

RANUNCULUS SUBGENUS BATRACHIUM

Introduction

Within this Subgenus, difficulties with identification arise mainly from extreme phenotypic plasticity, morphological reduction and frequent hybridisation. Most species look very different in summer and winter, and are impossible to identify in the vegetative state. Except for species such as *R. hederaceus*, *R. omiophyllus* and *R. tripartitus*, it is unwise to try to identify plants in winter. Even when good flowering and fruiting material is available it is important to take care to gather an adequate specimen. In heterophyllous species, small apical portions of shoot are inadequate and specimens should include capillary leaves attached 5 or 6 nodes away from the apex. Try to collect mature fruits as well as flowers. The flowers are delicate and soon fall apart, so it may help to keep a few separate so that petals can be measured and stamens counted, but leave some attached to the plant!

The most authoritative taxonomic work on the group world-wide is the monograph by Cook (1966). Holmes (1979) used essentially the same characters, and included an important new feature, a tabular summary of the main features of each species. This is particularly useful because it often allows incomplete material to be identified, and the whole range of characters for a species can be seen simultaneously. This helps to avoid the frequent problem with a dichotomous key of misidentifying material on account of a single character. The revised tabular key is based on many of the old characters combined with the results of more detailed research. A key to *R. peltatus*, *R. aquatilis*, *R. fluitans*, and subspecies and varieties of *R. penicillatus* is also given in the species accounts (Webster 1991).

Hybrids are not included in the keys. However, three hybrids, *R. omiophyllus* \times *R. tripartitus, R. peltatus* \times *R. fluitans* and *R. fluitans* \times *R. trichophyllus* and/or *R. aquatilis* have a distribution which is not strictly limited by the distribution of their parents and brief descriptions are included for these hybrids.

R. penicillatus now comprises two subspecies, subsp. *penicillatus* and subsp. *pseudofluitans* (Webster 1988). Within subsp. *pseudofluitans* two varieties are recognised which are sometimes difficult to separate and difficult material should be recorded simply as subsp. *pseudofluitans*. The new and old names are as follows:

New name

R. penicillatus subsp. *penicillatusR. penicillatus* subsp. *pseudofluitans* var. *pseudofluitansR. penicillatus* subsp. *pseudofluitans* var. *vertumnus*

Old name

R. penicillatus var. penicillatus R. penicillatus var. calcareus R. penicillatus var. vertumnus

Many taxonomic problems, to which there are no easy answers, still remain. For example, the hybrid *R*. *omiophyllus* \times *R*. *tripartitus*, which is frequent in the New Forest, includes forms which have arisen from extensive back-crossing and closely resembles *R*. *tripartitus*. A second common problem arises with plants that resemble *R*. *baudotii* very closely, except that they have hairy carpels, whereas 'good' *R*. *baudotii* has glabrous fruits.

A further problem, and possibly the most frustrating, is the morphological continuity between *R. fluitans* and *R. penicillatus* var. *pseudofluitans*. Holmes (1979) pointed out that forms of var. *pseudofluitans* resemble *R. fluitans* in their leaf characters. This places all the more importance on the other main character separating the taxa, namely, the hairiness of the receptacle. Although some receptacles are readily determined as either glabrous (*R. fluitans*) or distinctly hairy (*R. penicillatus* var. *pseudofluitans*), an embarrassing number of receptacles are intermediate.

Taxonomic characters

LEAVES: characters 1-14 on the tabular key

Two kinds of leaf are found within the group; the flat, rounded LAMINAR type, and CAPILLARY leaves which are finely dissected into many capillary segments.

In the heterophyllous species, laminar leaves are normally formed in response to specific environmental stimuli, normally the onset of longer photoperiods in summer, acting on the submerged shoot apex. In these species, flower production is not linked to the production of laminar leaves, and flowering can start about a month before the laminar leaves appear. In *R. tripartitus* the first seedling leaf is always laminar, and the plants continue to produce laminar leaves under warm conditions, irrespective of the day length. Capillary leaves are produced in cold water under short photoperiods, which, in the field, means up to about the middle of March. In heterophyllous species, many plants produce one or two intermediate leaves at the transition between the capillary and laminar leaf types, and these can be helpful in identification (see characters 7-9).

