elliptical or obovate, (30–)50–95(–125) mm long, 10–35(–50) mm wide, 2–6 times as long as wide, opaque, coriaceous, bright green, sometimes with a reddish tinge, 11–19-veined, narrowly cuneate to broadly cuneate at base, acute to obtuse at apex; petiole (45–)80–260(–390) mm long, 0.5–7.0 times as long as the lamina. Stipules axillary, convolute, 40–105 mm long, translucent, persistent. Peduncles 45–105 mm long, 1–3 times as long as the fruiting spike, slightly thicker than the stem, inserted in the axils of floating leaves. Spikes cylindrical, 25–80 mm long in fruit, contiguous. Flowers numerous, with 1–2(–4) carpels. Fruits 2.9–3.7 mm long, dorsal keel more or less distinct.

Stem anatomy

Stele of trio (1,2) type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles mostly absent, pseudohypodermis mostly absent, rarely 1-layered.

Distribution

E and SE Asia, Pacific islands.

Hybrids

19 × 21. *P.* ×*malainoides* MIKI, Water Phan. Japan 20. 1937.
[= *P. distinctus* × *P. wrightii*]

Notes

(1) *P. distinctus* is closely related to *P. nodosus*. Because transitional plants are sometimes found it may be regarded in the future as its geographical subspecies (see WIEGLEB 1990a).
(2) The identity of *P.* ×*malainoides* might be doubted since it cannot be excluded that its type specimen represents a shallow water form of *P. wrightii* with floating leaves. However, intermediate forms between the parent species occur without doubt, but their origin has not been satisfactorily explained.

20. *Potamogeton nodosus* POIRET in LAMARCK, Encycl. Méth. Bot., Suppl. 4: 535. 1816. ("nodosum")

≡ *P. fluitans* proles *rothii* G. FISCH., Mitt. Bayer. Bot. Ges. 3(5): 103. 1914. ("Rothii")
– *P. indicus* ROXB., Hort. Bengal. 12. 1814, nom. nud.
= *P. indicus* ROXB. in CAREY, Fl. Ind. 1: 471. 1820, nom. illeg. ("indicum"), non ROTH ex ROEM. et SCHULT. 1818.
≡ *P. roxburghianus* SCHULT. et SCHULT. f., Mant. 3: 367. 1827. ("Roxburghianus")
= *P. petiolaris* C. PRESL in J. PRESL et C. PRESL, Delic. Prag. 151. 1822, nom. illeg. ("petiolare"), non *P. petiolaris* RAF. 1811.
≡ *P. natans* subsp. γ. *petiolaris* [C. PRESL] ARCANG., Comp. Fl. Ital. 642. 1882.
≡ *P. fluitans* proles *petiolaris* [C. PRESL] GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 59. 1907.
= *P. canariensis* LINK in BUCH, Phys. Beschr. Canar. Ins. 138. 1825.
= *P. petiolatus* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 352. 1827.
= *P. leschenaultii* CHAM. et SCHLTDL., Linnaea 2(2): 223, t. 6. fig. 23. 1827. ("Leschenaultii")
= *P. occidentalis* SIEBER ex CHAM. et SCHLTDL., Linnaea 2(2): 224. 1827.
= *P. americanus* CHAM. et SCHLTDL., Linnaea 2(2): 226. 1827.
≡ *P. natans* var. *angustatus* f) *americanus* (CHAM. et SCHLTDL.) KUNTH, Enum. Pl. 3: 128. 1841.
≡ *P. fluitans* subsp. *americanus* (CHAM. et SCHLTDL.) MAGNIN, Bull. Soc. Bot. France 43: 436. 1896.
– *P. fluitans* subsp. *americanus* (CHAM. et SCHLTDL.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 60. 1907. [isonymum]
= *P. syriacus* CHAM. et SCHLTDL., Linnaea 2(2): 227. 1827.
≡ *P. fluitans* proles *syriacus* (CHAM. et SCHLTDL.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 60. 1907.
= *P. marianensis* CHAM. et SCHLTDL., Linnaea 2(2): 228. 1827.
= *P. mascarensis* CHAM. et SCHLTDL., Linnaea 2(2): 228. 1827.
≡ *P. fluitans* proles *mascarensis* (CHAM. et SCHLTDL.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 60. 1907.
≡ *P. americanus* subsp. *mascarensis* (CHAM. et SCHLTDL.) A. BENN., J. Bot. 46: 160. 1908.
= ? *P. owaihiensis* CHAM. et SCHLTDL., Linnaea 2(2): 228. 1827. ("O-Waihiensis")
≡ ? *P. fluitans* proles *owaihensis* (CHAM. et SCHLTDL.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 60. 1907.
= *P. malaianus* MIQ., Ill. Fl. Archipel Ind. 1: 46. 1870. ("malaina")
= *P. mexicanus* A. BENN., J. Bot. 25: 289. 1887.
– ? *P. peruvianus* C. PRESL ex A. BENN., J. Bot. 28: 298. 1890, pro syn. ("peruviana")

= *P. delavayi* A. BENN., J. Bot. 30: 228. 1892. ("Delavayi")
= *P. lonchites* var. *novaeboracensis* MORONG, Mem. Torrey Bot. Club 3(2): 20. 1893.
= *P. drucei* FRYER, Potamoget. Brit. Isles 31, t. 21. 1898. ("Drucei")
= *P. semicoloratus* A. BENN., J. Bot. 48: 150. 1910.
= *P. stagnorus* HAGSTR. in R.E. FR., Wiss. Ergenb. Schwed. Rhod.-Kongo-Exped. 1911–1912, 1(2): 187. 1916. ("stagnorum")
= *P. rotundatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 153. 1916.
= ? *P. insulanus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 154. 1916.

Description

Rhizome slender, terete, perennial, with apical winter buds. Stem unbranched or sparingly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves present, absent in landforms, petiolate; lamina narrowly oblong to oblanceolate-oblong, sometimes that of the lowest leaves reduced to phyllodes, (47–)160–280(–350) mm long, (11–)22–38 mm wide, 5–9 times as long as wide, bright green to dark green, (7–)11–21-veined, with narrow to broad rows of lacunae bordering the midrib, minutely denticulate at margins, narrowly cuneate at base, acute at apex; petiole (12–)60–180(–250) mm long, 0.2–1.5 times as long as the lamina. Floating leaves present, rarely absent, petiolate; lamina oblong to broadly elliptical, (35–)60–130 mm long, (11–)25–50 mm wide, 2.0–4.5 times as long as wide, opaque, coriaceous, bright green to olive green, sometimes with a reddish tinge, (11–)15–23-veined, narrowly cuneate to rounded at base, obtuse to broadly acute at apex; petiole 30–210 mm long, 0.5–2.3 times as long as the lamina. Stipules axillary, convolute, (33–)45–125 mm long, translucent, persistent or decaying. Peduncles (32–)45–130 mm long, 2–3 times as long as the fruiting spike, thicker than the stem, inserted in the axils of floating leaves, rarely of submerged leaves. Spikes cylindrical, 25–70 mm long in fruit, contiguous. Flowers numerous, with (2–)4(–5) carpels. Fruits 2.7–4.1(–4.3) mm long, dorsal keel distinct.

Stem anatomy

Stele of trio (1,2) or proto type, endodermis mostly of O-type, sometimes of O-U-type, interlacunar bundles absent, rarely a few present, subepidermal bundles absent, rarely a few present, pseudohypodermis absent.

Distribution

Subcosmopolitan; Europe, Africa, temperate and tropical Asia, Australia, Pacific islands, North America, N and C South America.

Hybrids

16 × 20. *P.* ×*schreberi* G. FISCH., Mitt. Bayer. Bot. Ges. 1(37): 471. 1905. ("Schreberi")
[= *P. natans* × *P. nodosus*]

? 22 × 20. *P.* ×*faxonii* MORONG, Mem. Torrey Bot. Club 3(2): 22, t. 32. 1893, pro sp. ("Faxonii")
[= ? *P. illinoensis* × *P. nodosus*]

= *P.* ×*champlainii* A. BENN., J. Bot. 46: 248. 1908. ("Champlainii")
– *P.* ×*rugelii* A. BENN., J. Bot. 46: 250. 1908, nom. nud. ("Rugelii")

Notes

(1) *P. nodosus* is one of the most polymorphic *Potamogeton* species. It shows several regionally distinct morphotypes as well as an extreme phenotypic plasticity all over its range.
(2) The southern limits of the distribution of *P. nodosus* in South America and the Malesia-Australia area is unclear. Confusion with species like *P. linguatus*, *P. ferrugineus*, *P. tepperi*, and *P. sulcatus* is common.
(3) The identity of *P. owaihiensis* is questionable. The original material could not be studied. The name has been placed into the synonymy of *P. nodosus* by several authors. However, broad-leaved specimens from Hawaii collected later are more similar to *P. solomonensis* than to *P. nodosus*.
(4) *P.* ×*faxonii* is provisionally placed here as a hybrid, but its exact identity has not been proved so far. Because of the phenotypic plasticity of the parent species *P. nodosus* hybrids are generally difficult to verify without experimental crossing.

21. *Potamogeton wrightii* MORONG, Bull. Torrey Bot. Club 13: 158, t. 59. 1886. ("Wrightii")

= *P. mucronatus* C. PRESL, Epimel. Bot. 245. 1851. ("1849"), nom. illeg., non SCHRAD. ex SONDER 1850.
= ? *P. sumatranus* MIQ., Fl. Ind. Batav., Suppl. 1 [= Fl. Ned. Ind., Eerste Bijv.], 2: 259, 3: 597. 1861.
– *P. japonicus* FRANCH. et SAV., Enum. Pl. Jap. 2: 15. 1877, nom. nud.

– *P. tretocarpus* MAXIM. ex A. BENN., J. Bot. 29: 154. 1891, pro syn.
= *P. tonkinensis* A. CAMUS in LECOMTE, Not. Syst. 1: 86. 1909.
– *P. distinctus* var. *tonkinensis* (A. CAMUS) CUONG in CUONG et J.E. VIDAL, Fl. Cambodge Laos Vietnam 20: 58. 1983, nom. inval.
= *P. hindostanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 156. 1916.
= *P. miyakezimensis* HONDA, Bot. Mag. (Tokyo) 50: 435. 1936.
= *P. jeholensis* KITAGAWA, J. Jap. Bot. 44(6): 182. 1969.

Description

Rhizome slender, terete, perennial, with apical winter buds. Stem unbranched or sparingly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves petiolate; lamina lanceolate or mostly oblong to narrowly oblong, with parallel margins, sometimes that of the lowest leaves reduced to phyllodes, 80–200(–310) mm long, (7–)14–20(–27) mm wide, 4–10(–17) times as long as wide, bright green to yellow-green, 9–13-veined, with narrow rows of lacunae bordering the midrib, minutely denticulate at margins, narrowly cuneate at base, mucronate at apex; petiole (16–)30–70(–140) mm long, 0.1–1.0 times as long as the lamina. Intermediate leaves sometimes present. Floating leaves usually absent or sometimes present, petiolate; lamina oblong to elliptical, 52–125 mm long, 12–25 mm wide, 2.5–8.0 times as long as wide, opaque, coriaceous, bright green, sometimes with a reddish tinge, 11–25-veined, cuneate at base, mucronate at apex; petiole 25–135 mm long, 0.5–2.0 times as long as the lamina. Stipules axillary, convolute, 25–85 mm long, translucent, persistent. Peduncles 46–70(–105) mm long, 1–2 times as long as the fruiting spike, slightly thicker than the stem. Spikes cylindrical, 25–56 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 2.0–3.3 mm long, with a ventral protrusion, dorsal keel more or less distinct.

Stem anatomy

Stele of trio, rarely of proto type, endodermis mostly of U-type, sometimes O-type, interlacunar bundles present, in 1–2(–3) circles, subepidermal bundles absent, rarely a few present, pseudohypodermis present, 1-layered.

Distribution

C, E and SE Asia, Pacific islands.

Hybrids

19 × 21. *P.* ×*malainoides* MIKI, Water Phan. Japan 20. 1937.
[= *P. distinctus* × *P. wrightii*]

24 × 21. *P.* ×*inbaensis* KADONO, Acta Phytotax. Geobot. 34(1–3): 54. 1983.
[= *P. lucens* × *P. wrightii*]

26 × 21. *P.* ×*anguillanus* KOIDZ., Bot. Mag. (Tokyo) 43: 398. 1929.
[= *P. perfoliatus* × *P. wrightii*]
= ? *P. intortusifolius* J.B. HE, L.Y. ZHOU et H.Q. WANG, Bull. Bot. Res. North-East. Forest. Inst. 8(3): 125. 1988.

37 × 21. *P.* ×*philippinensis* A. BENN., PHILIPP. J. Sci. 9: 342. 1914.
[= *P. maackianus* × *P. wrightii*]

Notes

(1) *P. wrightii* is a clearly circumscribed species. Nevertheless, confusion has occurred until recently with *P. lucens*, *P. distinctus* and *P. nodosus*.
(2) The species here called *P. wrightii* was generally treated under the name "*P. malaianus* MIQ." until the typification of that name was carried out (WIEGLEB 1990b). The type specimen of *P. malaianus* actually relates to *P. nodosus*.
(3) *P. sumatranus* MIQ. differs from the type in certain characters (abundant formation of floating leaves, wider submerged leaves, lower number of interlacunar bundles, see WIEGLEB 1990b for details). At present it cannot be decided whether this is a regional morphotype of *P. wrightii*, a hybrid, or a species in its own right. In the first mentioned case nomenclatural consequences arise.
(4) *P.* ×*anguillanus* has also been described under the informal name *Potamogeton* sp. B by LEACH & OSBORNE (1985).
(5) *P.* ×*philippinensis* has been described from a collection which may also contain ordinary *P. maackianus*. Lectotypification will be carried out in the future.

22. *Potamogeton illinoensis* MORONG, Bot. Gaz. (Crawfordsville) 5: 50. 1880.

= *P. lucens* var. *connecticutensis* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 488. 1867. ("Connecticutensis")
≡ *P. angustifolius* var. *connecticutensis* (J.W. ROBBINS) A. BENN., J. Bot. 39: 199. 1901. ("Connecticutensis")
= *P. lucens* subsp. *brasiliensis* A. BENN. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 79. 1907.
≡ *P. brasiliensis* (A. BENN. ex GRAEBN.) A. BENN., J. Bot. 48: 150. 1910.
= *P. zizii* var. η. *gracilis* A. BENN. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 83. 1907.
= *P. zizii* var. ζ. *porrectifolius* A. BENN. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 83. 1907.
= *P. curvatus* A. BENN., J. Bot. 46: 249. 1908, pro hybr. *P. angustifolius* × *P. lucens*.
= *P. illinoensis* f. *rosulatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 199. 1916.
= *P. illinoensis* f. *homophyllus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 199. 1916.
= *P. fragillimus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 202. 1916.
= *P. macrophylloides* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 202. 1916.
= *P. pulchelliformis* HAGSTR., Ark. Bot. 17(7): 12. 1922.
= *P. pedersenii* TUR, Darwiniana 24(1–4): 253. 1982.
= ? *P. dunicola* TUR, Darwiniana 24(1–4): 254. 1982.

Description

Rhizome slender to robust, terete, perennial, with apical winter buds. Stem unbranched or sparingly branched, slender to robust, terete, annual; specialized dormant turions not developing. Submerged leaves sessile to shortly petiolate; lamina narrowly oblong or oblanceolate to elliptical, sometimes that of the lowest leaves reduced to phyllodes, (50–)70–180(–220) mm long, (4–)15–40(–53) mm wide, 3.5–7.0 times as long as wide, yellow-green to bright green, sometimes with a reddish or brownish tinge, (7–)9–17(–19)-veined, with or without narrow rows of lacunae bordering the midrib, minutely denticulate to entire at margins, cuneate at base, mucronate at apex; petiole 0–21(–40) mm long, 0.0–0.2(–0.3) times as long as the lamina. Intermediate leaves sometimes present. Floating leaves present or absent, petiolate; lamina oblong to elliptical or ovate–elliptical, (40–)52–125(–190) mm long, 19–65 mm wide, 1.9–3.1 times as long as wide, opaque, subcoriaceous to coriaceous, yellow-green to dark green, sometimes with a brownish tinge, (11–)13–29-veined, cuneate to rounded or subcordate at base, obtuse or mucronate to acute at apex; petiole (8–)14–90 mm long, 0.1–0.8 times as long as the lamina. Stipules axillary, convolute, (13–)25–80 mm long, translucent, persistent. Peduncles 35–130(–310) mm long, 0.8–3.0(–5.0) times as long as the fruiting spike, as thick as or slightly thicker than the stem. Spikes cylindrical, 20–65 mm long in fruit, contiguous. Flowers numerous, with (2–)4 carpels. Fruits 2.7–3.6(–3.9) mm long, dorsal keel distinct.

Stem anatomy

Stele of proto or trio to oblong type, endodermis of U-type, rarely O-type, interlacunar bundles present, in 1–2 circles, the inner one complete, well developed, subepidermal bundles present, incomplete, or absent, pseudohypodermis present, 1-layered, or absent.

Distribution

North America and South America.

Hybrids

? 22 × 20. *P.* ×*faxonii* MORONG, Mem. Torrey Bot. Club 3(2): 22, t. 32. 1893, pro sp. ("Faxonii")
[= ? *P. illinoensis* × *P. nodosus*]

25 × 22. *P.* ×*deminutus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 209. 1916.
[= *P. gramineus* × *P. illinoensis*]
= ? *P. gramineus* var. *spathulaeformis* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 487. 1867. ("spathulæformis")
– ? *P. spathaeformis* TUCK. ex J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 487. 1867, pro syn. ("spathæformis")
≡ ? *P.* ×*spathulaeformis* (J.W. ROBBINS) MORONG, Mem. Torrey Bot. Club 3(2): 26, t. 35. 1893.
= ? *P. angustifolius* var. *methyensis* A. BENN., J. Bot. 29: 151. 1891. ("Methyensis")
– ? *P. zizii* var. *methyensis* A. BENN. in MACOUN, Catal. Canad. Pl. 5: 370. 1890, nom. nud.
≡ ? *P. zizii* var. *methyensis* (A. BENN.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 89. 1907.
≡ ? *P.* ×*methyensis* (A. BENN.) A. BENN., Trans. & Proc. Bot. Soc. Edinburgh 29(1): 50. 1924.
= *P.* ×*pseudolucens* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 199. 1916.

= *P.* ×*pseudozizii* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 210. 1916. ("pseudo-Zizii")

Notes

(1) *P. illinoensis* is a polymorphic species which has been established by North American authors as an independent entity since the beginning of this century. Nowadays the concept includes also plants from South America. The species is very closely related to *P. lucens*.

(2) *P. dunicola* is either an aberrant form of *P. illinoensis* or a non-floating leaved form of *P. linguatus*. Stem anatomy seems to justify the first assumption (see TUR 1982).

23. *Potamogeton schweinfurthii* A. BENNETT in DYER, Fl. Trop. Afr. 8: 220. 1901. ("Schweinfurthii")

- *P. capensis* SCHEELE ex A. BENN., Ann. K. K. Naturhist. Hofmus. Wien 7: 287. 1892, nom. nud.
- *P. capensis* SCHEELE ex A. BENN. in DYER, Fl. Capens. 7: 46. 1897, pro syn.
- *P. lucens* var. *azoricus* A. BENN., J. Bot. 42: 71. 1904, nom. nud. ("azorica")
- *P. azoricus* A. BENN. ex HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 198 et 265. 1916, nom. nud.

= ? *P. chamissoi* A. BENN., J. Bot. 42: 74. 1904. ("Chamissoi")

= ? *P. repens* HAGSTR. in R.E. FR., Wiss. Ergenb. Schwed. Rhod.-Kongo-Exped. 1911–1912, 1(2): 185. 1916.

= *P. nodosus* var. *billotii* f. *angustissimus* HAGSTR. in R. E. FR., Wiss. Ergenb. Schwed. Rhod.-Kongo-Exped. 1911–1912, 1(2): 186. 1916.

= *P. promontoricus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 182. 1916.

= *P. capensis* SCHEELE ex HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 203. 1916.

= *P. venosus* A. BENN., Trans. & Proc. Bot. Soc. Edinburgh 29(1): 52. 1924.

Description

Rhizome slender, terete, perennial, with apical winter buds. Stem sparingly to richly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile to shortly petiolate; lamina narrowly lanceolate to oblong–elliptical, sometimes that of the lowest leaves reduced to phyllodes, 52–170(–235) mm long, (3–)7–28 mm wide, 4–17(–21) times as long as wide, yellow-green to bright green, often with a reddish or brownish tinge, 7–11-veined, with or without narrow rows of lacunae bordering the midrib, minutely denticulate, cuneate at base, mucronate at apex; petiole 0–25(–65) mm long, 0.00–0.15(–0.35) times as long as the lamina. Intermediate leaves sometimes present, instead of floating leaves. Floating leaves present or often absent, petiolate; lamina oblong to elliptical or ovate, 43–130 mm long, 12–30 mm wide, 2–6 times as long as wide, opaque, subcoriaceous to coriaceous, yellow-green to dark green, with a reddish tinge, 11–21-veined, cuneate to rounded at base, obtuse to acute at apex; petiole 14–63 mm long, 0.1–0.6 times as long as the lamina. Stipules axillary, convolute, 20–62 mm long, translucent, persistent. Peduncles 35–250 mm long, 2–3 times as long as the fruiting spike, slightly thicker than the stem, mostly terminal or lateral in the axils of submerged leaves, sometimes in the axils of floating leaves. Spikes cylindrical, 30–90 mm long in fruit, contiguous. Flowers numerous, with 4 carpels. Fruits 3.0–3.9 mm long, dorsal keel distinct.