LAMINAR LEAVES: characters 1, 3-6

The shape of the laminar leaves is useful taxonomically. *Ranunculus hederaceus* and *R. omiophyllus* rarely cause any difficulty since *R. hederaceus* has a very distinctive leaf shape, with the lobes broadest at the base, whereas in all other species, including *R. omiophyllus*, the lobes are narrowest at the base. In *R. tripartitus* and *R. baudotii* the leaves are deeply 3-lobed, whereas *R. aquatilis*, *R. peltatus* and *R. penicillatus* generally have 5 lobes and are more shallowly lobed, although leaves produced under water tend to have deeper sinuses. In *R. aquatilis*, the leaf margin is dentate, and this is useful to support other characters in distinguishing this species from *R. peltatus*, in which the margin is normally crenate. However, care is needed if leaves of *R. peltatus* have formed under water or in shade, as these leaves are often dentate. These leaves will look etiolated and have long petioles. In *R. penicillatus* subsp. *penicillatus* the leaves may be crenate or dentate.

[A simple way of remembering which leaf shapes are which species in *R. hederaceus* and *R. omiophyllus* is to remember for the former that the lobes resemble an 'h' for *hederaceus* being widest at the base, and in the latter an 'o' for *omiophyllus* with the lobes widest in the middle.]

INTERMEDIATE LEAVES: characters 7-9

Intermediate leaves are not always formed, but when present, they can be helpful towards identification. *R. tripartitus* and *R. baudotii* are the only species that produce radially symmetrical intermediate leaves. In *R. tripartitus* the lobes are fine and pointed, whereas in *R. baudotii* they take the form of flattened capillary lobes. In *R. aquatilis, R. peltatus* and *R. penicillatus* subsp. *penicillatus* the intermediate leaves are mosaic in type: parts of the leaf are laminar, and parts capillary. In *R. aquatilis,* the capillary part is normally proximal (i.e. between the petiole and the laminar part) so that the leaf appears to have stalked lobes, whereas in *R. peltatus* and *R. penicillatus*, the capillary part is distal, the tips of the leaf lobes being extended into fine points. In *R. penicillatus* these capillary appendages can be quite long. As

Holmes (1979) points out, this character is not 100% reliable but it can, nevertheless, be useful. Since these patterns are difficult to visualize, they are illustrated below.



Intermediate leaves. (a) radially symmetrical leaves with pointed lobes as in *R. tripartitus*, (b) radially symmetrical leaves with flattened capillary lobes as in *R. baudotii*, (c) 'mosaic' type leaves with capillary portion proximal as in *R. aquatilis*, (d) 'mosaic' type leaves with capillary portion distal as in *R. peltatus* and *R. penicillatus*.

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CAPILLARY LEAVES, AQUATIC FORMS: characters 10-14

Ranunculus circinatus stands out on account of its capillary leaves, which are short and rigid, with divergent segments that are held in a single plane, like the spokes of a wheel. (This leaf-shape is less distinctive in winter as the segments become longer and more flaccid). *Ranunculus tripartitus* is unlikely to be confused with any other species and has capillary leaves which are extremely fine and hair-like; these leaves spread divergently in water, but are flaccid and collapse when taken out.

Of the remaining species, *R. baudotii*, *R. peltatus*, *R. aquatilis*, *R. penicillatus* var. *vertumnus* and *R. trichophyllus* have leaves which are shorter than the corresponding internodes, whilst in *R. penicillatus* subsp. *penicillatus* and *R. fluitans* the leaves are longer than the internodes. In *R. penicillatus* var. *pseudofluitans* the leaves may be longer or shorter than the internodes. The rigidity of the segments is

also important; *R. baudotii, R. trichophyllus* and *R. penicillatus* var. *vertumnus* normally have leaves with rigid, divergent segments, *R. aquatilis, R. peltatus* and *R. penicillatus* var. *pseudofluitans* have leaves which may be rigid or flaccid, and *R. penicillatus* subsp. *penicillatus* and *R. fluitans* have flaccid leaves with sub-parallel segments. However, these characters must be used with some caution, since the capillary leaves of species such as *R. peltatus* and *R. aquatilis*, as well as *R. penicillatus* subsp. *pseudofluitans* show a seasonal pattern of variation, the leaves produced in mid-summer being shorter and more rigid than those produced during the autumn, winter and spring. Further, these characters are modified by environmental conditions, and leaves produced in full light and swiftly flowing water are, again, shorter and more rigid than those produced under shaded conditions or in slowly flowing water. It is also important to compare fully expanded leaves and internodes; towards the shoot apex, where the internodes are not fully elongated, the capillary leaves exceed the internodes in most species, thus, specimens consisting only of a short apical portion of shoot cannot be determined.

Ranunculus penicillatus subsp. *pseudofluitans* var. *pseudofluitans* encompasses a wide range of variation in leaf form, and the capillary leaves are critical in separating long, flaccid-leaved plants of var. *pseudofluitans* from *R. fluitans* at one end of the range, and short, rigid-leaved plants of var. *pseudofluitans* from var. *vertumnus* at the other. The capillary leaves of *R. fluitans* sometimes reach 500 mm long, and are rarely forked more than four times. Long, flaccid-leaved forms of var. *pseudofluitans* (frequently produced in response to slowly flowing or shaded water) resemble *R. fluitans* but normally have leaves which are at least five times forked and have only been recorded as reaching up to 385 mm long. Occasionally, mainly in poor growing conditions, var. *pseudofluitans* may form leaves which are less than five times forked, and, wherever possible, additional evidence should be sought from the receptacle (character 30) although this, too, is difficult in some cases (cf. above).

	var. vertumnus	var. pseudofluitans		
Rigidity	Normally rigid (semi-rigid or flaccid in winter)	Rigid or flaccid		
Segment habit	Divergent	Divergent or sub-parallel		
Leaf length/internode length ratio	0.3-1.9	0.6-3.9		
Leaf shape when rigid	Globose, compact	Obconical		
Segment number	Rarely less than 100, frequently over 400	30-350		
Leaf length	30-70mm (to 132mm in winter)	48-385 mm		
Petioles	5-15 mm (to 32 mm in winter)	12-148 mm		
Number of segments	1.3-9.1 / mm leaf length	0.1-4.4 / mm leaf length		

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Var. *pseudofluitans* also produces forms with short, rigid leaves which are shorter than the internodes, with a large number (often over 300) of divergent segments. These forms are frequently seen in swiftly flowing water in summer, and resemble var. *vertumnus*. The leaves are obconical and may have a distinctive, untidy appearance when the water is shaken from them. Var. *pseudofluitans* does, in fact, intergrade with var. *vertumnus* but 'good' var. *vertumnus* has globose (i.e. spherical) leaves, which are compact and lack the untidy appearance of rigid, divergent var. *pseudofluitans*. The compact nature of the leaves gives var. *vertumnus* a distinctive appearance in the field, where it is seen to form dense, rather neat beds, which are always a very dark green.

Var. *vertumnus* has consistently shorter petioles and leaves than var. *pseudofluitans* and more leaf segments relative to the length of the leaves. Because these characters apply rather specifically to this part of varieties, they have not been included in the tabular key, and instead they are tabulated below. Var. *vertumnus* is less phenotypically plastic in these characters than var. *pseudofluitans* in response to environmental conditions such as shading and flow rate, but it is difficult to distinguish from var. *pseudofluitans* in winter since the leaves then become longer and more flaccid.

CAPILLARY LEAVES: TERRESTRIAL FORMS

When growing on mud, or on top of banks of *Ranunculus* which rise above the water, species which are capable of forming capillary leaves form small, crisped terrestrial leaves, with relatively long petioles and slightly flattened segments. Not only do these leaves offer virtually no diagnostic characters, but the flowers produced by these mud forms are often abnormal for the species, being smaller and less fertile than usual. They are therefore impossible to determine reliably.

STIPULES: character 15

The stipules of leaves in bud are similar in all species, and on old shoots they become damaged, so it is important to examine the stipules of the first fully expanded leaf. The stipules of *R. hederaceus* are strongly pointed whereas those of *R. baudotii* are very broad and rounded and *R. omiophyllus*, *R. circinatus* and *R. tripartitus* are also rounded. However, these species are the more distinctive ones in the group anyway, and the shape of the stipules is difficult to use diagnostically between the remaining species because it is continuously variable and intergrades between species. Cook (1966) regards the degree of joining of the stipules to the petiole as important, and although this character is not used in the tabular key, it is included in the descriptions.



Stipules. (e) R. hederaceus, (f) R. omiophyllus, (g) R. tripartitus, R. penicillatus, (h) R. baudotii, (i) R. peltatus, (j) R. aquatilis, (k) R. trichophyllus, (l) R. circinatus, (m) R. fluitans.