Stem anatomy

Stele of proto or trio to oblong type, endodermis of U-type, interlacunar bundles present, in 1 circle, subepidermal bundles absent or scattered ones present, pseudohypodermis present, 1-layered.

Distribution

Africa, Madagascar, Mascarene Islands, the Azores, Mediterranean islands?, SW Asia?

Hybrids

? 26 × 23. *P.* ×*vaginans* (BOJER ex A. BENN.) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 280. 1916, pro sp.

[= ? *P. perfoliatus* × *P. schweinfurthii*]

≡ *P. lucens* subsp. *vaginans* BOJER ex A. BENN., Annuaire Conserv. Jard. Bot. Genève 9: 94. 1905.

Notes

(1) *P. schweinfurthii* is closely related to *P. lucens* and *P. illinoensis*. It is more widespread than formerly assumed. However, the exact geographical delimitation from *P. lucens* is unknown, in particular in the Atlantic Islands, the Mediterranean and SW Asia. Transitional forms of unknown status are known e.g. from Palestine, Greece, and Iraq.

(2) *P. chamissoi* most probably represents an apetiolate form of *P. schweinfurthii*. Unfortunately, its type specimen is badly preserved. Specimens collected later under that name refer to *P. nodosus*.
(3) *P.* ×*vaginans* is provisionally placed here as this hybrid. Morphology and distribution are insufficiently known. As far as is known, it shows a morphological variation pattern analogous to *P.* ×*salicifolius*.

24. *Potamogeton lucens* Linnaeus, Sp. Pl. 126. 1753.

≡ *Spirillus lucens* (L.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
= *P. acuminatus* SCHUMACH., Enum. Pl. 1: 49. 1801. ("acuminatum")
≡ *P. lucens* [var.] γ *acuminatus* (SCHUMACH.) RCHB., Icon. Fl. Germ. Helv. 7: 23. 1845.
= *P. longifolius* J. GAY in LAM., Encycl. Méth. Bot., Suppl. 4: 535. 1816. ("longifolium")
≡ *P. lucens* subsp. *longifolius* (J. GAY) MAGNIN, Bull. Soc. Bot. France 43: 440. 1896.
= *P. volhynicus* BESSER ex ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 509. 1818.
= *P. cornutus* J. PRESL et C. PRESL, Fl. Čech. 37. 1819. ("cornutum")
≡ *P. caudatus* SEIDL ex OPIZ, Böheims Phäner. Crypt. Gewächse 23. 1823, nom. illeg. ("caudatum")
= *P. lucens* var. β. *macrophyllus* WALLR., Sched. Crit. 1: 65. 1822. ("macrophylla")
= *P. macrophyllus* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 358. 1827.
≡ *P. lucens* subsp. *macrophyllus* (WOLFG.) NYMAN, Consp. Fl. Eur. 4: 682. 1882.
= *P. gaudichaudii* CHAM. et SCHLTDL., Linnaea 2(2): 199. 1827. ("Gaudichaudii")
= *P. lucens* var. *teganumensis* MAKINO, Bot. Mag. (Tokyo) 19: 142. 1905.
≡ *P. teganumensis* (MAKINO) MAKINO, Bot. Mag. (Tokyo) 26: 122. 1912.
= *P. dentatus* HAGSTR., Bot. Not. 1908: 101. 1908.
= *P. sinicus* MIGO, J. Shanghai Sci. Inst., sect. 3, 3: 2. 1934.
≡ *P. lucens* subsp. *sinicus* (MIGO) HARA, J. Jap. Bot. 60(8): 238. 1985.

Description

Rhizome slender to robust, terete, biennial to perennial, with apical winter buds. Stem sparingly to richly branched, slender to robust, terete, annual; specialized dormant turions not developing. Submerged leaves shortly petiolate; lamina narrowly oblong to broadly elliptical, sometimes that of the lowest leaves reduced to phyllodes, (49–)70–200(–300) mm long, (10–)25–65 mm wide, (2–)3–6(–10) times as long as wide, yellow-green to bright green, 9–11-veined, without rows of lacunae bordering the midrib, denticulate at margins, broadly to narrowly cuneate at base, mucronate at apex; petiole 2–7(–15) mm long, 0.03–0.10 times as long as the lamina. Floating leaves always absent. Stipules axillary, convolute, (20–)30–80(–110) mm long, translucent, persistent. Peduncles 50–200(–350) mm long, 2–3(–5) times as long as the fruiting spike, conspicuously thicker than the stem. Spikes cylindrical, 25–70 mm long in fruit, contiguous. Flowers numerous, with 4(–6) carpels. Fruits 3.2–4.5 mm long, dorsal keel distinct.

Stem anatomy

Stele mostly of oblong type, sometimes of proto or trio type, endodermis of U-type, interlacunar bundles present, multicellular, in 1–3 circles, subepidermal bundles present, often in incomplete circle, pseudohypodermis present, 1-layered.

Distribution

Europe, N and E? Africa, W, N and E Asia (southwards to Luzon).

Hybrids

13 × 24. *P.* ×*nerviger* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 359. 1827, pro sp.
[= *P. alpinus* × *P. lucens*]

24 × 16. *P.* ×*fluitans* ROTH, Tent. Fl. Germ. 1: 72. 1788, pro sp.
[= *P. lucens* × *P. natans*]

24 × 21. *P.* ×*inbaensis* KADONO, Acta Phytotax. Geobot. 34(1–3): 54. 1983.
[= *P. lucens* × *P. wrightii*]

25 × 24. *P.* ×*angustifolius* J. PRESL in BERCHT. et J. PRESL, Rostlinář 1, fasc. Žábnjkowité 19. 1821, pro sp.
[= *P. gramineus* × *P. lucens*]

– *P. zizii* MERT. et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 845. 1823, pro syn. ("Zizii")
= *P. lucens* [var.] δ. *coriaceus* MERT. et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 850. 1823.
≡ *P. lucens* var. γ. *amphibius* FR., Novit. Fl. Suec. ed. 2. 34. 1828, nom. illeg.

≡ *P. coriaceus* (MERT. et W.D.J. KOCH) FRYER ex A. BENN., J. Bot. 24: 223. 1886.
= *P.* ×*zizii* W.D.J. KOCH ex ROTH, Enum. Pl. Phaen. Germ. 1(1): 531. 1827, pro sp. ("Zizii")
≡ *P. gramineus* var. γ. *zizii* (W.D.J. KOCH ex ROTH) KUNTH, Enum. Pl. 3: 131. 1841. ("Zizii")
≡ *P. heterophyllus* var. c. *zizii* (W.D.J. KOCH ex ROTH) BOREAU, Fl. Centre France ed. 3. 2: 600. 1857. ("Zizii")
≡ *P. lucens* var. β. *zizii* (W.D.J. KOCH ex ROTH) ASCH., Fl. Brandenb. 1: 660. 1864. ("Zizii")
≡ *P. lucens* subsp. *zizii* (W.D.J. KOCH ex ROTH) NYMAN, Consp. Fl. Eur. 4: 682. 1882.
≡ *Spirillus zizii* (W.D.J. KOCH ex ROTH) NIEUWL., Amer. Midl. Naturalist 3: 19. 1913. ("Zizii")
= *P. lucens* var. b. *heterophyllus* FR., Novit. Fl. Suec. ed. 2. 34. 1828.
= *P. coriaceus* FRYER, J. Bot. 27: 8. 1889, nom. illeg., non (MERT. et W. D. J. KOCH) FRYER ex A. BENN. 1886.
= *P.* ×*babingtonii* A. BENN., J. Bot. 32: 204. 1894. ("Babingtonii")
= *P.* ×*heidenreichii* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 327. 1897. ("Heidenreichii")
= *P.* ×*decipiens* var. *berolinensis* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 331. 1897.
≡ *P. berolinensis* (ASCH. et GRAEBN.) GRAEBN., Naturwiss. Wochenschr. 22(6): 361. 1907. ("Berolinensis")

24 × 26. *P.* ×*salicifolius* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 355. 1827, pro sp.
[= *P. lucens* × *P. perfoliatus*]
= *P.* ×*decipiens* NOLTE ex W.D.J. KOCH, Syn. Fl. Germ. Helv. ed. 2. 779. 1844.
≡ *P. lucens* var. *decipiens* (NOLTE ex W.D.J. KOCH) HOOK. f., Stud. Fl. Brit. Isl. 372. 1870.
– *P. olivaceus* O. LANG, Flora 29(30): 472. 1846, pro syn.
= *P. decipiens* var. *affinis* A. BENN., J. Bot. 20: 184. 1882.
≡ *P.* ×*affinis* (A. BENN.) P. FOURNIER, Quatre Fl. Fr. 140. 1935.
= *P. upsaliensis* TISELIUS, Bot. Not. 1884: 15. 1884.
≡ *P. decipiens* subsp. *upsaliensis* (TISELIUS) MAGNIN, Bull. Soc. Bot. France 43: 443. 1896.
= *P. decipiens* var. β. *torssanderi* TISELIUS, Potamog. Suec. Exs., fasc. 2: [sched.] no. 75. 1895. ("Torssandri")
≡ *P. torssanderi* (TISELIUS) DÖRFLER, Herb. Norm. No. 3583. 1898. ("Torssandri")
= *P. salignus* FRYER in HIERN, Victoria Hist. Devon. 1: 129. 1906.
= *P.* ×*decipiens* var. γ. *vollmannii* G. FISCH. in E. BAUMANN, Veg. Untersees 105. 1911. ("Vollmanni")
– *P. vollmannii* (G. FISCH.) G. FISCH., Repert. Spec. Nov. Regni Veg. 14(385): 4. 1914, nom. inval. ("Vollmanni")
– *P.* ×*steriliformis* HAGSTR. in HOLMB., Hartmans Handb. Skand. Fl. 1: 97. 1922, nom. nud.
= *P.* ×*kupfferi* A. BENN., J. Bot. 66: 103. 1928. ("Kupfferi")

35 × 24. *P.* ×*cadburyae* DANDY et G. TAYLOR, Kew Bull. 12: 332. 1957.
[= *P. crispus* × *P. lucens*]

Notes

(1) *P. lucens* is a distinct species which is easily distinguishable over most of its range. Taxonomic difficulties appear on the southern border of its distribution.
(2) The hybrid between *P. gramineus* and *P. lucens* has been called either *P.* ×*zizii* or *P.* ×*angustifolius*. KAPLAN (1997) definitively designated the type of *P. angustifolius* and confirmed its priority.
(3) The name *P. salicifolius* has often been misapplied to plants of *P.* ×*nitens*. In particular, morphotypes called *P. torssanderi* lead to some confusion causing some authors to assume even triple hybrids among *P. gramineus*, *P. lucens*, and *P. perfoliatus*.
(4) *P. decipiens* has often been wrongly considered to be a result of hybridization of *P. lucens* × *P. praelongus*. The last named hybrid has never been confirmed, even though it was also proposed under various other names.
(5) Recently described species *P. xinganensis* Y.C. MA, Acta Sci. Nat. Univ. Intramongolicae 20(2): 281. 1989, might represent another hybrid of *P. lucens*.

25. *Potamogeton gramineus* Linnaeus, Sp. Pl. 127. 1753.

= *P. heterophyllus* SCHREB., Spicil. Fl. Lips. 21. 1771.
≡ *Spirillus heterophyllus* (SCHREB.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
≡ *P. gramineus* subsp. *heterophyllus* (SCHREB.) SCHINZ et THELL., Fl. Schweiz ed. 3. 2: 16. 1914.
= *P. hybridus* PETAGNA, Inst. Bot. 2: 289. 1787.
≡ *P. gramineus* subsp. β. *hybridus* (PETAGNA) ARCANG., Comp. Fl. Ital. 642. 1882.

= *P. augustanus* BALB., Mém. Acad. Sci. Turin, Sci. Phys. Math. 1, 10–11 (1802–1803): 330. 1804. ("Augustanum")
= *P. distachyus* BELLARDI, Mém. Acad. Sci. Turin, Sci. Phys. Math. 1, 10–11 (1802–1803): 447. 1804. ("distachyum")
= *P. lanceolatus* POIR. in LAM., Encycl. Méth. Bot., Suppl. 4: 536. 1816, nom. illeg. ("lanceolatum"), non SM. 1809.
≡ *P. lanciformis* ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 512. 1818.
– *P. paucifolius* OPIZ, Böheims Phäner. Crypt. Gewächse 23. 1823, nom. nud.
= *P. paucifolius* OPIZ, Naturalientausch 223. 1824.
= *P. gracilis* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 355. 1827.
≡ *P. wolfgangii* KIHLM. in A. T. SAELÁN, KIHLM. et HJELT, Herb. Mus. Fenn. ed. 2. 1: 128. 1889, nom. illeg. ("Wolfgangii")
≡ *P. gramineus* proles *wolfgangii* [KIHLM.] GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 89. 1907. ("Wolfgangii")
= *P. gramineus* var. α. *graminifolius* FR., Novit. Fl. Suec. ed. 2. 36. 1828.
≡ *P. gramineus* subsp. *graminifolius* (FR.) SCHINZ et THELL., Fl. Schweiz ed. 3. 2: 15. 1914.
≡ *P. graminifolius* (FR.) FRYER in FRYER et A. BENN., Potamoget. Brit. Isles 64. 1915.
= *P. gramineus* var. β. *heterophyllus* FR., Novit. Fl. Suec. ed. 2. 37. 1828.
= *P. gramineus* [var.] ("spielart") c. *heterophyllus* G. MEY., Chloris Han. 520. 1836, nom. illeg., non Fr. 1828.
= *P. nigrescens* FR., Novit. Fl. Suec. Mant. 3: 17. 1842.
≡ *P. rufescens* subsp. *nigrescens* (FR.) NYMAN, Consp. Fl. Eur. 4: 681. 1882.
= *P. kochii* O. LANG, Flora 29(30): 471. 1846, nom. illeg. ("Kochii"), non F. W. Schultz 1844.
= *P. lonchites* TUCK., Amer. J. Sci. Arts, ser. 2, 6: 226. 1848.
≡ *P. heterophyllus* subsp. *lonchites* (TUCK.) HOOK. f., Stud. Fl. Brit. Isl. 371. 1870. ("lonchitis")
≡ *Spirillus lonchites* (TUCK.) NIEUWL., Amer. Midl. Naturalist 3: 16. 1913.
= *P. latifolius* SLOBODA, Rostlinictví 229. 1852.
= *P. gramineus* var. *myriophyllus* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 487. 1867.
= *P. gramineus* var. *maximus* MORONG ex A. BENN., J. Bot. 19: 241. 1881.
= *P. varians* MORONG ex FRYER, J. Bot. 25: 308. 1887.
= *P. falcatus* FRYER, J. Bot. 27: 65, t. 286. 1889.
– *P. gramineus* var. *mongolicus* MAXIM. ex A. BENN., J. Bot. 28: 300. 1890, pro syn.; MAXIM. ex A. BENN., Bull. Herb. Boissier 4: 546. 1896, pro syn.
= ? *P.* ×*seemenii* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 335. 1897, pro hybr. *P. gramineus* × *P. polygonifolius*. ("Seemenii")
= *P. biformis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 247. 1916.
= ? *P. sarmaticus* MÄEMETS, Novosti Sist. Vyssh. Rast. 15: 4. 1979. ("1978")
= *P. biformoides* PAPCHENKOV, Bot. Zhurn. 82(12): 69. 1997.

Description

Rhizome slender, rarely filiform, terete, perennial, with apical winter buds. Stem sometimes sparingly to mostly richly branched, filiform to slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile, linear-oblong or narrowly oblong to oblong or oblanceolate, sometimes that of the lowest leaves reduced to phyllodes, (17–)35–90(–170) mm long, (2–)5–12(–17) mm wide, 4–12(–15) times as long as wide, bright green to dark green, (3–)7–9(–13)-veined, with or without narrow rows of lacunae bordering the midrib, denticulate at margins, cuneate at base, mucronate at apex. Intermediate leaves sometimes present, often as membranous petiolate leaves. Floating leaves present or absent, petiolate; lamina broadly oblong to elliptical or obovate-elliptical, 15–70(–95) mm long, (5–)8–34 mm wide, 1.3–3.6 times as long as wide, opaque, coriaceous, yellow-green to dark green, (7–)11–21(–23)-veined, cuneate to subcordate at base, obtuse to acute at apex; petiole (7–)18–60(–172) mm long, 0.5–4.0 times as long as the lamina. Stipules axillary, convolute, (6–)10–25(–35) mm long, translucent to opaque, persistent. Peduncles (20–)35–100(–350) mm long, usually thicker than the stem, 2–6(–9) times as long as the fruiting spike. Spikes cylindrical, 15–40 mm long in fruit, contiguous. Flowers numerous, with (3–)4(–5) carpels. Fruits 2.4–3.1 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of U-type, interlacunar bundles present, in 1 outer circle, multicellular, subepidermal bundles present or absent, pseudohypodermis absent or present, 1-layered.

Distribution

Circumpolar, boreal and temperate regions throughout the Northern Hemisphere.

Hybrids

25 × 1. *P.* ×*lanceolatifolius* (TISELIUS) C.D. PRESTON, Watsonia 16(4): 437. 1987.

[= *P. gramineus* × *P. polygonifolius*]

3 × 25. *P.* ×*billupsii* FRYER, J. Bot. 31: 353, t. 337 et 338. 1893. ("Billupsii")

[= *P. coloratus* × *P. gramineus*]

13 × 25. *P.* ×*nericius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 145. 1916.

[= *P. alpinus* × *P. gramineus*]

25 × 16. *P.* ×*sparganiifolius* LAEST. ex FR., Novit. Fl. Suec. Mant. 1: 9. 1832. ("sparganifolius")

[= *P. gramineus* × *P. natans*]

25 × 22. *P.* ×*deminutus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 209. 1916.

[= *P. gramineus* × *P. illinoensis*]

25 × 24. *P.* ×*angustifolius* J. PRESL in BERCHT. et J. PRESL, Rostlinář 1, fasc. Žábnjkowité 19. 1821, pro sp.

[= *P. gramineus* × *P. lucens*]

25 × 26. *P.* ×*nitens* WEBER, Suppl. Fl. Holsat. 5. 1787.

[= *P. gramineus* × *P. perfoliatus*]

≡ *P. heterophyllus* subsp. *nitens* (WEBER) HOOK. f., Stud. Fl. Brit. Isl. 371. 1870.

= *P. curvifolius* HARTM., Handb. Skand. Fl. 78. 1820.

≡ *P. nitens* var. β. *curvifolius* (HARTM.) C. HARTM., Handb. Skand. Fl. ed. 11. 433. 1879.

= *P.* ×*lundii* K. RICHT., Pl. Eur. 1: 13. 1890. ("Lundii")

= *P. nipponicus* MAKINO, Ill. Fl. Japan 1(9): 2, t. 56. 1891.

= *P. nitens* f. *involutus* FRYER, J. Bot. 34: 1, t. 353 et 354. 1896. ("involuta")

≡ *P.* ×*involutus* (FRYER) H. GROVES et J. GROVES in BAB., Man. Brit. Bot. ed. 9. 440. 1904.

= *P.* ×*fallax* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 330. 1897.

= *P.* ×*fischeri* ASCH. et GRAEBN., Synops. Mitteleur. Fl. ed. 2. 1: 504. 1913. ("Fischeri")

= ? *P.* ×*subnitens* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 259. 1916.

25 × 37. *P.* ×*biwaënsis* MIKI, Bot. Mag. (Tokyo) 48: 326. 1934.

[= *P. gramineus* × *P. maackianus*]

Notes

(1) *P. gramineus* is another extremely polymorphic species. Delimitation is particularly difficult because of the great number of hybridizations in which it is involved.

(2) *P. sarmaticus* is most probably a large-leaved form of *P. gramineus*. Plants of comparable leaf size have also been described from Scandinavia and North America.

(3) No separate taxonomic value is acknowledged for *P. nipponicus*. The differences from the type result from an independent crossing of *P. gramineus* with the small leaved form of *P. perfoliatus* which occurs in East Asia, and which has been described as a separate species under various names (e.g. *P. sachalinensis*, *P. juzepczukii*).

26. *Potamogeton perfoliatus* Linnaeus, Sp. Pl. 126. 1753.

≡ *Spirillus perfoliatus* (L.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.

– *P. perfoliatus* var. *typicus* OGDEN, Rhodora 45: 177. 1943, nom. inval.

= *P. loeselii* ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 508. 1818. ("Loeselii")

≡ *P. perfoliatus* [subsp.] β. *loeselii* (ROEM. et SCHULT.) SCHÜBL. et G. MARTENS, Fl. Württemb. 110. 1834. ("Loeselii")

= *P. perfoliatus* var. α. *ovatifolius* WALLR., Sched. Crit. 1: 66. 1822.

= *P. perfoliatus* var. β. *rotundifolius* WALLR., Sched. Crit. 1: 67. 1822.