PEDICELS: character 16

The absolute length of the pedicel and its length relative to the petiole of the opposed laminar leaf is important in separating *R. aquatilis* from species such as *R. peltatus*, *R. penicillatus* and *R. baudotii*. The pedicel tends to elongate when plants are submerged in deep water, particularly in certain strains. However, the pedicel and the petiole of the opposed laminar leaf respond to the same degree so that the ratio of their lengths can still be used. The pedicel is shorter than the opposed laminar leaf (and usually shorter than 50 mm) in *R. aquatilis* and longer in *R. peltatus*, *R. penicillatus* and *R. baudotii*. In *R. baudotii* the pedicel is characteristically strongly recurved, although this sometimes occurs in other species. Pedicels bearing undeveloped fruiting heads are frequently elongated, remaining erect, and this can sometimes be an indication of sterility and hybrid origin.

SEPALS: characters 17-18

Cook (1966) reported blue-tipped sepals in *R. tripartitus* and *R. baudotii*. Since then, Holmes (1979) reported blue-tipped sepals in some plants of *R. fluitans*, and I have also seen them in *R. trichophyllus*. In other species, the sepals are green when young, becoming brown at maturity. They have also been reported in *R. aquatilis*, *R. peltatus*, *R. penicillatus* and *R. omiophyllus* (Messenger 1988).

PETALS: characters 19-24

Petal length is an important taxonomic character, although it is slightly difficult to split the ranges for individual species into 3 discreet ranges, so please see also the ranges given for each species. In R. *trichophyllus*, the petals are non-contiguous at anthesis, a character which is useful in distinguishing this species from R. *aquatilis*, which it sometimes resembles closely.

NECTAR-PITS: characters 22-24



Nectar-pits at anthesis. (n) Lunate or crescent shaped, as in *R. hederaceus, R. omiophyllus, R. tripartitus, R. baudotii, R.. trichophyllus, R. circinatus*; (o) circular as in *R. aquatilis*; (p) pyriform or pear-shaped as in *R. peltatus, R. penicillatus, R. fluitans.*

Nectar-pit shape is an extremely important character in the group. The developmental sequence leading to the formation of the pyriform (pear-shaped) type passes through lunate (crescent-shaped) and circular phases, and circular nectar-pits become elongated on senescent petals, so it is important to look at recently matured petals (at anthesis) and not at petals in bud or senescent petals. The nectar-pits are best examined with a hand lens, holding the petal flat and looking from above, at right angles to the surface. A lunate pit can often appear circular if it is viewed by looking down the length of the petal, parallel to the surface. Dried petals on herbarium sheets must be rehydrated.

STAMEN NUMBER: character 25

Stamen number varies to some extent with plant vigour, and it is therefore unwise to rely on it for determining plants growing in the terrestrial state or in other unfavourable conditions such as deep water or shade.

Tabular key to Ranunculus section Batrachium



O not applicable

fluitane	circinatus	trichophyllus	рса, жебласних ман, местасних	pen, sulst, pseudofisiturs var, pseudofiutrans	Pericillarus Subay. Pericillatus	aquatilis	peltatus	baudotíi	tripartitus	omiophyllus	hederaceus	Species, subspecies, or variety Characters
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CARPELS: characters 26-28

Carpel number can be a helpful guide, although, as with petal length, it is difficult to divide the ranges into useful classes, so again it is best to refer to the range given in the descriptions. The hairiness of the carpels is critical as *R. hederaceus*, *R. omiophyllus*, *R. tripartitus* and *R. baudotii* have glabrous carpels, whereas the immature carpels of *R. peltatus*, *R. aquatilis* and *R. trichophyllus* are hairy. The carpels of *R. fluitans* are frequently glabrescent. It is important to examine immature carpels since hairy carpels lose their hairs as they mature.



Glabrous, winged carpel of R. baudotii

R. baudotii is the only species which produces carpels with both a dorsal and a ventral wing (see above). The carpels of *R. baudotii* are not always winged, but when present, the wings are a good indicator of *R. baudotii*. Beware specimens of other species which have been gathered and dried when the fruit is immature, since on these specimens the seed fails to develop fully and shrinks within the carpel, giving the appearance of wings.

RECEPTACLE: characters 29-30

A further good indicator of *R. baudotii* is the receptacle which elongates in fruit (Fig. q), whereas in other, closely related species, such as *R. peltatus* and *R. aquatilis*, it remains globose (Fig. r).