= *P. perfoliatus* [var.] α. *ovalifolius* MERT. et W.D.J. KOCH ex FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 251. 1838; MERT. et W.D.J. KOCH ex FIEBER in BERCHT. et FIEBER, Potam. Böhmens 14. 1838, nom. illeg., non WALLR. 1822.

= *P. perfoliatus* [var.] β. *cordatolanceolatus* MERT. et W.D.J. KOCH ex FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 251. 1838; MERT. et W.D.J. KOCH ex FIEBER in BERCHT. et FIEBER, Potam. Böhmens 14. 1838. ("cordato-lanceolatus")

= *P. perfoliatus* [var.] γ. *rotundifolius* MERT. et W. D. J. KOCH ex FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 251. 1838; MERT. et W. D. J. KOCH ex FIEBER in BERCHT. et FIEBER, Potam. Böhmens 14. 1838, nom. illeg., non WALLR. 1822.
= *P. perfoliatus* var. α. *rotundifolius* MERT. et W.D.J. KOCH ex RCHB., Icon. Fl. Germ. Helv. 7: 19. 1845, nom. illeg., non WALLR. 1822.
= *P. perfoliatus* var. α. *rotundifolius* SONDER, Fl. Hambug. 98. 1850. ("1851"), nom. illeg., non WALLR. 1822.
= *P. perfoliatus* var. *muelleri* A. BENN., J. Bot. 25: 177. 1887. ("Muelleri")
≡ *P. perfoliatus* subsp. *muelleri* (A. BENN.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 95. 1907. ("Muelleri")
= *P. perfoliatus* var. *mandschuriensis* A. BENN., Annuaire Conserv. Jard. Bot. Genève 9: 100. 1905.
≡ *P. alatofructus* A. BENN., Trans. & Proc. Bot. Soc. Edinburgh 29(1): 49. 1924.
= *P. bupleuroides* FERNALD, Rhodora 10: 46. 1908; FERNALD in B.L. ROBINSON et FERNALD, Gray's New Manual ed. 7. 75. 1908.
≡ *P. perfoliatus* subsp. *bupleuroides* (FERNALD) HULTÉN, Kungl. Svenska Vetenskapsakad. Handl., ser. 4, 8(5) [Circump. Pl. 1]: 254. 1964.
= *P. perfoliatus* var. *sachalinensis* H. LÉV., Repert. Spec. Nov. Regni Veg. 8: 285. 1910.
≡ *P. sachalinensis* (H. LÉV.) H. LÉV., Repert. Spec. Nov. Regni Veg. 10: 441. 1912.
= *P. juzepczukii* P. DOROF. et TZVELEV, Novosti Sist. Vyssh. Rast. 20: 4. 1983.

Description

Rhizome slender, terete, perennial, with apical winter buds. Stem unbranched to richly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile, narrowly lanceolate to broadly ovate or orbicular-ovate, 16–115 mm long, 7–42 mm wide, (1.0–)1.3–7.0(–10.0) times as long as wide, yellow-green or bright green to dark green, sometimes with a reddish tinge, (7–)11–25-veined, with narrow rows of lacunae bordering the midrib, denticulate at margins, amplexicaul at base, obtuse to acute and often slightly hooded at apex. Floating leaves always absent. Stipules axillary, convolute, 3–22 mm long, translucent, decaying early. Peduncles 20–110 mm long, 1–5 times as long as the fruiting spike, as thick as or slightly thicker than the stem. Spikes cylindrical, 13–25 mm long in fruit, contiguous. Flowers (6–)9–20, with 4 carpels. Fruits 2.2–3.5(–4.0) mm long, dorsal keel indistinct.

Stem anatomy

Stele of trio (2) type, with the trio bundle in central position, or rarely of oblong type, endodermis of O-type, cell wall thickening indistinct or almost absent, interlacunar bundles absent, subepidermal bundles absent or scattered uni-cellular ones present, pseudohypodermis absent or partly present, 1-layered.

Distribution

Europe, N and C Africa, Asia, Australia, E North and C America.

Hybrids

13 × 26. *P.* ×*prussicus* HAGSTR., Bot. Not. 1908: 103. 1908.
[= *P. alpinus* × *P. perfoliatus*]

26 × 21. *P.* ×*anguillanus* KOIDZ., Bot. Mag. (Tokyo) 43: 398. 1929.
[= *P. perfoliatus* × *P. wrightii*]

24 × 26. *P.* ×*salicifolius* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 355. 1827, pro sp.
[= *P. lucens* × *P. perfoliatus*]

? 26 × 23. *P.* ×*vaginans* (BOJER ex A. BENN.) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 280. 1916, pro sp.
[= ? *P. perfoliatus* × *P. schweinfurthii*]

25 × 26. *P.* ×*nitens* WEBER, Suppl. Fl. Holsat. 5. 1787.
[= *P. gramineus* × *P. perfoliatus*]

26 × 28. *P.* ×*cognatus* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 317. 1897.
[= *P. perfoliatus* × *P. praelongus*]

= *P.* ×*intermixtus* A. BENN., J. Bot. 41: 166. 1903.

35 × 26. *P.* ×*cooperi* (FRYER) FRYER, Bot. Exch. Club Brit. Isles Rep. 1: 497. 1897; (FRYER) FRYER, J. Bot. 35: 311. 1897. ("Cooperi")
[= *P. crispus* × *P. perfoliatus*]
≡ *P. undulatus* var. *cooperi* FRYER, J. Bot. 29: 289, t. 313. 1891. ("Cooperi")

≡ *P.* ×*cymatodes* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 337. 1897, nom. illeg.
= ? *P.* ×*cymbifolius* G. FISCH., Mitt. Bayer. Bot. Ges. 1(31): 366. 1904.

37 × 26. *P.* ×*leptocephalus* KOIDZ. in Y. DOI, Fl. Satsum. 2: 162. 1931.
[= *P. maackianus* × *P. perfoliatus*]
– *P. nakamurai* YAMAUCHI et MOMIY., Rep. Faun. Fl. Lake Kasumigaura 7. 1971, nom. nud.

26 × 48. *P.* ×*mysticus* MORONG, Bot. Gaz. (Crawfordsville) 5: 50. 1880, pro sp.
[= *P. perfoliatus* × *P. pusillus*]

Note
(1) *P. juzepczukii*, like other *P. perfoliatus*-forms from East Asia, shows certain deviant characters but in total morphological delimitation is indistinct.

27. *Potamogeton richardsonii* (A. BENNETT) RYDBERG, Bull. Torrey Bot. Club 32: 599. 1905. ("Richardsonii")

≡ *P. perfoliatus* var. *lanceolatus* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 488. 1867, nom. illeg., non BLYTT 1861.
≡ *P. perfoliatus* var. *richardsonii* A. BENN., J. Bot. 27: 25. 1889. ("Richardsonii")
≡ *P. perfoliatus* proles *loeselii* var. *cordatolanceolatus* subvar. *richardsonii* (A. BENN.) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 314. 1897.
≡ *Spirillus perfoliatus* var. *richardsonii* (A. BENN.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
≡ *P. perfoliatus* subsp. *richardsonii* (A. BENN.) HULTÉN, Fl. Alaska Yukon 1: 102. 1941.
– *P. perfoliatus* subsp. *richardsonii* (A. BENN.) E. MURRAY, Kalmia 12: 23. 1982. [isonymum]

Description
Rhizome slender, terete, perennial, with apical winter buds. Stem sparingly to richly branched, slender, annual; specialized dormant turions not developing. Submerged leaves sessile, narrowly lanceolate to ovate-lanceolate, (15–)30–100 mm long, 5–19 mm wide, 2.5–7.0 times as long as wide, yellow-green to dark green, (7–)13–25(–33)-veined, with narrow rows of lacunae bordering the midrib, denticulate at margins, amplexicaul at base, narrowly obtuse to acute but not hooded at apex. Floating leaves always absent. Stipules axillary, convolute, 8–26 mm long, opaque, fibrous, decaying but remaining as whitish fibres. Peduncles (14–)20–100(–250) mm long, 0.9–6.0 times as long as the fruiting spike, as thick as or slightly thicker than the stem. Spikes cylindrical, 8–30(–40) mm long in fruit, contiguous. Flowers 7–17, with 4 carpels. Fruits 2.7–4.2 mm long, dorsal keel indistinct.

Stem anatomy
Stele of trio type, with the trio bundles in central position, endodermis of O-type, cell wall thickening indistinct or almost absent, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis absent or partly 1-layered.

Distribution
North America.

Note
(1) *P. richardsonii* is closely related to *P. perfoliatus*. They are partly vicariant in their distribution.

28. *Potamogeton praelongus* WULFEN in ROEMER, Arch. Bot. 3(3): 331. 1805.

≡ *P. acuminatus* WAHLENB., Fl. Upsal. 58. 1820, nom. illeg. ("acuminatum")
≡ *P. lucens* [var.] ("spielart") a. *corniculatus* G. MEY., Chloris Han. 522. 1836.
≡ *Spirillus praelongus* (WULFEN) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
= *P. flexuosus* WREDOW, Oekon.-Techn. Fl. Meklenb. 1: 255. 1811.
= *P. perfoliatus* var. *lacustris* WALLMAN in LILJ., Utkast Sv. Fl. ed. 3. 706. 1816.
= *P. gramineus* var. α. *borealis* LAEST., Kongl. Svenska Vetenskapsakad. Handl. 1824: 162. 1824. ("boreale")
= *P. praelongus* var. *brevifolius* ČELAK., Sitzungsber. Königl. Böhm. Ges. Wiss. Prag, Math.-Naturwiss. Cl. 1886: 11. 1886.
= *P. praelongus* var. δ. *angustifolius* GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 97. 1907.
= *P. praelongus* f. *pygmeus* GALINIS in NATKEVIČAITE-IVANAUSKIENE, Liet. TSR Flora 2: 677. 1963.

Description

Rhizome slender or robust, terete, perennial, with apical winter buds and overwintering short shoots. Stem unbranched to richly branched, slender to robust, terete, annual to perennial; winterbuds as axillary, short, leafy shoots, specialized dormant turions not developing. Submerged leaves sessile, narrowly lanceolate to lanceolate-ovate, (45–)60–180(–360) mm long, 14–40 mm wide, (2.5–)3.0–7.5(–11.0) times as long as wide, bright green to dark green, 11–19(–25)-veined, with narrow rows of lacunae bordering the midrib, entire at margins, rounded and semiamplexicaul at base, obtuse and distinctly hooded at apex. Floating leaves always absent. Stipules axillary, convolute, 10–80 mm long, translucent when fresh, opaque when dry, persistent. Peduncles (50–)80–250(–800) mm long, 2–7(–9) times as long as the fruiting spike, as thick as or thicker than the stem. Spikes cylindrical, 20–80 mm long in fruit, contiguous. Flowers numerous, with (2–)4 carpels. Fruits (3.8–)4.5–5.5 mm long, dorsal keel distinct.

Stem anatomy

Stele of proto type, endodermis of U-type, rarely O-type, interlacunar bundles present, in 2–3 circles, strong, subepidermal bundles present, pseudohypodermis present, 1–3-layered.

Distribution

Circumboreal, throughout the northern hemisphere.

Hybrids

13 × 28. *P.* ×*griffithii* A. BENN., J. Bot. 21: 65, t. 235. 1883. ("Griffithii")

[= *P. alpinus* × *P. praelongus*]

26 × 28. *P.* ×*cognatus* ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 317. 1897.

[= *P. perfoliatus* × *P. praelongus*]

35 × 28. *P.* ×*undulatus* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 360. 1827, pro sp.

[= *P. crispus* × *P. praelongus*]

29. *Potamogeton epihydrus* RAFINESQUE, Med. Repos., Hexade 3, 2: 409. 1811. . ("epihydrum")

– *P. epihydrus* var. *typicus* FERNALD, Mem. Amer. Acad. Arts Sci. 17(1): 114. 1932, nom. inval.

– *P. epihydrus* RAF., Med. Repos., Hexade 2, 5: 354. 1808, nom. prov. ("epihydrum")

= *P. nuttallii* CHAM. et SCHLTDL., Linnaea 2(2): 226, t. 6, fig. 25. 1827. ("Nuttalii")

≡ *P. epihydrus* var. *nuttallii* (CHAM. et SCHLTDL.) FERNALD, Mem. Amer. Acad. Arts Sci. 17(1): 115. 1932.

≡ *P. epihydrus* subsp. *nuttallii* (CHAM. et SCHLTDL.) CALDER et R.L. TAYLOR, Canad. J. Bot. 43: 1388. 1965.

= *P. pennsylvanicus* WILLD. ex CHAM. et SCHLTDL., Linnaea 2(2): 227. 1827. ("pensylvanicus")

= *P. pumilus* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 354. 1827.

= *P. claytonii* TUCK., Amer. J. Sci. Arts, ser. 1, 45: 38. 1843. ("Claytoni")

= *P. nuttallii* var. *ramosus* PECK, Annual Rep. New York State Mus. 47: 162. 1894.

≡ *P. epihydrus* var. *ramosus* (PECK) H.D. HOUSE, New York State Mus. Bull. 254: 52. 1924.

= *P. nuttallii* var. *cayugensis* WIEGAND, Rhodora 2: 102. 1900. ("Cayugensis")

≡ *P. epihydrus* var. *cayugensis* (WIEGAND) A. BENN., J. Bot. 42: 69. 1904. ("Cayugensis")

≡ *P. cayugensis* (WIEGAND) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 140. 1906.

= *P. tennesseensis* FERNALD, Rhodora 38: 167. 1936.

Description

Rhizome slender to robust, compressed, perennial, with apical scaly winter buds. Stem unbranched or sparingly branched, slender to robust, compressed to terete towards the apex, annual; specialized dormant turions not developing. Submerged leaves sessile, often markedly distichous, linear to ribbon-like, 65–240 mm long, (1.0–)2.5–11.0 mm wide, 18–30(–60) times as long as wide, bright green to olive green or brown-green, sometimes with a reddish or brownish tinge, 5–9(–13)-veined, with broad rows of lacunae bordering the midrib, entire at margins, straight to narrowly cuneate at base, narrowly obtuse to acute at apex. Intermediate leaves sometimes present, short petiolate; petiole often flattened. Floating leaves petiolate; lamina oblong to elliptical, 35–80 mm long, 7–22 mm wide, 2.5–5.0 times as long as wide, opaque, coriaceous, brown-green to dark green, 9–21-veined, cuneate at base, obtuse at apex; petiole not flattened, 20–60(–90) mm long, 0.5–2.0 times as long as the lamina. Stipules axillary, convolute, 10–45 mm long, translucent, decaying early. Peduncles 23–90 mm long, 1.5–4.0 times as long as the fruiting spike, usually as thick as the stem, mostly inserted in the axils of floating leaves, rarely in the axils of, or subopposite to, submerged leaves. Spikes cylindrical,

10–30 mm long in fruit, contiguous. Flowers 11–18, with 4 carpels. Fruits 2.5–3.1(–4.0) mm long, dorsal keel indistinct.

Stem anatomy
Stele of eight bundles or oblong to four bundles type, endodermis of O-type, interlacunar bundles absent or scattered ones present, subepidermal bundles absent or scattered ones present, pseudohypodermis absent.

Distribution
North America, NW Europe (British Isles).

30. *Potamogeton ulei* K. SCHUMANN in MARTIUS, Fl. Bras. 3(3): 690. 1894. ("Ulei")

= ? *P. sclerocarpus* K. SCHUM. in MART., Fl. Bras. 3(3): 688. t. 120, fig. 2. 1894.
= *P. paramoanus* R.R. HAYNES et HOLM-NIELS., Syst. Bot. 7(4): 498. 1982.

Description
Rhizome slender, compressed, perennial, with apical winter buds. Stem unbranched, slender, terete to slightly compressed, annual; specialized dormant turions not developing. Submerged leaves sessile, linear, 35–265 mm long, 1.0–4.1 mm wide, 25–70 times as long as wide, bright green to olive green or brown-green, sometimes with a reddish or brownish tinge, 3–7-veined, with broad rows of lacunae bordering the midrib, entire at margins, straight at base, narrowly obtuse to acute at apex. Intermediate leaves often present. Floating leaves mostly present, petiolate; lamina oblong to elliptical, 14–31 mm long, 6–9 mm wide, 2–4 times as long as wide, opaque, coriaceous, brown-green to dark green, 5–9-veined, narrowly cuneate at base, acute to obtuse at apex; petiole 14–44 mm long, 0.8–1.5 times as long as the lamina, mostly flattened. Stipules axillary, convolute, 5–26 mm long, translucent, decaying early. Peduncles 11–27 mm long, 1.5–2.5 times as long as the fruiting spike, as thick as or thinner than the stem, inserted in the axils of both floating and submerged leaves. Spikes cylindrical, 6–14 mm long in flower, contiguous. Flowers 12–18, with 4 carpels. Fruits 2.3–2.7 mm long, dorsal keel distinct.

Stem anatomy
Stele of four bundles type, endodermis of O-type, interlacunar bundles absent, rarely present, subepidermal bundles present, pseudohypodermis present (1-layered?).

Distribution
N and NE South America.

Notes
(1) *P. ulei* is closely related to *P. epihydrus*.
(2) Since its original introduction, *P. ulei* has always been considered as a homophyllous species similar to *P. polygonus*. However, the leaf anatomy of the original collection ULE *1919* (HBG), with their well developed lacunae and abundant anastomoses, clearly points these plants to the *P. epihydrus*-group. In addition, isolectotype plants have well developed floating leaves, by which character they are definitively distinguished from *P. polygonus*.
(3) *P. sclerocarpus* shows certain deviating characters in its general appearance and stem anatomy. We are inclined to presume that such named plants represent deep-water forms of *P. ulei*, since both the morphotypes share many important distinguishing characters, especially in leaf anatomy.

31. *Potamogeton montevidensis* A. BENNETT, Ann. K. K. Naturhist. Hofmus. Wien 7(4): 293. 1892.

Description
Rhizome slender, terete, perennial, non-dormant scaly winterbuds present. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile; lamina linear-lanceolate to linear, mostly decaying early, 70–100 mm long, 4–6 mm wide, 14–21 times as long as wide, bright green to brown-green, 5–9-veined, with broad rows of lacunae bordering the midrib, entire at margins, straight to narrowly cuneate at base, acute at apex. Intermediate leaves sometimes present, petiolate, lanceolate. Floating leaves petiolate; lamina oblong or lanceolate to obovate, 33–50(–65) mm long, (5–)15–20(–25) mm wide, 2.1–4.5(–6.6) times as long as wide, opaque, coriaceous, bright green to brown-green, 11–15(–17)-veined, cuneate at base, rounded or subacute at apex; petiole flattened, 40–115(–150) mm long, 1.1–2.5 times as long as the lamina. Stipules axillary, convolute, 20–35 mm long, translucent, decaying early. Peduncles 40–100 mm

long, 2–5 times as long as the fruiting spike, as thick as or slightly thinner than the stem, inserted as lateral or terminal in the axils of floating leaves, or rarely subopposite to floating leaves. Spikes cylindrical, 10–30 mm long in fruit, contiguous. Flowers 11–13, with 4 carpels. Fruits 3.0–3.5 mm long, dorsal keel distinct.

Stem anatomy

Stele of trio or complex 4 bundles type, endodermis of O-type or faint U-type, interlacunar bundles absent or 1 circle present, subepidermal bundles present as incomplete circle, pseudohypodermis absent.

Distribution

Argentina, Uruguay, Brazil.

Note

(1) *P. montevidensis* is closely related to *P. epihydrus* and to *P. ulei*. Delimitation is indistinct despite the geographical distance.

32. *Potamogeton drummondii* BENTHAM in BENTHAM et F. MUELLER, Fl. Austral. 7: 171. 1878. ("Drummondii")

= ? *P. similis* A. BENN., J. Bot. 40: 146. 1902.

Description

Rhizome filiform to slender, terete, perennial, winterbuds not seen. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile to shortly petiolate; lamina narrowly oblong to lanceolate or broadly ovate, 40–120 mm long, 5–20 mm wide, 2–12 times as long as wide, pale green, 3–11-veined, with narrow rows of lacunae bordering the midrib, entire at margins, cuneate at base, acute at apex; petiole 0–5 mm long, 0–0.05 times as long as the lamina. Floating leaves present or absent, petiolate; lamina elliptical to broadly elliptical, 20–40 mm long, 12–25 mm wide, 1.2–2.0 times as long as wide, opaque, coriaceous, yellow-green to olive green, 9–15-veined, broadly cuneate at base, acute at apex; petiole (10–)35–80 mm long, (0.3–)1.0–2.4 times as long as the lamina. Stipules axillary, convolute, 16–25 mm long, translucent, persistent. Peduncles 30–90 mm long, 4–6 times as long as the fruiting spike, slightly thicker than the stem, inserted in the axils of floating and submerged leaves. Spikes subglobose to cylindrical, 7–22 mm long in fruit, contiguous. Flowers 10–16, with 4 carpels. Fruits 1.7–2.0(–2.5) mm long, dorsal keel distinct, lateral keels indistinct.

Stem anatomy

Stele mostly of four bundles type, sometimes of proto or trio type, endodermis of O-type, interlacunar bundles absent or present in 1 incomplete circle, subepidermal bundles usually absent, rarely faint ones present, pseudohypodermis absent or partly present.

Distribution

Western and Southern Australia, Tasmania.

Note

(1) *P. drummondii* is not sufficiently known as to the range of its characters. It is either another extremely polymorphic species or it consists of two independent taxa. The "holotype" Drummond, Nova Hollandia, is of uncertain origin, and has relatively well-developed subepidermal bundles. RAUNKIAER (1903) found no such bundles, only single strands, although HAGSTRÖM (1916) did. In the specimen investigated (from C) it was difficult to decide what one can really see. There are some bundles but whether they are truly subepidermal or the outer interlacunar ones cannot be discerned. The present description is based on recent specimens only (Weston *80-44*, PERTH; Gardner *1372*, PERTH; Orchard *4356*, PERTH; Strid *21233*, B, C, PERTH; Strid *21234*, B, C, M; Meebold *2/27*, M). Within these specimens two morphotypes exist, one with lanceolate and one with oblong submerged leaves. The oblong morphotype always lacks subepidermal bundles. Cultivation experiments are necessary to clarify the status of the morphotypes.

33. *Potamogeton cheesemanii* A. BENNETT, J. Bot. 21: 66. 1883. ("Cheesemanii")

– *P. oblongifolius* KIRK ex HOOK. f., Handb. New Zeal. Fl. 2: 742. 1867, nom. nud.

– *P. natans* var. *australis* KIRK ex A. BENN., J. Bot. 25: 177. 1887, pro syn.; KIRK ex A. BENN., Ann. K. K. Naturhist. Hofmus. Wien 7: 286. 1892, pro syn.

= ? *P. tricarinatus* F. MUELL. et A. BENN., J. Bot. 30: 229. 1892.

= ? *P. samariformis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 166. 1916.

= ? *P. sessilifolius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 167. 1916.
= *P. porrigens* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 172. 1916.
= *P. cheesemanii* f. *tasmanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 174. 1916.
= ? *P. cheesemanii* f. *frondosus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 174. 1916.

Description

Rhizome filiform to slender, terete, perenial, winterbuds not seen. Stem unbranched or sparingly branched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves sessile or subsessile to shortly petiolate; lamina narrowly linear-lanceolate or narrowly elliptical, relatively uniform, 40–100 mm long, 5–15 mm wide, 6–12 times as long as wide, bright green to dark green, sometimes with a brownish tinge, 5–11-veined, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, rounded to emarginate or subacute at apex; petiole 0–5(–30) mm long, 0.00–0.05(–0.30) times as long as the lamina. Intermediate leaves sometimes present, petiolate, lanceolate to lanceolate-spathulate; petiole up to 20 mm long. Floating leaves present or absent, petiolate; lamina ovate to elliptical-oblong, 20–45(–58) mm long, 10–26 mm wide, 1.3–3.3 times as long as wide, opaque, coriaceous, yellow-green to olive green, sometimes with a brownish tinge, (5–)9–15(–17)-veined, rounded or truncate to subcordate at base, rounded to subacute at apex; petiole (15–)30–80 mm long, (0.3–)1.5–3.2 times as long as the lamina. Stipules axillary, convolute, (13–)24–35 mm long, translucent, decaying or persistent. Peduncles (23–)40–60 mm long, 2.5–4.0 times as long as the fruiting spike, as thick as the stem, inserted in the axils of floating leaves. Spikes cylindrical, 10–25 mm long in fruit, contiguous. Flowers 16–numerous, with 4 carpels. Fruits 2.0–2.6 mm long, dorsal keel distinct, lateral keels distinct.

Stem anatomy

Stele mostly of four bundles type, sometimes of proto or trio type, with strong central sclerenchyma, endodermis of O-type, rarely O-U-type, interlacunar bundles absent or outer circle present, subepidermal bundles present, mostly strongly developed, pseudohypodermis absent.

Distribution

New Zealand, Australia, Tasmania.

Notes

(1) In the present treatment *P. cheesemanii* is conceived as a species comprising a wide range of divergent morphotypes. Because of this polymorphism the wide distribution of *P. cheesemanii* has been overlooked until recently. Confusion with *P. sulcatus* (under *P. tricarinatus*), *P. australiensis*, *P. drummondii*, and *P. suboblongus* has occurred. The ultimate identity of several synonyms (*P. sessilifolius*, *P. samariformis*, also *P. similis*) depends on the choice of lectotypes in the future and the exact delimitation between *P. cheesemanii* and *P. drummondii*. So far unrecognized hybridization may be another cause of confusion.
(2) The name "*P. tricarinatus*" has been applied to almost any broad-leaved *Potamogeton* species of Australia. In the strict sense however, *P. tricarinatus* may be regarded as a species in its own right. In their treatment submitted to Flora of Australia, Papassotiriou, Jacobs and Hellquist provide a short description. The plant resembles *P. cheesemanii* in general habit but is closer to *P. sulcatus* with respect to fruit shape. The plant is rare, and obviously rarely collected and distributed among the herbaria. At present there is not enough material available to provide a fully satisfactory description.

34. *Potamogeton solomonensis* WIEGLEB, Blumea 37: 381. 1993.

Description

Rhizome slender, terete, perennial, winterbuds not seen. Stem unbranched, slender, terete, annual; specialized dormant turions not developing. Submerged leaves mostly petiolate, sometimes subsessile; lamina lanceolate to ribbon-like, partly falcate, 80–135(–150) mm long, 5–8(–15) mm wide, 8–19 times as long as wide, bright green to dark green, 3–5-veined, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute at the apex; petiole (0–)20–50 mm long, (0–)0.2–0.4 times as long as the lamina. Floating leaves present or absent, petiolate; lamina oblong to lanceolate, 35–45 mm long, 12–18 mm wide, 2.3–3.1 times as long as wide, opaque, coriaceous, yellow-green to olive green, 9–11-veined, narrowly to broadly cuneate at base, obtuse to subacute at apex; petiole 40–80 mm long, 1.7–4.0 times as long as the lamina. Stipules axillary, convolute, 20–30 mm long, translucent, persistent. Inflorescences dimorphic. Peduncle of apical inflorescences inserted in the axils of floating leaves, 40–60 mm long, 2.5–4.0 times as long as the flowering spike, as thick as the stem; peduncle of lateral inflorescences inserted in the axils of submerged

leaves or subopposite to submerged leaves, 10 mm long, with the spike 6 mm long, often undeveloped. Spikes dimorphic, cylidrical or subglobose, (6–)10–15 mm long in flower, contiguous. Flowers numerous, with 4 carpels. Ripe fruits not seen.

Stem anatomy

Stele of reduced trio or four bundles type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis absent or present, 1-layered.

Distribution

Solomon Islands, New Caledonia.

Note

(1) *P. solomonensis* is closely related to *P. cheesemanii*.

35. *Potamogeton crispus* Linnaeus, Sp. Pl. 126. 1753.

– *P. crispus* var. α. *genuinus* RCHB., Icon. Fl. Germ. Helv. 7: 18. 1845, nom. inval.
– *P. tuberosus* ROXB., Hort. Beng. 12. 1814, nom. nud. ("tuberosum")
= *P. tuberosus* ROXB. in CAREY, Fl. Ind. 1: 472. 1820. ("tuberosum")
– *P. serrulatus* OPIZ, Flora 5: 267. 1822, nom. nud.; OPIZ, Böheims Phäner. Crypt. Gewächse 23. 1823, nom. nud. ("serrulatum")
= *P. crenulatus* D. DON, Prodr. Fl. Nepal. 22. 1825. ("crenulatum")
– *P. crispatus* WALLMAN ex FR., Novit. Fl. Suec. ed. 2. 43. 1828, pro syn.
= *P. crispus* [var.] ("spielart") a. *planifolius* G. MEY., Chloris Han. 523. 1836.
= *P. crispus* [var.] α. *acutifolius* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 269. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 32. 1838.
= *P. crispus* [var.] β. *obtusifolius* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 269. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 32. 1838.
= *P. crispus* var. β. *gemmifer* RCHB., Icon. Fl. Germ. Helv. 7: 18, t. 30, fig. 51. 1845.
= *P. crispus* var. γ. *serrulatus* SCHRAD. ex RCHB., Icon. Fl. Germ. Helv. 7: 18, t. 30, fig. 52. 1845.
= *P. lactucaceus* MONTANDON, Guide Bot. Sundgau [= FRICHE-JOSET, Syn. Fl. Jura ed. 2.] 305. 1868. ("lactucaceum")
= *P. hohenackeri* GAND., Oesterr. Bot. Z. 31: 43. 1881. ("Hohenackeri")
= *P. hungaricus* GAND., Oesterr. Bot. Z. 31: 43. 1881.
= *P. pallidior* GAND., Oesterr. Bot. Z. 31: 43. 1881.
= *P. rubricans* GAND., Oesterr. Bot. Z. 31: 43. 1881.
= *P. austriacus* GAND., Oesterr. Bot. Z. 31: 44. 1881.
= *P. leptophyllus* GAND., Oesterr. Bot. Z. 31: 44. 1881.
= *P. macrorrhynchus* GAND., Oesterr. Bot. Z. 31: 44. 1881.
≡ *P. crispus* var. *macrorrhynchus* (GAND.) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 336. 1897.
= *P. notarisii* GAND., Oesterr. Bot. Z. 31: 44. 1881. ("Notarisii")
= *P. rubrinaevus* GAND., Oesterr. Bot. Z. 31: 44. 1881.

Description

Rhizome filiform to slender, compressed, annual or biennial. Stem unbranched or sparingly branched, filiform to slender, compressed, bicanaliculate, annual or partly wintergreen; stiff axillary non-dormant turions of various shapes developing throughout the growth season. Submerged leaves sessile, linear to linear-oblong, 25–95(–132) mm long, (4–)6–12(–18) mm wide, 5–9(–13) times as long as wide, bright green to dark green, often with a reddish tinge, (3–)5(–7)-veined, with narrow to broad rows of lacunae bordering the midrib, serrate and usually strongly undulate at margins, broadly cuneate at base, obtuse to acute at apex. Floating leaves always absent. Stipules axillary, convolute to shortly connate, 4–12(–17) mm long, translucent, decaying early. Peduncles 14–65(–125) mm long, 3–8 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 5–16 mm long in fruit, contiguous to shortly distant. Flowers 3–8, with (2–)4 carpels. Fruits 4.0–6.2 mm long, adnate at base, dorsal keel distinct, beak very prominent, 0.5–0.8 times as long as the rest of the fruit.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis present, 1-layered, or absent.

Distribution
Europe, Africa, Asia, Australia, introduced in New Zealand, North America and S South America.

Hybrids

13 × 35. *P.* ×*olivaceus* Baagöe ex G. Fisch., Ber. Bayer. Bot. Ges. 11: 33. 1907.
[= *P. alpinus* × *P. crispus*]

35 × 24. *P.* ×*cadburyae* Dandy et G. Taylor, Kew Bull. 12: 332. 1957.
[= *P. crispus* × *P. lucens*]

35 × 26. *P.* ×*cooperi* (Fryer) Fryer, Bot. Exch. Club Brit. Isles Rep. 1: 497. 1897; (Fryer) Fryer, J. Bot. 35: 311. 1897. ("Cooperi")
[= *P. crispus* × *P. perfoliatus*]

35 × 28. *P.* ×*undulatus* Wolfg. in Schult. et Schult. f., Mant. 3: 360. 1827, pro sp.
[= *P. crispus* × *P. praelongus*]

35 × 47. *P.* ×*lintonii* Fryer, J. Bot. 38: 366. 1900; Fryer, Bot. Exch. Club Brit. Isles Rep. 1899–1900: 21. 1900. ("Lintoni")
[= *P. crispus* × *P. friesii*]

35 × 55. *P.* ×*bennettii* Fryer, J. Bot. 33: 1, t. 348. 1895. ("Bennettii")
[= *P. crispus* × *P. trichoides*]

Note
(1) *P. crispus* exhibits extreme morphological variation. Despite this fact it is always easily recognizable as being the most distinct species within the genus.

36. *Potamogeton robbinsii* Oakes, Mag. Hort. Bot. 7(5): 180. 1841. ("Robbinsii")

≡ *Spirillus robbinsii* (Oakes) Nieuwl., Amer. Midl. Naturalist 3: 19. 1913. ("Robbinsii")
– *P. pumilus* Nutt. ex A. Benn., Ann. K. K. Naturhist. Hofmus. Wien 7: 292. 1892, pro syn. ("pumilum")

Description
Rhizome slender, terete, perennial. Stem sparingly branched below, richly branched upwards, filiform to slender, terete, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear to lanceolate, 25–80(–120) mm long, (2–)3–6(–8) mm wide, 7–15 times as long as wide, dark green, 5–7-veined, with 20–72 additional sclerenchymatous strands, without rows of lacunae bordering the midrib, mostly serrulate at margins, auriculate at base, acute at apex. Floating leaves always absent. Stipules adnate, convolute, 5–21 mm long, fused with the leaves for 2–12 mm, opaque, whitish, persistent. Peduncles 30–50(–70) mm long, 2–5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 5–20 mm long in fruit, contiguous to shortly distant. Flowers 4–7, with 4 carpels. Fruits extremely rare, 3.5–4.7(–6.2) mm long, dorsal keel distinct.

Stem anatomy
Stele of complex oblong type, sometimes of proto type, endodermis of O-type, with varying strength, scattered interlacunar bundles present, subepidermal bundles present, pseudohypodermis present, 1-layered.

Distribution
North America.

Note
(1) *P. robbinsii* is closely related to *P. maackianus*.

37. *Potamogeton maackianus* A. Bennett, J. Bot. 42: 74. 1904. ("Maackianus") [nom. cons. prop.]

≡ *P. serrulatus* Regel et Maack in Regel, Mém. Acad. Imp. Sci. Saint Pétersbourg, sér. 7, Sci. Phys.-Math., 4(4): 139. 1861.
= *P. robbinsii* var. *japonicus* A. Benn., Bull. Herb. Boissier 4: 549. 1896.

Description
Rhizome slender, terete, perennial, with wintergreen short shoots. Stem richly branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, linear, 14–80(–100) mm long, (1.1–)1.5–4.0 mm wide, 8–25 times as long as wide, bright green to olive green or dark green, 3–5-veined, with 4–8 additional sclerenchymatous strands, with narrow rows of lacunae bordering the midrib, serrulate at margins, rounded at base, acute at apex. Floating leaves always absent. Stipules adnate, convolute, 4–12 mm

long, fused with the leaves for 2–6 mm, translucent to opaque, persistent. Peduncles 12–35 mm long, 1.5–5.5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 4–10 mm long in fruit, contiguous to shortly distant. Flowers 2–4, with 4 carpels. Fruits rare, 3.3–3.8 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis 1-layered.

Distribution

E and SE Asia.

Hybrids

37 × 21. *P.* ×*philippinensis* A. BENN., Philipp. J. Sci. 9: 342. 1914.

[= *P. maackianus* × *P. wrightii*]

25 × 37. *P.* ×*biwaënsis* MIKI, Bot. Mag. (Tokyo) 48: 326. 1934.

[= *P. gramineus* × *P. maackianus*]

37 × 26. *P.* ×*leptocephalus* KOIDZ. in Y. DOI, Fl. Satsum. 2: 162. 1931.

[= *P. maackianus* × *P. perfoliatus*]

37 × 46. *P.* ×*kyushuensis* KADONO et WIEGLEB, J. Jap. Bot. 62(3): 76. 1987.

[= *P. maackianus* × *P. oxyphyllus*]

= *P. tenuinervis* A. CAMUS in LECOMTE, Not. Syst. 1: 88. 1909, p. p.

Notes

(1) *P. serrulatus* REGEL et MAACK, the earliest name relating to the species concerned, has been found not to be illegitimate as formerly supposed. However, for reasons of preserving nomenclatural stability and in order to avoid a disadvantageous nomenclatural change it is proposed to conserve the widely and persistently used name, *P. maackianus* (KAPLAN 1998).

(2) The type collection of *P. tenuinervis* consists of plants of both *P. maackianus* and *P.* ×*kyushuensis*. Selection of a single lectotype will be necessary in the future.

38. *Potamogeton polygonus* CHAMISSO et SCHLECHTENDAL, Linnaea 2(2): 184, t. 4, fig. 11. 1827.

= ? *P. pseudopolygonus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 81. 1916.

Description

Rhizome filiform to slender, terete, perennial. Stem richly branched, filiform to slender, compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear to linear-lanceolate, 90–170 mm long, 3–6(–9) mm wide, 17–30 times as long as wide, bright green to dark green or olive green, (5–)7–9-veined, with 24–36 additional sclerenchymatous strands, bordered by a very strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 15–30 mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles 15–55 mm long, 0.8–2.0 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 12–23 mm long in fruit, contiguous to shortly distant. Flowers (6–)12–16, with 1–2 carpels. Fruits 2.8–3.5 mm long, dorsal keel distinct.

Stem anatomy

Stele of proto or reduced trio type, endodermis of O-type, scattered interlacunar bundles present or absent, subepidermal bundles present, pseudohypodermis present, 1-layered.

Distribution

South America.

Hybrids

38 × 48. *P.* ×*attenuatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 112. 1916.

[= *P. polygonus* × *P. pusillus*]

Note

(1) *P. polygonus* is superficially similar to non-floating leaved phenotypes of *P. ulei*. However, they can be clearly distinguished by the presence of distinct sclerenchymatous strands, absence of extensive lacunae, longer internodes and reduced carpel number. The morphological similarity is due to convergence among distinct species groups (*P. epihydrus*-group vs. *P. compressus*-group).

39. *Potamogeton ochreatus* RAOUL, Ann. Sci. Nat., Sér. 3, 2: 117. 1844.

Description

Rhizome slender, terete, perennial, short. Stem richly branched, slender, terete, annual; lateral dormant turions developing. Submerged leaves sessile, linear, 25–90(–130) mm long, 2–5(–6) mm wide, 10–25 times as long as wide, bright green to dark green, sometimes with a brownish tinge, (3–)5-veined, with 20–32 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, obtuse at apex. Floating leaves always absent. Stipules axillary, convolute, 4–15(–20) mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles (20–)30–75 mm long, 2–4 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 9–15 mm long in fruit, contiguous. Flowers 6–9, with 4 carpels. Fruits 2.8–4.5 mm long, dorsal keel distinct to indistinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis present, 2–3-layered.

Distribution

SW, S, SE and E Australia, New Zealand.

40. *Potamogeton furcatus* HAGSTRÖM, Kungl. Svenska Vetenskapsakad. Handl. 55(5): 80. 1916.

Description

Rhizome filiform to slender, terete, perennial, short. Stem richly branched, terete, slender, annual; specialized dormant turions not seen. Submerged leaves sessile, linear, 85–140(–200) mm long, 2–4 mm wide, 25–50 times as long as wide, bright green to dark green, sometimes with a brownish tinge, (3–)5-veined, with 20–32 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute at apex. Floating leaves always absent. Stipules axillary, convolute, 8–15 mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles 10–24 mm long, 1–3 times as long as the flowering spike, as thick as the stem. Spikes cylindrical, 8–12 mm long in flower, contiguous. Flowers 8, with 4 carpels. Fruits not seen.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis present, 2–3-layered.

Distribution

Papua-New Guinea, New Caledonia?, SE and E? Australia.

Note

(1) *P. furcatus* is closely related to *P. ochreatus*, but has a different geographical distribution. It has also been informally described as *Potamogeton* sp. A by LEACH & OSBORNE (1985).

41. *Potamogeton acutifolius* LINK in ROEMER et SCHULTES, Syst. Veg. ed. 16. 3: 513. 1818.

≡ *P. zosterifolius* [var.] β. *acutifolius* (LINK) SCHULT. et SCHULT. f., Mant. 3: 362. 1827.
≡ *P. compressus* subsp. *acutifolius* (LINK) HOOK. f., Stud. Fl. Brit. Isl. 373. 1870.
– *P. cuspidatus* SCHRAD. ex MERT. et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 854. 1823, pro syn.
= *P. acutifolius* var. α. *major* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 272. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 35. 1838.
= *P. acutifolius* var. β. *minor* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 272. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 35. 1838.
= ? *P. henningii* A. BENN., J. Bot. 48: 151. 1910. ("Henningii")

Description

Rhizome absent or filiform, compressed to almost terete, annual, short. Stem sparingly to richly branched, filiform to slender, strongly compressed to flattened, 0.4–3.0 mm wide, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 35–80(–135) mm long, 1.8–3.8(–5.5) mm wide, 13–30(–40) times as long as wide, bright green to dark green, sometimes with a reddish tinge, 3-veined, with 16–24 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae

bordering the midrib, entire at margins, narrowly cuneate at base, acute to acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 10–21(–29) mm long, translucent to opaque, persistent but soon eroding to fibrous strands at the apex. Peduncles 3–15(–26) mm long, 1–6 times as long as the fruiting spike, as thick as the stem. Spikes almost globose, 4–8 mm long in fruit, contiguous. Flowers 4–7, with 1 carpel. Fruits 3.0–4.0(–4.7) mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, multicellular, pseudohypodermis absent.

Distribution

Temperate regions of Europe, W Asia?

Hybrids

41 × 47. *P.* ×*pseudofriesii* DANDY et G. TAYLOR, Kew Bull. 12: 332. 1957.
[= *P. acutifolius* × *P. friesii*]

41 × 48. *P.* ×*sudermanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 73. 1916.
[= *P. acutifolius* × *P. pusillus*]

Notes

(1) *P. acutifolius* is a species closely related to *P. compressus*. Even though not always easily recognizable in its non-flowering state, it is distinguished in many characters of its inflorescence and flower/fruit morphology. Unlike *P. compressus*, it occupies a limited geographical area.
(2) *P. henningii* A. BENN. has been recently reported from several places in Siberia (VOLOBAEV 1993). However, the present-day concept is unlikely to correspond to the original one. Biosystematical revision of the whole group is desirable.
(3) The occurrence of the hybrid *P. acutifolius* × *P. compressus* has repeatedly been claimed to arise. However, both parents are often indistinguishable vegetatively owing to significant overlap of characters. Therefore, their hybrid cannot be identified on the basis of non-flowering specimens. Experimental crossing is necessary to confirm the existence of the hybrid.

42. *Potamogeton compressus* Linnaeus, Sp. Pl. 127. 1753. ("compressum")

= *P. zosterifolius* SCHUMACH., Enum. Pl. 1: 50. 1801. ("zosteræfolium")
  ≡ *P. zosterophyllus* DUMORT., Fl. Belg. 164. 1827, nom. illeg.
  ≡ *Spirillus zosterifolius* (SCHUMACH.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
= *P. complanatus* WILLD., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 3: 297. 1809. ("complanatum")
= *P. laticaulis* WAHLENB., Fl. Suec. 1: 107. 1824. ("laticaule")
= *P. carinatus* KUPFFER in MÜHLEN, Korrespondensbl. Naturf.-Vereins Riga 49: 164. 1906.
  ≡ *P. acutifolius* subsp. *carinatus* (KUPFFER) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 104. 1907.
= *P. monoginus* MIKI, Water Phan. Japan 18. 1937.

Description

Rhizome absent or filiform, compressed, annual, usually short. Stem richly branched, filiform to slender, strongly flattened, 0.5–3.4(–4.8) mm wide, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, (70–)85–240(–290) mm long, (2.2–)2.9–5.4(–6.0) mm wide, 20–60(–90) times as long as wide, olive green to dark green, sometimes with a reddish tinge, (3–)5-veined, with 20–32 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute to mucronate at apex. Floating leaves always absent. Stipules axillary, convolute, (19–)22–35(–55) mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles (21–)28–69(–95) mm long, 2–5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 16–33 mm long in fruit, contiguous. Flowers 10–20, with (1–)2(–3) carpels. Fruits 3.4–4.0 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, multicellular, pseudohypodermis absent.

Distribution
Boreal and temperate regions of Europe and Asia.

Hybrids

42 × 46. *P.* ×*fauriei* (A. BENN.) MIKI, Water Phan. Japan 45. 1937. ("Fauriei")
[= *P. compressus* × *P. oxyphyllus*]
≡ *P. oxyphyllus* var. *fauriei* A. BENN., J. Bot. 42: 76. 1904. ("Fauriei")

43. *Potamogeton zosteriformis* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 36. 1932.

≡ *P. zosterifolius* subsp. *zosteriformis* (FERNALD) HULTÉN, Kungl. Svenska Vetenskapsakad. Handl., ser. 4, 8(5) [Circump. Pl. 1]: 168. 1964.
= *P. zosterifolius* var. *minor* HOOK., Fl. Bor.-Amer. 2: 172. 1838.
= *P. zosterifolius* var. *americanus* A. BENN., Trans. & Proc. Bot. Soc. Edinburgh 29(1): 46. 1924.

Description
Rhizome absent or filiform to slender, compressed, annual. Stem richly branched, filiform to slender, flattened, 0.6–3.2 mm wide, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 50–200 mm long, (1.8–)2.3–5.0 mm wide, 25–50 times as long as wide, bright green to dark green, sometimes with a reddish tinge, 3-veined, with 20–34 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute to mucronate at apex. Floating leaves always absent. Stipules axillary, convolute, (16–)20–32(–40) mm long, translucent, persistent, generally intact throughout the season. Peduncles (19–)30–100 mm long, 1.5–5.0 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 15–32 mm long in fruit, contiguous. Flowers 10–20, with (1–)2 carpels. Fruits 4.0–5.0(–5.5) mm long, dorsal keel distinct.

Stem anatomy
Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
North America.

Hybrids

51 × 43. *P.* ×*haynesii* HELLQ. et G.E. CROW, Brittonia 38(4): 415. 1986.
[= *P. strictifolius* × *P. zosteriformis*]

53 × 43. *P.* ×*ogdenii* HELLQ. et R.L. HILTON, Syst. Bot. 8(1): 88. 1983, pro sp.
[= *P. hillii* × *P. zosteriformis*]

Notes
(1) *P. zosteriformis* is closely related to *P. compressus*. They are vicariant in their distribution. The former occurs in North America while the latter is Eurasian.
(2) *P. ogdenii* was described as a species of hybridogenous origin. The species nature was justified especially by the rich fruit production. However, especially *P.* ×*angustifolius*, but also *P.* ×*fluitans* and *P.* ×*sudermanicus*, are also known to produce fruits. Nothing is known, however, about the viability and germination rate of these fruits. Even though *P.* ×*ogdenii* is clearly intermediate between the putative parents, its species status may be substantiated in future studies.

44. *Potamogeton manchuriensis* (A. BENNETT) A. BENNETT, Trans. & Proc. Bot. Soc. Edinburgh 29: 50. 1924. ("mandschuriensis")

≡ *P. acutifolius* subsp. *manchuriensis* A. BENN., J. Bot. 42: 76. 1904.
– *P. manchuriensis* (A. BENN.) FERNALD, Mem. Amer. Acad. Arts Sci. 17: 68. 1932. [isonymum]

Description
Rhizome filiform, slightly compressed, perennial. Stem sparingly to richly branched, filiform, slightly compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 40–150 mm long, 1.5–2.5 mm wide, 25–60 times as long as wide, olive green to dark green, 3-veined, with 10–18 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent.

Stipules axillary, convolute, 18–30 mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles 20–55 mm long, 2.5–3.5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 6–17 mm long in fruit, contiguous. Flower and carpel numbers unknown. Fruits 2.8–3.5 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution

NE Asia.

Note

(1) *P. manchuriensis* is insufficiently known. At present it is regarded as being related to *P. compressus*.

45. *Potamogeton sibiricus* A. BENNETT, J. Bot. 28: 300. 1890.

= *P. subsibiricus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 84. 1916.
= *P. porsildiorus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 40. 1932. ("Porsildiorum")
= *P. anadyrensis* V.N. VASSIL., Bot. Mat. Gerb. Bot. Inst. Akad. Nauk SSSR [= Not. Syst. Herb. Inst. Bot. Acad. Sci. URSS] 17: 45. 1955.

Description

Rhizome filiform, slightly compressed, perennial. Stem unbranched or sparingly branched, filiform, slightly compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 35–80(–95) mm long, 1.2–2.0(–2.5) mm wide, 20–40 times as long as wide, olive green to dark green, 3-veined, with (8–)12–20 additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute to rounded or mucronate at apex. Floating leaves always absent. Stipules axillary, convolute, (10–)15–25 mm long, translucent to opaque, persistent but eroding early to fibrous strands at the apex. Peduncles 17–35(–50) mm long, 1–3 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 7–17 mm long in fruit, contiguous. Flower and carpel numbers unknown. Fruits 2.1–3.0 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution

NE Europe, N Asia, NW and N North America.

Note

(1) *P. sibiricus* is insufficiently known. Most probably it is related to *P. oxyphyllus* or *P. compressus*.

46. *Potamogeton oxyphyllus* MIQUEL, Ann. Mus. Bot. Lugduno-Batavum 3: 161. 1867.

= ? *P. chongyangensis* W.X. WANG, Acta Phytotax. Sin. 22(6): 490. 1984.

Description

Rhizome filiform, terete, perennial, continously growing. Stem richly branched, filiform, terete, mostly wintergreen; axillary dormant turions developing. Submerged leaves sessile, linear to narrowly linear-lanceolate, 50–105(–135) mm long, 2.0–3.5(–4.2) mm wide, 20–40 times as long as wide, bright green to dark green, 5–7(–9)-veined, with (2–)8–16(–20) faint additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 15–25 mm long, translucent, persistent. Inflorescence axillary. Peduncles 20–45 mm long, 2–3 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 6–15 mm long in fruit, contiguous. Flowers 5–9, with 4 carpels. Fruits 3.2–3.8 mm long, dorsal keel indistinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
E and SE Asia.

Hybrids

37 × 46. *P.* ×*kyushuensis* KADONO et WIEGLEB, J. Jap. Bot. 62(3): 76. 1987.
[= *P. maackianus* × *P. oxyphyllus*]

42 × 46. *P.* ×*fauriei* (A. BENN.) MIKI, Water Phan. Japan 45. 1937. ("Fauriei")
[= *P. compressus* × *P. oxyphyllus*]

46 × 48. *P.* ×*orientalis* HAGSTR., Bot. Not. 1908: 102. 1908, pro sp.
[= *P. oxyphyllus* × *P. pusillus*]
= *P. henryi* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 73. 1932. ("Henryi")

56 × 46. *P.* ×*kamogawaensis* MIKI, Bot. Mag. (Tokyo) 48: 328. 1934.
[= *P. octandrus* × *P. oxyphyllus*]

Note
(1) *P.* ×*orientalis* is a widespread hybrid occurring almost throughout the area of *P. oxyphyllus*. Despite its vital and abundant growth it is completely sterile.

47. *Potamogeton friesii* RUPRECHT, Beitr. Pflanzenk. Russ. Reiches 4: 43. 1845. ("Friesii")

≡ *P. pusillus* subsp. *friesii* (RUPR.) HOOK. f., Stud. Fl. Brit. Isl. ed. 3. 435. 1884. ("Friesii")
≡ *Spirillus friesii* (RUPR.) NIEUWL., Amer. Midl. Naturalist 3: 17. 1913.
– *P. mucronatus* SCHRAD. ex ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 517. 1818, nom. nud.
= *P. compressus* var. β. *acutus* SCHLTDL., Fl. Berol. 1: 117. 1823.
= *P. compressus* [var.] β. *elongatus* WAHLENB., Fl. Suec. 1: 107. 1824. ("elongatum")
≡ *P. pusillus* [var.] ("spielart") a. *latifolius* G. MEY., Chloris Han. 525. 1836, nom. illeg.
= *P. pusillus* [var.] a. *major* FR., Novit. Fl. Suec. ed. 2. 48. 1828, nom. illeg., non MERT. et W.D.J. KOCH 1823.
≡ *P. major* [FR.] MORONG, Mem. Torrey Bot. Club 3(2): 41. 1893. [non vidimus]
– *P. mucronatus* SCHRAD. ex RCHB., Icon. Fl. Germ. Helv. 7: 15. t. 24. 1845, pro syn.
= *P. oederi* G. MEY., Fl. Hanov. Exscurs. 536. 1849. ("Oederi")
= *P. mucronatus* SCHRAD. ex SONDER, Fl. Hamburg. 99. 1850. ("1851")
≡ *P. pusillus* var. *mucronatus* (SCHRAD. ex SONDER) HOOK. f., Stud. Fl. Brit. Isl. 374. 1870.
≡ *P. pusillus* [subsp.] b) *mucronatus* (SCHRAD. ex SONDER) ČELAK., Analyt. Květ. Čech, Mor. a Rak. Slezska ed. 3. 44. 1897.
= *P. compressus* var. *dimidius* CRÉP., Notes Pl. Rar. Belgique 4: 44. 1864.

Description
Rhizome absent or present, filiform, compressed, annual, short. Stem richly branched, filiform, compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, (31–)40–85(–100) mm long, 1.5–3.5(–4.0) mm wide, 15–45 times as long as wide, bright green, sometimes with a reddish tinge, (3–)5(–7)-veined, without additional sclerenchymatous strands, bordered by a faint marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, mucronate at apex. Floating leaves always absent. Stipules axillary, shortly connate only at base and split into two remnants at apex, 7–25 mm long, opaque, whitish, persistent. Peduncles 15–40(–70) mm long, 1–5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 7–14 mm long in fruit, contiguous to shortly distant. Flowers 4–8, with 4 carpels. Fruits 2.4–3.0 mm long, dorsal keel indistinct.

Stem anatomy
Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
Circumpolar, boreal and temperate regions throughout the northern hemisphere.

Hybrids

35 × 47. *P.* ×*lintonii* FRYER, J. Bot. 38: 366. 1900; FRYER, Bot. Exch. Club Brit. Isles Rep. 1899–1900: 21. 1900. ("Lintoni")
[= *P. crispus* × *P. friesii*]

41 × 47. *P.* ×*pseudofriesii* DANDY et G. TAYLOR, Kew Bull. 12: 332. 1957.
[= *P. acutifolius* × *P. friesii*]

48. *Potamogeton pusillus* LINNAEUS, Sp. Pl. 127. 1753.

– *P. pusillus* [subsp.] a) *genuinus* ČELAK., Analyt. Květ. Čech, Mor. a Rak. Slezska ed. 3. 43. 1897, nom. inval.
≡ *Spirillus pusillus* (L.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
= *P. pusillus* [var.] α. *major* MERT. et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 857. 1823.
= *P. pusillus* var. β. *tenuissimus* MERT. et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 857. 1823.
≡ *P. pusillus* [subsp.] β. *tenuissimus* (MERT. et W.D.J. KOCH) SCHÜBL. et G. MARTENS, Fl. Württemb. 112. 1834.
≡ *P. tenuissimus* (MERT. et W.D.J. KOCH) RCHB., Icon. Fl. Germ. Helv. 7: 14, t. 22, fig. 39. 1845.
– *P. pusillus* subsp. *tenuissimus* (MERT. et W.D.J. KOCH) R.R. HAYNES et HELLQ., Novon 6(4): 370. 1996. [isonymum]
= ? *P. denticulatus* LINK in BUCH, Phys. Beschr. Canar. Ins. 138. 1825.
= *P. gracilis* FR., Novit. Fl. Suec. ed. 2. 50. 1828, nom. illeg., non WOLFG. 1827.
≡ *P. noltei* A. BENN., J. Bot. 28: 300. 1890. ("Noltei")
= *P. panormitanus* BIV. in A. BIV. f., Nuove Piante 6. 1838.
≡ *P. pusillus* var. *panormitanus* (BIV.) A. BENN., J. Bot. 19: 242. 1881.
≡ *P. pusillus* subsp. *panormitanus* (BIV.) G. FISCH. in DÖRFLER, Herb. Norm. no. 4767. 1905.
≡ *P. pusillus* proles *panormitanus* (BIV.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 116. 1907.
= *P. panormitanus* var. *minor* BIV. in A. BIV. f., Nuove Piante 6. 1838.
= *P. berchtoldii* FIEBER in BERCHT. et OPIZ, Oekon.Techn. Fl. Böhm. 2(1): 277. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 40. 1838. ("Berchtoldi")
≡ *P. pusillus* subsp. *berchtoldii* (FIEBER) MAGNIN, Bull. Soc. Bot. France 43: 446. 1896. ("Berchtoldi")
≡ *P. pusillus* var. *berchtoldii* (FIEBER) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 345. 1897.
≡ *P. pusillus* proles *berchtoldii* (FIEBER) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 115. 1907. ("Berchtoldii")
= *P. berchtoldii* [var.] α. *mucronatus* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 277. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 40. 1838.
= *P. berchtoldii* [var.] β. *acuminatus* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 278. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 41. 1838.
= *P. grisebachii* HEUFF., Verh. K. K. Zool.-Bot. Ges. Wien 8: 200. 1858. ("Grisebachii")
= ? *P. berteroanus* PHIL., Linnaea 30: 200. 1859–1860. ("Berteroanus")
= *P. subtrichoides* SCHUR, Enum. Pl. Transsilv. 633. 1866.
= *P. pusillus* var. *gemmiparus* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 489. 1867.
– *P. gemmiparus* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 489. 1867, pro syn.
≡ *P. gemmiparus* (J.W. ROBBINS) MORONG, Bot. Gaz. (Crawfordsville) 5: 51. 1880.
≡ *P. pusillus* subsp. *gemmiparus* (J.W. ROBBINS) R.R. HAYNES et HELLQ., Novon 6(4): 370. 1996.
= *P. tenuifolius* F. PHIL., Anal. Mus. Nac. Chile 2(8): corr. pag. 95. 1891, nom. illeg., non RAF. 1811.
≡ *P. aschersonii* A. BENN., J. Bot. 31: 294. 1893. ("Aschersonii")
= *P. trinervius* G. FISCH., Ber. Bayer. Bot. Ges. 11: 29 et 123. 1907, pro hybr. *P. pusillus* (sub *P. panormitanus*) × *P. trichoides*.
= ? *P. uruguayensis* A. BENN. et GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 111. 1907.
= *P. pusillus* subsp. *argentinus* A. BENN., J. Bot. 46: 250. 1908.
= *P. turionifer* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 91. 1916, pro hybr. *P. foliosus* × *P. pusillus*.
= ? *P. pusilliformis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 97. 1916, pro hybr. *P. friesii* (sub *P. mucronatus*) × *P. pusillus*.
= *P. dualis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 103. 1916, pro hybr. *P. panormitanus* × *P. pusillus*.
= *P. badius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 104. 1916.
= ? *P. antaicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 105. 1916.
= *P. exiguus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 106. 1916.
= *P. lacunatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 120, fig. 53. 1916.

= ? *P. loculosus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 120. 1916.
= ? *P. groenlandicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 127. 1916.
≡ ? *P. pusillus* subsp. *groenlandicus* (HAGSTR.) BÖCHER, Meddel. Groenland 147(9): 44. 1952.
= *P. subjavanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 129. 1916.
= *P. pusillus* subsp. *lacustris* PEARSALL et PEARSALL f., J. Bot. 59: 163. 1921.
≡ *P. lacustris* (PEARSALL et PEARSALL f.) DRUCE, List Brit. Pl. ed. 2. 117. 1928.
= ? *P. tubulatus* HAGSTR. in HEDIN, Southern Tibet 6(3): 96. 1922.
= *P. clystocarpus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 79. 1932.
= *P. hoggarensis* DANDY, J. Linn. Soc., Bot. 50: 522. 1937.
= *P. millardii* HESL. HARR., Proc. Univ. Durham Phil. Soc. 10: 365. 1942.
= *P. skvortsovii* KLINKOVA, Byull. Glavn. Bot. Sada 1993(168): 48. 1993.

Description

Rhizome absent or present later in the growing season, filiform, terete, annual to biennial. Stem sparingly to richly branched, filiform, terete to slightly compressed, annual to perennial; axillary or apical dormant turions developing, rarely directly on rhizomes, or sometimes not developing. Submerged leaves sessile, linear, (15–)20–85(–110) mm long, (0.3–)0.8–2.5(–3.1) mm wide, (15–)20–60(–90) times as long as wide, bright green to olive green or dark green, sometimes with a brownish tinge, (1–)3(–5)-veined, without additional sclerenchymatous strands, mostly bordered by a faint marginal vein, with or without narrow or sometimes broad rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate or acute to subobtuse at apex. True floating leaves absent but rarely the uppermost leaves with lamina floating at the water surface, subsessile, linear-oblanceolate, 18–38 mm long, 1.3–3.5 mm wide, 7–20 times as long as wide, translucent, membranous to almost subcoriaceous, bright green, 3–5-veined, with broad rows of lacunae bordering the midrib, narrowly cuneate at base, acute to narrowly obtuse at apex. Stipules axillary, convolute or connate, 4–18(–32) mm long, translucent, persistent to decaying. Peduncles (6–)10–45(–80) mm long, 1–6 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 4–13 mm long in fruit, contiguous to shortly distant. Flowers 2–7, with (3–)4(–7) carpels. Fruits 1.8–2.7(–3.3) mm long, dorsal keel indistinct.

Stem anatomy

Stele of circular type, rarely of oblong type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent or partly 1-layered.

Distribution

Europe, Africa, Asia, North America and South America.

Hybrids

1 × 48. *P.* ×*rivularis* GILLOT in MAGNIER, Scrin. Fl. Select. 6: 118. 1887.
[= *P. polygonifolius* × *P. pusillus*]

3 x 48. *P.* ×*lanceolatus* SM. in SOWERBY, ENGL. Bot. 28: t. 1985. 1809, pro sp. ("lanceolatum")
[= *P. coloratus* × *P. pusillus*]

25 × 48. *P.* ×*variifolius* THORE, Essai Chloris 47. 1803, pro sp. ("variifolius")
[= *P. natans* × *P. pusillus*]

26 × 48. *P.* ×*mysticus* MORONG, Bot. Gaz. (Crawfordsville) 5: 50. 1880, pro sp.
[= *P. perfoliatus* × *P. pusillus*]

38 × 48. *P.* ×*attenuatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 112. 1916.
[= *P. polygonus* × *P. pusillus*]

41 × 48. *P.* ×*sudermanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 73. 1916.
[= *P. acutifolius* × *P. pusillus*]

46 × 48. *P.* ×*orientalis* HAGSTR., Bot. Not. 1908: 102. 1908, pro sp.
[= *P. oxyphyllus* × *P. pusillus*]

48 × 55. *P.* ×*grovesii* DANDY et G. TAYLOR, Watsonia 6: 316. 1967.
[= *P. pusillus* × *P. trichoides*]

56 × 48. *P.* ×*apertus* MIKI, Bot. Mag. (Tokyo) 49: 690. 1935.
[= *P. octandrus* × *P. pusillus*]

Notes

(1) *P. pusillus* is regarded here as a highly polymorphic species with numerous regional forms and ecomorphoses. More detailed classification seems to be impossible because of the highly reticular variation. No correlated set of characters which would make discrimination of taxa possible have been confirmed.
(2) The South American *P. pusillus* has been often treated as a separate species, viz *P. berteroanus*. However, these plants fall well within the variation pattern of *P. pusillus* as defined here.
(3) Many authors regard *P. berchtoldii* and/or *P. gemmiparus* as a separate species of the respective regions where they occur. Their distinction from *P. pusillus* s. str. is, however, insufficient.
(4) Some of the plants called *P. groenlandicus* show certain characters deviant from the present concept of *P. pusillus*. They are characterized especially by the leaves with up to 8 additional sclerenchymatous strands. These plants are known only from a geographically limited area in Western Greenland. Further research, such as experimental cultivation, is necessary in order to clarify their status.
(5) *P. clystocarpus* and *P. hoggarensis* are regarded as extreme local morphotypes of *P. pusillus*. Both are known only from the type locality.
(6) Many hybrids between species within the *P. pusillus*-group have been proposed. Linear-leaved species have a reduced morphological variation and are phenotypically extremely variable and plastic. Distinguishing hybrids on a solely morphological basis is generally avoided. Consequently many proposed names of alleged hybrids cannot be accepted on the basis of our present state of knowledge. Crossing experiments are necessary to solve this problem.

49. *Potamogeton gayi* A. BENNETT, Ann. K. K. Naturhist. Hofmus. Wien 7(4): 293. 1892. ("Gayii")

= *P. burkartii* HORN ex TUR in CABRERA et al., Fl. Prov. Buenos Aires 4(1): 287. 1968.

Description

Rhizome filiform to slender, terete, perennial, long, regularly produced. Stem sparingly to richly branched, filiform, terete to slightly compressed, perennial; axillary dormant turions sometimes developing. Submerged leaves sessile, linear, 55–100 mm long, (2–)3–6 mm wide, 18–25 times as long as wide, bright green to dark green, often with a reddish or brownish tinge, 3–5-veined, without additional sclerenchymatous strands, bordered by a strong marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute at apex. Floating leaves always absent. Stipules axillary, convolute, 14–20 mm long, translucent, persistent to decaying. Peduncles 15–60 mm long, 1.5–4.5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 10–17 mm long in fruit, contiguous. Flowers 5–12, with 4 carpels. Fruits 4.3–4.6 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O type, interlacunar bundles absent or rarely present, subepidermal bundles present, multicellular, pseudohypodermis 1(–2)-layered.

Distribution

South America.

Note

(1) *P. gayi* is closely related to *P. pusillus*. However, it deviates from the variation pattern of the latter species and it is confined to a restricted geographical area.

50. *Potamogeton rutilus* WOLFGANG in SCHULTES et SCHULTES f., Mant. 3: 362. 1827.

≡ *P. pusillus* var. *rutilus* (WOLFG.) WIEDEM. et E. WEBER, Beschr. Phan. Gew. Esth-, Liv-Curl. 94. 1852. – *P. cespitosus* NOLTE ex RCHB., Icon. Fl. Germ. Helv. 7: 15, t. 23, fig. 41. 1845, pro syn. ("cespitosum")

Description

Rhizome absent or filiform, slightly compressed, annual. Stem unbranched or sparingly branched, filiform, slightly compressed, annual; axillary dormant turions developing. Submerged leaves sessile, linear, 32–75 mm long, 0.5–1.1 mm wide, 35–80 times as long as wide, bright green, sometimes with a brownish tinge, somewhat rigid, 3-veined, without additional sclerenchymatous strands, bordered by a strong marginal vein, without rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent. Stipules axillary, shortly connate, 15–20 mm long, opaque, fibrous, whitish, persistent. Peduncles (3–)10–17 mm long, 1–3 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 4–10 mm long in fruit, contiguous. Flowers 5–6, with (2–)4 carpels. Fruits 2.0–2.1 mm long, dorsal keel indistinct.

Stem anatomy
Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
W, N and C Europe, W Asia.

Note
(1) *P. rutilus* is related to *P. pusillus*. It comprises plants with a special set of characters of a restricted geographical area.

51. *Potamogeton strictifolius* A. BENNETT, J. Bot. 40: 148. 1902.

≡ *P. pusillus* var. *pseudorutilus* A. BENN., J. Bot. 39: 201. 1901. ("pseudo-rutilus")
– *P. strictifolius* var. *typicus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 56. 1932, nom. inval.
= *P. strictifolius* var. *rutiloides* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 57. 1932.
≡ *P. pusillus* var. *rutiloides* (FERNALD) B. BOIVIN, Naturaliste Canad. 94: 527. 1967.
= *P. longiligulatus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 66. 1932.

Description
Rhizome filiform, terete, annual, short. Stem unbranched or branched, filiform, slightly compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 12–63 mm long, 0.6–2.0 mm wide, 20–40 times as long as wide, bright green, sometimes with a brownish tinge, somewhat rigid, 3–5(–7)-veined, without additional sclerenchymatous strands, bordered by a strong marginal vein, without rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acute to acuminate at apex. Floating leaves always absent. Stipules axillary, connate, 6–16 mm long, opaque, fibrous, whitish, persistent. Peduncles 10–45 mm long, 1.5–3.5 times as long as the fruiting spike, as thick as the stem, slightly thickened upwards. Spikes cylindrical, 6–13 mm long in fruit, contiguous. Flowers 5–7, with 4 carpels. Fruits 1.9–2.1 mm long, dorsal keel indistinct.

Stem anatomy
Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
NW, C and E North America.

Hybrids

51 × 43. *P. ×haynesii* HELLQ. et G. E. CROW, Brittonia 38(4): 415. 1986.
[= *P. strictifolius* × *P. zosteriformis*]

Note
(1) *P. strictifolius* is closely related to *P. rutilus*. It is distinguished mainly on quantitative characters.

52. *Potamogeton foliosus* RAFINESQUE, Med. Repos., Hexade 3, 2: 409. 1811. ("foliorum")

– *P. foliosus* RAF., Med. Repos., Hexade 2, 5: 354. 1808, nom. prov. ("foliosum")
≡ *P. pauciflorus* PURSH, Fl. Amer. Sept. 1: 121. 1814, nom. illeg. ("pauciflorum")
≡ *Spirillus foliosus* (RAF.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
– *P. foliosus* var. *genuinus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 43. 1932, nom. inval.
= *P. niagarensis* TUCK., Amer. J. Sci. Arts, ser. 2, 7: 354. 1849.
≡ *P. pauciflorus* var. *niagarensis* (TUCK.) J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 2. 435. 1856.
≡ *P. foliosus* var. *niagarensis* (TUCK.) MORONG, Mem. Torrey Bot. Club 3(2): 39. 1893.
≡ *Spirillus foliosus* var. *niagarensis* (TUCK.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
= *P. pauciflorus* var. *californicus* MORONG, Bot. Gaz. (Crawfordsville) 10: 254. 1885.
≡ *P. foliosus* var. *californicus* (MORONG) MORONG, Mem. Torrey Bot. Club 3(2): 40. 1893.
≡ *P. californicus* (MORONG) PIPER, Contr. Unit. St. Nat. Herb. 11: 98. 1906.
= *P. curtisii* MORONG, Bull. Torrey Bot. Club 13: 145. 1886. ("Curtsii")
= *P. foliosus* var. *macellus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 46. 1932.
= *P. fibrillosus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 51. 1932.

≡ *P. foliosus* var. *fibrillosus* (FERNALD) R.R. HAYNES et REVEAL, Rhodora 75: 76. 1973.
≡ *P. foliosus* subsp. *fibrillosus* (FERNALD) R.R. HAYNES et HELLQ., Novon 6(4): 370. 1996.

Description

Rhizome filiform, slightly compressed, perennial. Stem branched, filiform, slightly compressed, annual; axillary or apical dormant turions developing. Submerged leaves sessile, linear, 13–82 mm long, 0.3–2.3 mm wide, 30–60 times as long as wide, bright green to olive green, sometimes with a reddish tinge, (1–)3(–5)-veined, without additional sclerenchymatous strands, bordered by a faint marginal vein, with or without narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, narrowly obtuse or acute to acuminate at apex. Floating leaves always absent. Stipules axillary, convolute or connate, 2–22 mm long, translucent to opaque, persistent to decaying. Peduncles 3–11(–37) mm long, 2–7 times as long as the fruiting spike, as thick as the stem, slightly thickened upwards. Spikes globose to cylindrical, 2–7 mm long in fruit, contiguous. Flowers 2–4, with 4 carpels. Fruits 1.4–2.7 mm long, dorsal keel distinct, undulate, dentate, to 0.4 mm high.

Stem anatomy

Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution

North and Central America.

Note

(1) *P. foliosus* is related to *P. pusillus*. It is distinguished mainly on the basis of inflorescence, flower and fruit characters.

53. *Potamogeton hillii* MORONG, Bot. Gaz. (Crawfordsville) 6: 290. 1881. ("Hillii")

= *P. porteri* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 73. 1932. ("Porteri")

Description

Rhizome absent or present, filiform, slightly compressed, perennial. Stem branched, filiform, slightly compressed, annual; apical dormant turions developing. Submerged leaves sessile, linear, 20–60 mm long, 0.6–2.5(–4.0) mm wide, 20–40 times as long as wide, bright green to olive green, 3-veined, without additional sclerenchymatous strands, bordered by a faint marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 7–16 mm long, translucent, persistent. Peduncles 6–14 mm long, 1.5–3.0 times as long as the fruiting spike, as thick as the stem. Spikes globose, 2–7 mm long in fruit, contiguous. Flowers 2–4, with 4 carpels. Fruits 2.3–4.0 mm long, dorsal keel distinct, dentate, to 0.2 mm high.

Stem anatomy

Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution

E North America.

Hybrids

53 x 43. *P.* ×*ogdenii* HELLQ. et R. L. HILTON, Syst. Bot. 8(1): 88. 1983, pro sp.

[= *P. hillii* × *P. zosteriformis*]

Note

(1) *P. hillii* is closely related to *P. pusillus*. Similar to *P. foliosus*, it is recognizable by some constant characters in a restricted area.

54. *Potamogeton obtusifolius* MERTENS et W.D.J. KOCH, Röhlings Deutschl. Fl. ed. 3. 1: 855. 1823.

≡ *Spirillus obtusifolius* (MERT. et W.D.J. KOCH) NIEUWL., Amer. Midl. Naturalist 3: 19. 1913.
= *P. compressus* var. β. *tenuis* WAHLENB., Fl. Upsal. 60. 1820.
= *P. compressus* var. α. *obtusus* SCHLTDL., Fl. Berol. 1: 117. 1823.
= *P. tataricus* LESSING, Linnaea 9: 206. 1834.

= *P. obtusifolius* [var.] α. *angustifolius* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 275. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 38. 1838.
= *P. obtusifolius* [var.] β. *latifolius* FIEBER in BERCHT. et OPIZ, Oekon.-Techn. Fl. Böhm. 2(1): 275. 1838; FIEBER in BERCHT. et FIEBER, Potam. Böhmens 38. 1838.
= *P. foliosus* var. *diffusus* A. BENN., Bot. Soc. Exch. Club Brit. Isles 6: 860. 1923.

Description

Rhizome absent or present, filiform, slightly compressed, annual, often short and not much differentiated from the stem. Stem richly branched, filiform, slightly compressed, annual; apical or axillary dormant turions developing. Submerged leaves sessile, linear, (30–)48–85(–100) mm long, (1.8–)2.5–3.5 mm wide, 15–30(–38) times as long as wide, bright green to dark green, often with a reddish tinge, 3(–5)-veined, without additional sclerenchymatous strands, not bordered by a marginal vein, with narrow to broad rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, obtuse to rounded at apex, often very shortly and rather obscurely mucronate. Floating leaves always absent. Stipules axillary, convolute, (6–)10–30 mm long, translucent to opaque, persistent. Peduncles (5–)8–20(–42) mm long, 1–4 times as long as the fruiting spike, as thick as the stem. Spikes shortly cylindrical, 7–13 mm long in fruit, contiguous. Flowers 6–8, with (3–)4(–5) carpels. Fruits 2.6–3.6 mm long, dorsal keel indistinct to distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type, interlacunar bundles absent or a few present, subepidermal bundles present, pseudohypodermis present, 1-layered.

Distribution

Circumpolar, Europe, W and N Asia, N North America.

Note

(1) *P. obtusifolius* is the most distinct species of the *P. pusillus*-group, being easy to identify in most of its phenotypes.

55. *Potamogeton trichoides* CHAMISSO et SCHLECHTENDAL, Linnaea 2(2): 175, t. 4, fig. 6. 1827.

≡ *P. pusillus var.* δ. *trichoides* (CHAM. et SCHLTDL.) KUNTH, Enum. Pl. 3: 137. 1841.
= *P. pusillus* var. β. *capillaris* GAUDIN, Fl. Helv. 1: 479. 1828.
= *P. condylocarpus* TAUSCH, Flora 19(2): 423. 1836.
≡ *P. trichoides* var. *condylocarpus* (TAUSCH) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 347. 1897.
= *P. monogynus* J. GAY in COSS. et GERM., Suppl. Cat. Pl. Env. Paris 89. 1843.
≡ *P. trichoides* var. γ. *monogynus* (J. GAY) MAGNIN, Bull. Soc. Bot. France 43: 447. 1896.
= *P. tuberculatus* TEN. et GUSS., Syll. Pl. Fl. Neapol., Append. 5: 4. 1842.
≡ *P. trichoides* var. *tuberculatus* (TEN. et GUSS.) ASCH., Fl. Brandenb. 1: 665. 1864, nom. illeg., non RCHB. 1845.
= *P. trichoides* var. β. *tuberculosus* RCHB., Icon. Fl. Germ. Helv. 7: 13, t. 22, fig. 35. 1845.
= *P. trichoides* var. *liocarpus* ASCH., Fl. Brandenb. 1: 665. 1864.
= *P. trichoides* var. *trimmeri* CASP., J. Linn. Soc., Bot. 8: 273. 1865. ("Trimmeri")
= *P. baenitzii* GAND., Oesterr. Bot. Z. 31: 19. 1881. ("Baenitzii")
= *P. danicus* GAND., Oesterr. Bot. Z. 31: 18. 1881.
= *P. orthorrhynchus* GAND., Oesterr. Bot. Z. 31: 18. 1881.
= *P. perneglectus* GAND., Oesterr. Bot. Z. 31: 18. 1881.
= *P. phialae* POST, Bull. Herb. Boissier 1(8): 409. 1893. ("Phialae")
≡ *P. trichoides* var. γ. *phialae* (POST) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 120. 1907. ("Phialae")

Description

Rhizome absent or present at the end of the growing season, filiform, terete. Stem sparingly to richly branched, filiform, terete to slightly compressed, annual to perennial; apical or axillary dormant turions developing. Submerged leaves sessile, linear, 14–80(–130) mm long, 0.3–1.0(–1.8) mm wide, (30–)40–80(–110) times as long as wide, bright green to dark green, often with a brownish tinge, 3-veined, lateral veins inconspicuous, without additional sclerenchymatous strands, not bordered by a marginal vein, without rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 5–27 mm long, translucent, often with a greenish tinge, persistent. Peduncles 10–75 mm long, (2–)3–9 times as long as the fruiting spike, as thick as the stem. Spikes shortly cylindrical,

3–9 mm long in fruit, contiguous to shortly distant. Flowers 3–5, with 1(–2) carpels. Fruits 2.5–3.2 mm long, dorsal keel distinct.

Stem anatomy
Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution
W, C, S and E Europe, N, E and S Africa, W, SW, N and C Asia.

Hybrids

35 × 55. *P.* ×*bennettii* FRYER, J. Bot. 33: 1, t. 348. 1895. ("Bennettii")
[= *P. crispus* × *P. trichoides*]

48 × 55. *P.* ×*grovesii* DANDY et G. TAYLOR, Watsonia 6: 316. 1967.
[= *P. pusillus* × *P. trichoides*]

Note
(1) *P. trichoides* is closely related to *P. pusillus*. It is sometimes difficult to distinguish from morphotypes of *P. pusillus* with extremely narrow leaves in the vegetative state. The species possesses a set of unique characters in flowers and fruit, which always make identification possible.

56. *Potamogeton octandrus* POIRET in LAMARCK, Encycl. Méth. Bot., Suppl. 4: 534. 1816. ("octandrum")

≡ *Hydrogeton heterophyllus* LOUR., Fl. Cochinch. 1: 244. 1790. ("heterophyllum") [non *Potamogeton heterophyllus* SCHREB. 1771]
= *P. javanicus* HASSKARL, Acta Soc. Regiae Sci. Indo-Neerl. 1(8): 26. 1856.
= *P. tenuicaulis* F. MUELL., Fragm. Phyt. Austral. 1: 90 et 244. 1858.
= *P. parvifolius* BUCHENAU, Abh. Naturwiss. Vereine Bremen 7: 32. 1882. ("parvifolia")
= *P. miduhikimo* MAKINO, Illustr. Fl. Japan 1(9): 2, tab. 54. 1891.
≡ *P. octandrus* var. *miduhikimo* (MAKINO) HARA, J. Jap. Bot. 20: 331. 1944.
– *P. huillensis* WELW. ex SCHINZ, Ber. Schweiz. Bot. Ges. 1: 61. 1891, pro syn. ("Huillensis")
= *P. limosellifolius* MAXIM. ex KORSH., Trudy Imp. S.-Peterburgsk. Bot. Sada [= Acta Horti Petrop.] 12(2): 393. 1893.
≡ *P. octandrus* var. *limosellifolius* (MAXIM. et KORSH.) TZVELEV in KHARKEV., Sosud. Rast. Sovet. Dal'nego Vostoka 2: 323. 1987.
= *P. asiaticus* A. BENN., Annuaire Conserv. Jard. Bot. Genève 9: 103. 1905.
≡ *P. octandrus* var. *asiaticus* (A. BENN.) TZVELEV in KHARKEV., Sosud. Rast. Sovet. Dal'nego Vostoka 2: 323. 1987.
= *P. numasakianus* A. BENN., Annuaire Conserv. Jard. Bot. Genève 9: 104. 1905.
= *P. javanicus* var. b. *major* A. BENN. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 161. 1907.
= *P. quinquenervius* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 130. 1916.
= *P. ligulatus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 131. 1916.
= *P. subfuscus* A. BENN., J. Bot. 65: 114. 1927.
= *P. hubeiensis* W.X. WANG, X.Z. SUN et H.Q. WANG, Acta Phytotax. Sin. 26(2): 160. 1988.
= *P. octandrus* subsp. *ethiopicus* LYE, Lidia 3(3): 79. 1993.

Description
Rhizome absent or present, filiform, terete, annual or perennial. Stem sparingly to richly branched, filiform, terete, annual; axillary dormant turions developing. Submerged leaves sessile, linear, 25–55(–79) mm long, 0.5–1.2(–1.9) mm wide, 30–75 times as long as wide, bright green to brown-green, 3-veined, lateral veins inconspicuous, with very broad rows of lacunae bordering the midrib, entire at margins, straight at base, acute to acuminate at apex. Intermediate leaves often present, petiolate, oblong to lanceolate. Floating leaves present or absent, petiolate; lamina linear-oblong to elliptical, sometimes with parallel margins, (5–)9–29(–38) mm long, 3–11 mm wide, 1.3–5.8(–8.5) times as long as wide, opaque, coriaceous to subcoriaceous, bright green to dark green, sometimes with a brownish tinge, 5–7-veined, cuneate at base, acute at apex; petiole 3–25(–34) mm long, 0.2–1.1 times as long as the lamina. Stipules axillary, convolute, 4–13 mm long, translucent, decaying early. Inflorescence terminal or lateral, in the axils of floating and submerged leaves. Peduncles 9–21 mm long,

0.7–2.4 times as long as the fruiting spike, as thick as or slightly thicker than the stem. Spikes cylindrical, 5–16 mm long in fruit, contiguous to shortly distant. Flowers 7–9, with 4(–5) carpels. Fruits 1.5–2.4 mm long, dorsal keel indistinct to distinct, beak short.

Stem anatomy

Stele of oblong or circular type, endodermis of O-type, interlacunar bundles absent, rarely a few present, subepidermal bundles present, pseudohypodermis absent or present, 1-layered.

Distribution

C and S Africa, S and E Asia, Australia.

Hybrids

25 × 56. *P.* ×*yamagataensis* KADONO et WIEGLEB, J. Jap. Bot. 62(3): 73. 1987.
[= *P. natans* × *P. octandrus*]

56 × 46. *P.* ×*kamogawaensis* MIKI, Bot. Mag. (Tokyo) 48: 328. 1934.
[= *P. octandrus* × *P. oxyphyllus*]

56 × 48. *P.* ×*apertus* MIKI, Bot. Mag. (Tokyo) 49: 690. 1935.
[= *P. octandrus* × *P. pusillus*]

Note

(1) *P. octandrus* is a highly polymorphic species with reticulate variation.

57. *Potamogeton cristatus* REGEL et MAACK in REGEL, Mém. Acad. Imp. Sci. Saint Pétersbourg, sér. 7, Sci. Phys.-Math., 4(4): 139, tab. 10, fig. 3–6. 1861.

= *P. iriomotensis* MASAMUNE, Trans. Nat. Hist. Soc. Taiwan 24: 281. 1934.

Description

Rhizome absent or filiform, filiform, terete, annual or perennial, short, with vegetative and generative stems. Stem unbranched or sparingly branched, filiform, terete, annual; axillary dormant turions developing. Submerged leaves sessile, linear, 30–60 mm long, 0.5–1.0 mm wide, 40–80 times as long as wide, bright green to dark green, 3-veined, lateral veins inconspicuous, with broad rows of lacunae along the midrib, entire at margins, straight at base, acute to acuminate at apex. Intermediate leaves often present, petiolate, lanceolate. Floating leaves present or absent, petiolate; lamina broadly lanceolate to oblong or elliptical, 15–27 mm long, 3–11 mm wide, 2.1–5.0 times as long as wide, opaque, subcoriaceous, bright green to dark green, 7-veined, cuneate at base, acute to obtuse at apex; petiole 6–14 mm, 0.2–0.7 times as long as the lamina. Stipules axillary, convolute, 6–10 mm long, translucent, decaying early. Inflorescences mostly lateral, some sometimes terminal, in the axils of floating leaves. Peduncles 10–20 mm long, 0.8–2.0 times as long as the fruiting spike, as thick as the stem, slightly thickened upwards. Spikes 10–15 mm long in fruit, contiguous. Flowers 9–11, with (3–)4 carpels. Fruits 1.5–2.5 mm long, dorsal keel distinct, strongly crested with hooked appendages, beak long and slender.

Stem anatomy

Stele of circular type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles absent, pseudohypodermis absent.

Distribution

East Asia (Japan, Korea, China?, Taiwan).

Note

(1) *P. cristatus* is closely related to *P. octandrus*. It is regarded as a distinct species because it shows a number of distinct features in a well defined area.

58. *Potamogeton vaseyi* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 5. 485. 1867. ("Vaseyi")

= *P. lateralis* MORONG, Bot. Gaz. (Crawfordsville) 5: 51. 1880, p. p.
= *P. vaseyi* var. *latifolius* MORONG, Mem. Torrey Bot. Club 3(2): 44. 1893.

Description

Rhizome absent or present, filiform, terete, annual or perennial. Stem sparingly to richly branched, filiform, terete, annual; apical or axillary dormant turions developing, in particular on non-flowering shoots. Submerged

leaves sessile, linear, 25–80 mm long, 0.1–0.5 mm wide, 150–250 times as long as wide, bright green to brown-green, 3-veined, lateral veins inconspicuous, with narrow rows of lacunae bordering the midrib, entire at margins, straight at base, acuminate at apex. Intermediate leaves often present. Floating leaves present or absent, petiolate; lamina linear-oblong to elliptical or obovate, 6–15 mm long, 3–8 mm wide, 1.6–2.3 times as long as wide, opaque, coriaceous to subcoriaceous, bright green to dark green, sometimes with a brownish tinge, 5–9-veined, cuneate at base, obtuse at apex; petiole 3–25 mm long, 0.7–2.0 times as long as the lamina. Inflorescence terminal or lateral, in the axils of floating leaves. Stipules axillary, convolute, 4–12 mm long, translucent, decaying early. Peduncles 8–16 mm long, 1.0–2.3 times as long as the fruiting spike, as thick as or thicker than the stem. Spikes cylindrical, 6–8 mm long in fruit, contiguous to shortly distant. Flowers 6, with 4 carpels. Fruits 1.6–2.2 mm long, dorsal keel distinct, beak short.

Stem anatomy

Stele of one bundle type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, pseudohypodermis absent.

Distribution

E North America.

Note

(1) *P. vaseyi* is very similar to *P. octandrus*. There is, however, a large distributional gap between the two taxa.

59. *Potamogeton confervoides* REICHENBACH, Icon. Fl. Germ. Helv. 7: 13. 1845.

= *P. tuckermanii* J.W. ROBBINS in A. GRAY, Manual Bot. North. U. S. ed. 2. 434. 1856. ("Tuckermani")
– *P. monticolus* SCHWEIN. ex A. BENN., Ann. K. K. Naturhist. Hofmus. Wien 7: 292. 1892, pro syn. ("monticola")

Description

Rhizome filiform to slender, terete, perennial, long creeping, with apical fusiform turions. Stem sparingly to richly branched, filiform, terete, annual; apical or axillary dormant turions developing. Submerged leaves sessile, filiform, (12–)18–65 mm long, 0.1–0.5 mm wide, 50–150 times as long as wide, bright green to dark green, sometimes with a reddish tinge, 1-veined, without additional sclerenchymatous strands, bordered by a faint marginal vein, with narrow rows of lacunae bordering the midrib, entire at margins, narrowly cuneate at base, long acuminate at apex. Floating leaves always absent. Stipules axillary, convolute, 5–12 mm long, translucent, decaying early. Inflorescence 1, rarely 2, terminal on primary stem, or rarely on lower renewal shoots. Peduncles 15–240 mm long, 3–25 times as long as the fruiting spike, as thick as the stem. Spikes subglobose to cylindrical, 3–12 mm long in fruit, contiguous. Flowers 3–5, with 4 carpels. Fruits 2.2–3.0 mm long, dorsal keel distinct.

Stem anatomy

Stele of oblong type, endodermis of O-type with strong cell walls, interlacunar bundles absent, subepidermal bundles rarely a few present, pseudohypodermis present, 1–2-layered.

Distribution

E North America.

Note

(1) *P. confervoides* is an isolated species within the subgenus *Potamogeton*.

60. *Potamogeton spirillus* TUCKERMAN, Amer. J. Sci. Arts, Ser. 2, 6: 228. 1848.

= *Zannichellia palustris* var. *gyrocarpa* TRIMEN, J. Bot. 12: 370. 1874.
– *Spirillus tuckermannii* J. GAY ex A. BENN., J. Bot. 28: 298. 1890, pro syn. ("Tuckermanni")
– *Zannichellia cochlosperma* A. BRAUN ex A. BENN., J. Bot. 28: 298. 1890, pro syn. ("Cochlospermum")

Description

Rhizome slender, compressed, perennial, with overwintering leafy short shoots. Stem sparingly to richly branched, filiform to slender, compressed, annual; specialized dormant turions not developing. Submerged leaves sessile, linear, 8–80 mm long, 0.5–2.0 mm wide, 15–80 times as long as wide, bright green, 1–3-veined, without additional sclerenchymatous strands, not bordered by a marginal vein, usually with narrow rows of lacunae bordering the midrib, entire at margins, straight at base, obtuse to acute at apex. Stipules of the submerged leaves adnate, convolute, 2–12 mm long, fused with the leaves for 1.5–6.0 mm, translucent, persistent. Intermediate leaves often present. Floating leaves shortly petiolate; lamina oblong to elliptic or

ovate-elliptic, 7–35 mm long, 2–13 mm wide, 2–4 times as long as wide, opaque, subcoriaceous, bright green to dark green, 5–13-veined, cuneate to rounded at base, obtuse at apex; petiole 5–25 mm long, 0.7–1.1 times as long as the lamina. Stipules of the floating leaves axillary, convolute, 3–15 mm long, translucent, persistent. Inflorescences dimorphic to trimorphic. Peduncle of inflorescences in the axils of the submerged leaves 1–3 mm long, 0.5–1.0 times as long as the fruiting spike, as thick as the stem; spike globose to subglobose, 2–5 mm long in fruit, contiguous. Spike of inflorescences in the axils of the intermediate leaves and lower floating leaves subglobose, 4–7 mm long in fruit, contiguous. Peduncle of inflorescences in the axils of floating leaves 4–27 mm long, 0.8–2.3 times as long as the fruiting spike, as thick as the stem; spike subglobose to cylindrical, 5–14 mm long in fruit, contiguous. Flowers 1–6 in submerged spikes, 2–8 in emersed spikes, with 4 carpels. Fruits 1.3–2.4 mm long, dorsal keel distinct, sharp, entire, lateral keels absent, embryo coiled more than 1 turn.

Stem anatomy

Stele of trio type, endodermis of O-type, interlacunar bundles absent, subepidermal bundles present, faint, pseudohypodermis absent.

Distribution

C and E North America.

Note

(1) *P. spirillus* is closely related to *P. diversifolius*.

61. *Potamogeton diversifolius* Rafinesque, Med. Repos., Hexade 3, 2: 409. 1811. ("diversifolium")

– *P. diversifolius* RAF., Med. Repos., Hexade 2, 5: 354. 1808, nom. prov. ("diversifolium")
– *P. diversifolius* var. *capitatus* ENGELM., Amer. J. Sci. Arts 46: 102. 1844, nom. inval.
≡ *Spirillus diversifolius* (RAF.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
= *P. capillaceus* POIR. in LAM., Encycl. Méth. Bot., Suppl. 4: 535. 1816. ("capillaceum")
= *P. dimorphus* RAF., Amer. Month. Mag. Crit. Rev. 1: 358. 1817. ("dimorphum")
= *P. diversifolius* var. *spicatus* ENGELM., Amer. J. Sci. Arts, 46: 102. 1844.
= *P. diversifolius* var. *multidenticulatus* MORONG, Mem. Torrey Bot. Club 3(2): 48. 1893. ("multidenticulatus")
≡ *P. hybridus* var. β. *multidenticulatus* (MORONG) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 51. 1907. ("multidenticulatus")
– *P. tricostatus* WALLR. ex GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 51. 1907, pro syn.
= ? *P. spirilliformis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 137. 1916.
= *P. conjungens* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 138. 1916.
= *P. dimorphoides* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 263. 1916, pro hybr. *P. diversifolius* (sub *P. dimorphus*) × *P. pusillus*.
= *P. capillaceus* var. *atripes* FERNALD, Rhodora 39: 380. 1937.
= ? *P. reniacoënsis* SPARRE, Bol. Soc. Argent. Bot. 6(2): 107. 1956.

Description

Rhizome filiform to slender, compressed, perennial. Stem richly branched, filiform to slender, compressed to subterete, annual; axillary dormant turions developing. Submerged leaves sessile, linear, (10–)20–65(–110) mm long, (0.2–)0.4–1.0(–1.5) mm wide, 20–180(–280) times as long as wide, bright green to dark green, 1(–3)-veined, without additional sclerenchymatous strands, not bordered by a marginal vein, with or without narrow rows of lacunae bordering the midrib, entire at margins, straight at base, narrowly obtuse to acuminate at apex. Stipules of the submerged leaves adnate, convolute, 2–6(–18) mm long, fused with the leaves for 0.3–4.0(–7.0) mm, translucent, persistent. Intermediate leaves often present. Floating leaves shortly petiolate; lamina oblong to elliptic or orbicular-elliptic, (7–)13–40 mm long, (2–)4–17(–20) mm wide, 2–4 times as long as wide, opaque, subcoriaceous, bright green to dark green, (3–)5–15(–17)-veined, cuneate to rounded at base, acute to rounded at apex; petiole 2–40 mm long, 0.6–1.2 times as long as the lamina. Stipules of the floating leaves axillary to slightly adnate, convolute, (2–)7–25 mm long, translucent, persistent. Inflorescences dimorphic. Peduncle of inflorescences in the axils of the submerged leaves 1–8 mm long, 0.5–1.5 times as long as the fruiting spike, as thick as the stem; spike globose to subglobose, 2–6 mm long in fruit, contiguous. Peduncle of inflorescences in the axils of floating leaves 3–32 mm long, 0.8–1.4 times as long as the fruiting spike, as thick as the stem; spike subglobose to cylindrical, 3–28 mm long in fruit, contiguous. Flowers 1–8

in submerged spikes, 4–30 in emersed spikes, with 4 carpels. Fruits 0.9–2.0(–2.2) mm long, dorsal keel distinct, sharp, dentate, lateral keels usually present, entire to dentate, embryo coiled more than 1 turn.

Stem anatomy

Stele of trio type, endodermis of O-type, interlacunar bundles absent or rarely present, subepidermal bundles absent or a few present, pseudohypodermis absent or partly present, 1-layered.

Distribution

North America, SE South America.

Note

(1) Despite their remote occurrence South American plants (like e.g. *P. spirilliformis*) are regarded as conspecific with North American ones. However, their variation is insufficiently known.

62. *Potamogeton bicupulatus* FERNALD, Mem. Amer. Acad. Arts Sci. 17: 112. 1932.

= *P. diversifolius* var. *trichophyllus* MORONG, Mem. Torrey Bot. Club 3(2): 49. 1893.
≡ *P. hybridus* var. γ. *trichophyllus* (MORONG) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 51. 1907.

Description

Rhizome filiform, compressed, perennial. Stem sparingly to richly branched, filiform, terete, annual; specialized dormant turions not developing. Submerged leaves sessile, setaceous, 30–110 mm long, 0.08–0.40(–0.50) mm wide, (140–)190–500(–600) times as long as wide, bright green to dark green, 1-veined, without additional sclerenchymatous strands, not bordered by a marginal vein, without rows of lacunae bordering the midrib, entire at margins, straight at base, acuminate at apex. Stipules of the submerged leaves adnate, convolute, 2–12 mm long, fused with the leaves for 0.3–3.5 mm, translucent, persistent. Intermediate leaves often present. Floating leaves shortly petiolate; lamina oblong to broadly elliptic, 6–23(–28) mm long, 2–11 mm wide, 2–5 times as long as wide, opaque, subcoriaceous, bright green to dark green, 5–15-veined, cuneate to rounded at base, acute at apex; petiole 5–35 mm long, 0.8–1.4 times as long as the lamina. Stipules of the floating leaves axillary, convolute, 3–11 mm long, translucent, persistent. Inflorescences dimorphic. Peduncle of inflorescences in the axils of the submerged leaves 1–10 mm long, 0.5–1.5 times as long as the fruiting spike, as thick as the stem; spike globose to subglobose, 2–7 mm long in fruit, contiguous. Peduncle of inflorescences in the axils of floating leaves 3–22 mm long, 1.0–1.9 times as long as the fruiting spike, as thick as the stem; spike subglobose to cylindrical, 3–14 mm long in fruit, contiguous. Flowers 1–8 in submerged spikes, 2–10 in emersed spikes, with 4 carpels. Fruits (1.1–)1.6–2.0 mm long, dorsal keel distinct, sharp, entire to dentate, lateral keels usually present, entire to dentate, embryo coiled more than 1 turn.

Stem anatomy

Not seen.

Distribution

C and E North America.

Note

(1) *P. bicupulatus* is closely related to *P. diversifolius* and may be regarded as an extreme morphotype of that species under a wider species concept.

63. *Potamogeton vaginatus* TURCZANINOW, Bull. Soc. Imp. Naturalistes Moscou 27(3): 66. 1854.

– *P. vaginatus* TURCZ., Bull. Soc. Imp. Naturalistes Moscou 11(1): 102. 1838, nom. nud.
≡ *P. pectinatus* subsp. *vaginatus* (TURCZ.) MAGNIN, Bull. Soc. Bot. France 43: 447. 1896.
≡ *P. pectinatus* var. *vaginatus* (TURCZ.) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 351. 1897.
≡ *Stuckenia vaginata* (TURCZ.) HOLUB, Folia Geobot. Phytotax. 19(2): 215. 1984.
≡ *Coleogeton vaginatus* (TURCZ.) LES et R.R. HAYNES, Novon 6(4): 390. 1996.
= *P. moniliformis* H. ST. JOHN, Rhodora 18: 130. 1916.
= *P. vaginatus* var. *canadensis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 36. 1916.
– *P. canadensis* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 36. 1916, nom. prov.

Description

Rhizome slender to robust, terete, perennial, with apical tubers. Stem richly branched, with several renewal shoots springing from one node, slender, terete, annual to perennial, wintergreen; specialized dormant turions not developing. Submerged leaves sessile, filiform to linear, 20–120(–150) mm long, 1–2 mm wide, 20–130

times as long as wide, olive green to dark green, often with a greyish tinge, 1–3-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, obtuse to sometimes slightly subretuse at apex. Floating leaves always absent. Stipules adnate, connate, 20–50(–70) mm long, 2–10 mm wide, fused with the leaves for 17–45(–65) mm, persistent. Peduncles 30–150(–200) mm long, 1.5–4.5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 25–70 mm long in fruit, contiguous to distant. Flowers 14–16(–20), with 4 carpels. Fruits 3.0–3.8 mm long, dorsal keel indistinct.

Stem anatomy

Stele of trio or four bundles type, endodermis of U-type, interlacunar bundles present in (3–)4 circles, subepidermal bundles absent, rarely a few present, pseudohypodermis present, 1–2-layered.

Distribution

Circumboreal; N Europe, N Asia, N North America.

Hybrids

66 × 63. *P.* ×*fennicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 24. 1916.

[= *P. filiformis* × *P. vaginatus*]

≡ *Stuckenia* ×*fennica* (HAGSTR.) HOLUB, Preslia 69: 364. 1997.

68 × 63. *P.* ×*bottnicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 52. 1916.

[= *P. pectinatus* × *P. vaginatus*]

≡ *Stuckenia* ×*bottnica* (HAGSTR.) HOLUB, Preslia 69: 364. 1997.

Note

(1) *P. vaginatus* is a well defined species which, until recently, has been sometimes confused with its own hybrids and wintergreen forms of *P. pectinatus*.

64. *Potamogeton subretusus* HAGSTRÖM, Kungl. Svenska Vetenskapsakad. Handl. 55(5): 30. 1916.

≡ *Stuckenia subretusa* (HAGSTR.) HOLUB, Preslia 69: 364. 1997.

Description

Rhizome slender, terete, perennial, with apical tubers. Stem sparingly to richly branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, filiform to linear, 20–100 mm long, 0.6–1.3(–1.5) mm wide, 25–90 times as long as wide, olive green to dark green, often with a greyish tinge, 3–5-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, obtuse to distinctly subretuse at apex. Floating leaves always absent. Stipules adnate, connate, 20–30(–40) mm long, 1.5–4.0 mm wide, fused with the leaves for 18–26(–35) mm, persistent. Peduncles 100–170(–200) mm long, 2–5 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 20–50 mm long in fruit, contiguous to distant. Flowers 6–16, with 4 carpels. Fruits 2.2–3.0 mm long, dorsal keel indistinct.

Stem anatomy

Stele of 4 bundles type, endodermis of U-type, interlacunar bundles present in 1 incomplete circle, subepidermal bundles absent, pseudohypodermis absent.

Distribution

NE Europe, N Asia, NW North America.

Note

(1) *P. subretusus* is closely related to *P. vaginatus* and in the future may be regarded as an extreme morphotype of that species.

65. *Potamogeton recurvatus* HAGSTRÖM, Kungl. Svenska Vetenskapsakad. Handl. 55(5): 37. 1916.

Description

Rhizome slender to robust, terete, perennial, with apical tubers. Stem branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, linear, strongly recurved at the top, (40–)50–120(–500) mm long, 1.0–1.6 mm wide, 30–100 times as long as wide, bright green to olive green, 3-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight

at base, obtuse at apex. Floating leaves always absent. Stipules adnate, connate, 7–140 mm long, fused with the leaves for 5–120 mm, persistent. Peduncles 20–50 mm long, 1–2 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, contiguous to distant. Flower and carpel numbers unknown. Fruits 3.0–3.5 mm long, dorsal keel indistinct.

Stem anatomy

Stele of four bundles type, endodermis of U-type, interlacunar bundles present in 1–2 circles, subepidermal bundles present, pseudohypodermis present, 1-layered.

Distribution

C Asia.

Note

(1) *P. recurvatus* has been described on the basis of a few specimens only. It is insufficiently known, but perhaps related to *P. vaginatus*.

66. *Potamogeton filiformis* PERSOON, Syn. Pl. 1: 152. 1805. ("filiforme")

≡ *P. setaceus* SCHUMACH., Enum. Pl. 1: 51. 1801, nom. illeg. ("setaceum"), non L. 1753.
≡ *P. pectinatus* var. β. *setaceus* [SCHUMACH.] C. HARTM, Handb. Skand. Fl. ed. 11. 437. 1879.
≡ *P. pectinatus* subsp. *filiformis* (PERS.) HOOK. f., Stud. Fl. Brit. Isl. 374. 1870.
≡ *Stuckenia filiformis* (PERS.) BÖRNER, Fl. Deutsche Volk 713. 1912.
≡ *Spirillus filiformis* (PERS.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
≡ *Coleogeton filiformis* (PERS.) LES et R.R. HAYNES, Novon 6(4): 390. 1996.
= *P. borealis* RAF., Med. Repos., Hexade 3, 2: 409. 1811.
– *P. borealis* RAF., Med. Repos., Hexade 2, 5: 354. 1808, nom. prov.
≡ *P. filiformis* var. *borealis* (RAF.) H. ST. JOHN, Rhodora 18: 134. 1916.
≡ *Stuckenia borealis* (RAF.) HOLUB, Preslia 69: 364. 1997.
= *P. fasciculatus* WOLFG. in SCHULT. et SCHULT. f., Mant. 3: 364. 1827.
≡ *P. filiformis* var. *fasciculatus* (WOLFG.) G. FISCH., Ber. Bayer. Bot. Ges. 11: 132. 1907.
= *P. strictus* PHIL., Fl. Atacam. 50. 1860. [non vidimus]
= *P. marinus* var. *alpinus* BLYTT, Norges Fl. 1: 370. 1861.
≡ *P. filiformis* var. β. *alpinus* (BLYTT) ASCH. et GRAEBN., Synops. Mitteleur. Fl. 1: 353. 1897.
≡ *Coleogeton filiformis* subsp. *alpinus* (BLYTT) LES et R.R. HAYNES, Novon 6(4): 390. 1996.
= *P. marinus* var. *occidentalis* J.W. ROBBINS in S. WATSON, U.S. Geol. Explor. Fortieth Parallel 5(Botany): 338. 1871.
≡ *P. filiformis* var. *occidentalis* (J.W. ROBBINS) MORONG, Mem. Torrey Bot. Club 3(2): 51. 1893.
≡ *P. interior* RYDB., Agric. Exp. Stat. Agric. Coll. Colorado Bull. [Fl. Colorado] 13. 1906. ("1905")
≡ *Coleogeton filiformis* subsp. *occidentalis* (J.W. ROBBINS) LES et R R. HAYNES, Novon 6(4): 390. 1996.
≡ *Stuckenia interior* (RYDB.) HOLUB, Preslia 69: 364. 1997.
= *P. marinus* var. *macounii* MORONG ex MACOUN, Catal. Canad. Pl. 4: 88. 1888. ("Macounii")
≡ *P. filiformis var. macounii* (MORONG ex MACOUN) MORONG, Mem. Torrey Bot. Club 3(2): 50. 1893.
= *P. aulacophyllus* K. SCHUM. in MART., Fl. Bras. 3, 3: 696. 1894. ("aulacophyllum")
= *P. juncifolius* A. KERN. ex C. FRITSCH, Verh. K. K. Zool.-Bot. Ges. Wien, 45(1895): 366. 1896.
≡ *P. filiformis* subsp. *juncifolius* (A. KERN. ex C. FRITSCH) ASCHERS. et GRAEBN., Synops. Mitteleur. Fl. ed. 2. 1: 544. 1913.
≡ *P. filiformis* var. *juncifolius* (A. KERN. ex C. FRITSCH) SUESS. in HEGI, Ill. Fl. Mitt.Europ. ed. 2. 1: 202. 1936.
= *P. strictus* var. *magellanicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 27. 1916.
= ? *P. rostratus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 27. 1916.
= *P. austrosibiricus* KASCHINA in KRASNOB. et SAFONOVA, Novoe Fl. Sibiri 243. 1986. ("austrosibiricus")
= *P. applanatus* Y.D. CHEN, Acta Hydrobiol. Sin. 11(3): 230. 1987.
≡ *P. filiformis* var. *applanatus* (Y.D. CHEN) Q.Y. LI, J. Wuhan Bot. Res. 10(1): 13. 1992.
= ? *P. punense* GALÁN-MERA, Phytologia 64(6): 495. 1988.

Description

Rhizome slender, terete, perennial, with apical tubers. Stem unbranched to sparingly branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, filiform,

30–175(–240) mm long, 0.3–1.2(–1.9) mm wide, (50–)100–300 times as long as wide, olive green to dark green, sometimes with a greyish tinge, 3-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, obtuse to subacute at apex. Floating leaves always absent. Stipules adnate, connate, 8–27(–55) mm long, fused with the leaves for 3–19(–50) mm, persistent to decaying. Peduncles (25–)50–190(–220) mm long, 2–5(–6) times as long as the fruiting spike, as thick as the stem, terminal on primary stem or on first order renewal shoots. Spikes cylindrical, 13–75 mm long in fruit, markedly distant. Flowers 4–11, with 4(–6) carpels. Fruits (1.9–)2.2–2.8(–3.2) mm long, dorsal keel indistinct.

Stem anatomy

Stele of four bundles or rarely oblong type, endodermis of U-type, rarely O-type, interlacunar bundles present in 1(–3) incomplete circles, subepidermal bundles absent, pseudohypodermis present, 1–2-layered.

Distribution

Europe, W, C and N Asia, North America and South America.

Hybrids

66 × 63. *P.* ×*fennicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 24. 1916.

[= *P. filiformis* × *P. vaginatus*]

66 × 68. *P.* ×*suecicus* K. RICHT., Pl. Eur. 1: 15. 1890.

[= *P. filiformis* × *P. pectinatus*]

≡ *Stuckenia* ×*suecica* (K. RICHT.) HOLUB, Preslia 69: 364. 1997.

Notes

(1) *P. filiformis* is a widespread polymorphic species. It includes several aberrant morphotypes like *P. rostratus*. (2) *P. strictus* differs from the type in some anatomical characters of stem structure (e.g. stele regularly of oblong type). Despite being geographically remote from the rest of the species, no further distinguishing character was found.

67. *Potamogeton amblyphyllus* C.A. MEYER, Beitr. Pflanzenk. Russ. Reiches 6: 10. 1849. ("amblyophyllus")

≡ *P. pectinatus* proles *amblyphyllus* (C.A. MEY.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 125. 1907.

≡ *Stuckenia amblyphylla* (C.A. MEY.) HOLUB, Preslia 69: 364. 1997.

= ? *P. pamiricus* BAAGÖE, Vidensk. Meddel. Dansk Naturhist. Foren. Kjöbenhavn 1903: 182. 1903.

Description

Rhizome slender, terete, perennial, with apical tubers. Stem unbranched to sparingly branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, filiform, 30–120 mm long, 1–3 mm wide, 20–50 times as long as wide, olive green to dark green, 3-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, obtuse at apex. Floating leaves always absent. Stipules adnate, connate, 10–35 mm long, fused with the leaves for 5–20 mm, persistent. Peduncles 50–80 mm long, 1.5–3.0 times as long as the fruiting spike, as thick as the stem. Spikes cylindrical, 30–35 mm long in fruit, distant. Flowers 9–12, with 4 carpels. Fruits (2.8–)3.0–3.5 mm long, dorsal keel indistinct.

Stem anatomy

Stele of four bundles type, endodermis of U-type, interlacunar bundles present as 1 incomplete circle, subepidermal bundles absent, pseudohypodermis present, 1–2-layered.

Distribution

SW and C Asia.

Note

(1) *P. amblyphyllus* is closely related to *P. filiformis*. It comprises more robust forms of a restricted geographical area. *P. pamiricus* is included in this concept of *P. amblyphyllus*.

68. *Potamogeton pectinatus* LINNAEUS, Sp. Pl. 127. 1753. ("pectinatum")

≡ *Stuckenia pectinata* (L.) BÖRNER, Fl. Deutsche Volk 713. 1912.

≡ *Spirillus pectiniformis* [L.] NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.

– *Coleogeton pectinatus* (L.) DOSTÁL, Sezn. Cévn. Rostl. Květ. Československ. 309. 1982, nom. inval.; DOSTÁL, Folia Mus. Rer. Natur. Bohem. Occid., Bot., 21: 15. 1984, nom. inval.
≡ *Coleogeton pectinatus* (L.) LES et R.R. HAYNES, Novon 6(4): 390. 1996.
= *P. marinus* L., Sp. Pl. 127. 1753. ("marinum")
= *P. interruptus* KIT. in SCHULT., Oesterr. Fl. ed. 2. 1: 328. 1814.
≡ *P. pusillus* [var.] β. *interruptus* (KIT.) J. PRESL et C. PRESL, Fl. Čech. 37. 1819.
≡ *P. pectinatus* var. *interruptus* (KIT.) ASCH., Fl. Brandenb. 1: 666. 1864.
≡ *P. pectinatus* proles *interruptus* (KIT.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 124. 1907.
≡ *Spirillus interruptus* (KIT.) NIEUWL., Amer. Midl. Naturalist 3: 18. 1913.
= *P. tenuifolius* KUNTH in HUMB., BONPL. et KUNTH, Nov. Gen. Sp. Pl. 1, ed. 4°: 370 [et ed. f°: 297]. 1815, nom. illeg. ("tenuifolium"), non Raf. 1811.
= *P. angustissimus* KUNTH in HUMB., BONPL. et KUNTH, Nov. Gen. Sp. Pl. 1, ed. 4°: 370 [et ed. f°: 297]. 1815. ("angustissimum")
= *P. vaillantii* ROEM. et SCHULT., Syst. Veg. ed. 16. 3: 514. 1818. ("Vaillantii")
≡ *P. pectinatus* [var.] ("spielart") a. *latifolius* G. MEY., Chloris Han. 526. 1836.
= *P. siculus* J. PRESL in BERCHT. et J. PRESL, Rostlinář 1, fasc. Žábnjkowité 21. 1821. ("siculum")
= *P. pectinatus* var. β. *dichotomus* WALLR., Sched. Crit. 1: 68. 1822.
= *P. pectinatus* var. α. *protensus* WALLR., Sched. Crit. 1: 67. 1822.
= *P. pectinatus* var. γ. *scoparius* WALLR., Sched. Crit. 1: 68. 1822.
≡ *P. pectinatus* var. *diffusus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 46. 1916, nom. illeg.
≡ *P. pectinatus* proles *scoparius* (WALLR.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 125. 1907.
≡ *P. diffusus* [HAGSTR.] HERTER, Revista Sudamer. Bot. 6(5–6): 132. 1940. [non vidimus]
= *P. zosteraceus* FR., Novit. Fl. Suec. ed. 2. 51. 1828.
≡ *P. pectinatus* var. *zosteraceus* (FR.) CASP., Schriften Phys.-Ökon. Ges. Königsberg 29: 89. 1888.
≡ *P. pectinatus* proles *zosteraceus* (FR.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 126. 1907.
= *P. pectinatus* [subsp.] β. *fluviatilis* SCHÜBL. et G. MARTENS, Fl. Württemb. 112. 1834.
= *P. drupaceus* O. LANG, Flora 29(30): 472. 1846.
= *P. flabellatus* BAB., Man. Brit. Bot. ed. 3. 343. 1851.
≡ *P. pectinatus* subsp. *flabellatus* (BAB.) HOOK. f., Stud. Fl. Brit. Isl. 374. 1870.
≡ *P. pusillus* subsp. *flabellatus* (BAB.) HOOK. f., Stud. Fl. Brit. Isl. ed. 3. 436. 1884.
= ? *P. pectinatus* var. *mongolicus* A. BENN., J. Bot. 32: 203. 1894.
≡ ? *P. pectinatus* proles *mongolicus* (A. BENN.) GRAEBN. in ENGL., Pflanzenr. 31 (IV.11): 125. 1907.
≡ ? *P. pectinatus* subsp. *mongolicus* (A. BENN.) VOLOB., Sibir. Biol. Zhurn. 1991(5): 75. 1991.
= *P. columbianus* SUKSDORF, Deutsche Bot. Monatsschr. 19: 92. 1901.
= *P. livingstonei* A. BENN. in DYER, Fl. Trop. Afr. 8: 223. 1901. ("Livingstonei")
= *P. vaginatus* var. *helveticus* G. FISCH., Ber. Bayer. Bot. Ges. 11: 134. 1907.
≡ *P. vaginatus* subsp. *helveticus* (G. FISCH.) SCHINZ et THELL., Fl. Schweiz ed. 4. 1: 32. 1923.
≡ *P. helveticus* (G. FISCH.) W. KOCH in W. KOCH et G. KUMMER, Mitt. Naturf. Ges. Schaffhausen 1923–1924(3): 38. 1924.
– *P. helveticus* (G. FISCH.) E. BAUMANN, Veröff. Geobot. Inst. ETH Stiftung Rübel Zürich 3(5): 594. 1925. [isonymum]
≡ *P. pectinatus var. helveticus* (G. FISCH.) GLÜCK in PASCHER, Süsswasserflora 15: 62. 1936.
≡ *Stuckenia helvetica* (RAF.) HOLUB, Preslia 69: 364. 1997.
= *P. helveticus* var. *balatonicus* GAMS, Arch. Balaton. 1: 30. 1926.
≡ *P. balatonicus* (GAMS) SOÓ, Arch. Balaton. [= Magyar Biol. Kutatóint. Munkái], 2: 136. 1928.
≡ *P. pectinatus* subsp. *balatonicus* (GAMS) SOÓ, Magyar Biol. Kutatóint. Munkái 8(1935–1936): 235. 1936.
– *Coleogeton pectinatus* subsp. *balatonicus* (GAMS) DOSTÁL, Sezn. Cévn. Rostl. Květ. Československ. 309. 1982, nom inval.; (GAMS) DOSTÁL, Folia Mus. Rer. Natur. Bohem. Occid., Bot., 21: 15. 1984, nom. inval.
= ? *P. pectinatus* var. *gracilis* KUZMIN et SKVORTZOV in BARANOV et SKVORTZOV, Diagn. Pl. Nov. Min. Cogn. Mandsch. 1. 1943.
= *P. macrocarpus* DOBROCHOT., Bot. Mat. Gerb. Bot. Inst. Akad. Nauk SSSR [= Not. Syst. Herb. Inst. Bot. Acad. Sci. URSS] 14: 70. 1951.
– *P. intramongolicus* Y.C. MA, Acta Bot. Bor.-Occid. Sin. 3(1): 8. 1983, nom. inval.; Y.C. MA, Fl. Intramongolica 7: 12. 1983, nom. inval.

– *P. acifolius* Y.C. MA, Acta Bot. Bor.Occid. Sin. 3(1): 10. 1983, nom. inval.
= *P. pectinatus* subsp. *chakassiensis* KASCHINA in KRASNOB. et SAFONOVA, Novoe o Fl. Sibiri 245. 1986.
≡ *P. chakassiensis* (KASCHINA) VOLOB., Sibir. Biol. Zhurn. 1991(5): 75. 1991.

Description
Rhizome slender to very robust, terete, perennial, with apical tubers at the end of the growing season. Stem sparingly to richly branched, filiform to slender, terete, annual to perennial, summergreen or wintergreen; specialized dormant turions not developing, sometimes with winterbuds as axillary leafy shoots. Submerged leaves sessile, filiform to linear, 22–125(–200) mm long, 0.2–4.0 mm wide, 24–160(–200) times as long as wide, bright green to olive green, 3–5-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, acuminate to acute at apex, sometimes the broadest leaves obtuse. Floating leaves always absent. Stipules adnate, convolute, 10–70 mm long, fused with the leaves for 8–65 mm, persistent. Peduncles 20–130(–450) mm long, 1.5–5.0(–10.0) times as long as the fruiting spike, as thick as the stem, flexible. Spikes cylindrical, 13–60 mm long in fruit, contiguous at first, later distant. Flowers (4–)8–14, with 4 carpels. Fruits 3.3–4.7(–5.1) mm long, dorsal keel indistinct.

Stem anatomy
Stele of four bundles, oblong or rarely 1 circular type, endodermis of U-type, interlacunar bundles present in 1 more or less complete circle, subepidermal bundles absent, rarely present, pseudohypodermis present, 1–2-layered.

Distribution
Cosmopolitan; Europe, Africa, Asia, Australia, North America and South America.

Hybrids

? 25 × 68. *P.* ×*nomotoensis* KADONO et T. Noguchi, Acta Phytotax. Geobot. 42(2): 175. 1991, pro sp.
[= ? *P. natans* × *P. pectinatus*]

68 × 63. *P.* ×*bottnicus* HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 52. 1916.
[= *P. pectinatus* × *P. vaginatus*]

66 × 68. *P.* ×*suecicus* K. RICHT., Pl. Eur. 1: 15. 1890.
[= *P. filiformis* × *P. pectinatus*]

Notes
(1) *P. pectinatus* is an extremely polymorphic species with numerous local and regional forms as well as extreme ecomorphoses.
(2) Robust wintergreen forms called *P. helveticus* are occasionally found in rivers and large clear-water lakes. Their characters are not stable when transplantated into cultivation and they are produced repeatedly under special ecological circumstances. The exact relationship of these similar plants known from distant areas is unknown.
(3) *P. chakassiensis* comprises a set of forms with stipules and leaves considerably longer than in the type. However, they do not deserve specific rank (KAPLAN 1995).

69. *Potamogeton striatus* RUIZ et PAVÓN, Fl. Peruv. Chil. 1: 70. 1798. ("striatum")

≡ *P. pectinatus var. striatus* (RUIZ et PAV.) HAGSTR., Kungl. Svenska Vetenskapsakad. Handl. 55(5): 51. 1916.
≡ *Coleogeton striatus* (RUIZ et PAV.) LES et R.R. HAYNES, Novon 6(4): 390. 1996.
≡ *Stuckenia striata* (RUIZ et PAV.) HOLUB, Preslia 69: 364. 1997.
= *P. pectinatus* var. *latifolius* J.W. ROBBINS in S. WATSON, U. S. Geol. Explor. Fortieth Parallel 5(Bot.): 338. 1871, nom. illeg., non G. MEY. 1836.
≡ *P. latifolius* [J.W. ROBBINS] MORONG, Mem. Torrey Bot. Club 3(2): 52, tab. 59. 1893. nom. illeg., non SLOBODA 1852.
≡ *P. filiformis* var. *latifolius* [J.W. ROBBINS] REVEAL in CRONQUIST et al., Intermountain Fl., Vasc. Pl. Intermountain West, USA 6: 26. 1977.
≡ *P. latior* HOLUB, Folia Geobot. Phytotax. 18(2): 204. 1983.
= *P. australis* F. PHIL., Anal. Mus. Nac. Chile 2(8): 95. 1891. [non vidimus]
= *P. dissimilis* A. BENN., J. Bot. 48: 150. 1910.

Description

Rhizome slender, terete, perennial, without apical tubers. Stem sparingly to richly branched, slender, terete, annual to perennial; specialized dormant turions not developing. Submerged leaves sessile, linear, 50–210 mm long, 0.4–5.1 mm wide, 35–150 times as long as wide, bright green to dark green, 3–7-veined, lateral veins inconspicuous, with air channels bordering the midrib, entire at margins, straight at base, acute to obtuse at apex, sometimes the broadest leaves obtuse. Floating leaves always absent. Stipules adnate, convolute, 12–34 mm long, fused with the leaves for 9–28 mm, persistent. Peduncles 12–54 mm long, 0.8–2.0 times as long as the fruiting spike, as thick as or slightly thinner than the stem. Spikes cylindrical, 17–60 mm long in fruit, contiguous at the beginning, distant later. Flowers 7–16, with 4 carpels. Fruits 3.0–3.9 mm long, dorsal keel indistinct.

Stem anatomy

Stele of complex oblong type or rarely circular type, endodermis of U-type, rarely O-type, interlacunar bundles present in 1–2 incomplete circles, subepidermal bundles absent, pseudohypodermis 1(–2)-layered.

Distribution

W and SW North America and South America.

Note

(1) *P. striatus* has often been treated as a subunit of *P. pectinatus*. Even though both species are closely related the differential characters seem to be constant throughout the range of *P. striatus*. The separate position of the species has been recently supported by an isozyme study (HOLLINGSWORTH et al. 1996). The relationship to morphologically similar plants known from Europe and Asia, here included in *P. pectinatus*, has to be clarified.

CONCLUSIONS

In the preceeding paragraphs a large bulk of information regarding the description and identification of *Potamogeton* species has been compiled. The present treatment can be summarized as follows:

(1) A total of 69 species are described. In several cases it was easier to construct a key to distinguish among those species than to present a really comprehensive description covering all important characters. Not all of the species listed fully meet the requirements of a "sufficiently known species". Nevertheless, we are convinced that they actually exist as biological entities. The true number of species may be lower, as ca. 10 species can be regarded as candidates to be lumped into other widespread polymorphic species.

(2) Several taxa otherwise recognized have been excluded from the treatment as they are obvious ecomorphoses or extreme morphotypes of other well-known species. The number of species in *Potamogeton* is generally overestimated. Estimates of 90–120 species are unjustified or based on a narrower species concept. We think that in the context of the species concept outlined above 69 is approximately the right order of magnitude to be expected worldwide for *Potamogeton* species. We do not believe that too many "question-mark species" will prove to be taxa in their own right in the future. Three species may lie undescribed in herbaria (one from Madagascar, New Guinea, and South America respectively).

The question marks in the synonym lists, and in particular the notes, show that there is a lot of work to be done in *Potamogeton* taxonomy, which has been hampered by the fact that authentic seed material from many parts of the world is difficult to obtain. Furthermore, many species are not easy to keep in cultivation and show only minimal development of morphological characters. Necessary work includes:

(1) Extensive field surveys and collection of specimens in the Southern Hemisphere in order to bring the total numbers of specimens comparable to that in the Northern Hemisphere.

(2) Typification of all relevant names. "Relevant" refers to all species and hybrids recognized here, all taxa contributing basionyms, and all taxa being important for applying the priority rule.

(3) Chromosome counts on well identified specimens, both from the Northern Hemisphere but in particular from the Southern Hemisphere.

(4) Experimental cultivation in order to reveal the actual range of phenotypic plasticity.

(5) Crossing experiments to verify or rule out assumed hybridization.

(6) Molecular approaches on the affinity of species and species groups as well as on the verification of hybrids.

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APPENDIX

Index of scientific names

Only final epithets with authorship are included into the index. Nomenclatural synonyms with the same final epithet are represented by their basionym only. Epithets of correct names (or their basionyms) of accepted species are printed in **bold**.

Supraspecific names

Specific and infraspecific names in *Potamogeton*

Specific and infraspecific names in other genera