Receptacle hairiness is important in distinguishing *R. tripartitus* (in which it is hairy) from *R. omiophyllus* (in which it is glabrous), and in distinguishing *R. penicillatus* var. *pseudofluitans*, in which it is densely hairy (Fig. t), from *R. fluitans* in which it is glabrous or sparsely hairy (Fig. s). It is important to remove at least some of the carpels to see this character.



Receptacles. (q) elongated receptacle of *R. baudotii*, (r) globose receptacle as in *R. aquatilis, R. trichophyllus, R. peltatus*, (s) sparsely hairy receptacle of *R. fluitans*, (t) densely hairy receptacle of *R. penicillatus*.

The problem arises in distinguishing between sparsely and densely hairy receptacles. Very few specimens of *R. fluitans* have completely glabrous receptacles. As a rough guide, if the receptacle is only sparsely hairy, the surface of the receptacle can be seen, complete with achene scars, whilst the surface of a densely hairy receptacle is obscured by the hairs. It is important to be aware that there are some plants with genuinely intermediate receptacles and these probably represent less-than-pure *Ranunculus fluitans* proper, so plants with intermediate receptacles should not be recorded under this name.

Descriptions and ecological notes

Except in *R. penicillatus*, where detailed measurements have been made, these largely follow Cook (1966).

R. hederaceus L.

Prostrate annual or perennial. Leaves laminar, opposite or alternate; stipules ovate, adnate to petiole for more than half their length, apex acute; petiole 2-4 times as long as lamina; lamina 4-25 mm long, 3-35 mm wide, reniform to subcordate with 3, 5 or rarely 7 lobes; lobes broadest at base; margin entire or crenulate. Pedicels in fruit more or less equal to petioles of opposed leaves. Sepals (1-)2-2.5(-3) mm long, spreading. Petals (1.25-)2.5-3.5(-4.25) mm long, ovate, not contiguous; nectar-pits lunate. Stamens (4-)7-10(-11). Carpels (9-)18-24(-42), glabrous; style lateral to subterminal. Receptacle glabrous.

More or less throughout Britain and Ireland. On wet mud in small streams, ditches and ponds, often in temporary water and usually in somewhat open and disturbed habitats. *Ranunculus hederaceus* grows in very similar habitats to *R. omiophyllus*, although it may show a preference for more base-rich and eutrophic habitats.

R. omiophyllus Ten.

Prostrate annual or perennial. Leaves laminar, opposite or alternate; stipules ovate, adnate to petiole for half their length or less, apex obtuse; petiole 3-6 times as long as lamina; lamina 2-26 mm long, 3-32 mm wide, reniform to suborbicular with 3, 5 or rarely 7 lobes; lobes narrowest at base; margin crenate. Pedicels in fruit equal to or less than petioles of opposed leaves. Sepals (1.75-)2.5-3(-3.75) mm long, reflexed. Petals (3.75-)5-6(-7) mm long, ovate, not contiguous; nectar-pits lunate. Stamens (5-)7-10(-13). Carpels (15-)20-50(-67), glabrous; style terminal. Receptacle glabrous.

The limits of distribution of *R. omiophyllus* closely follow the August 7.5 cm isohyetal, and it is absent from much of the drier areas of central and eastern England, northern Scotland and central and Northern Ireland. In similar habitats to *R. hederaceus*; on wet mud, in small streams, ditches and ponds, often in temporary water and open and disturbed habitats. It may grow in slightly more peaty, base-poor, oligotrophic habitats than *R. hederaceus*.

R. tripartitus DC.

Annual or perennial, prostrate in terrestrial state or spreading-erect under water. Leaves laminar or divided into capillary segments. Laminar leaves opposite or alternate; stipules suborbicular, adnate to petiole for more than two thirds their length, apex obtuse; petiole (10-)20-30(-70) mm long; lamina up to 40 mm wide, reniform to suborbicular, deeply 3- or rarely 5-lobed; lobes cuneate, distant, margin entire or crenate. Capillary leaves confined to lower nodes or lacking, alternate; petiole 1-10 mm long; lamina 10-40 mm long, globoid to obconical; segments extremely fine, flaccid. Pedicels in fruit equal to or slightly shorter than petioles of the opposed laminar leaves. Sepals 1-3 mm long, reflexed, caducous,

usually blue-tipped. Petals 1.25-4.5 mm long, ovate to slightly obovate, not contiguous; nectar-pits lunate. Stamens (1-)5-8(-10). Carpels 4-27, glabrous; style subterminal. Receptacle hairy.

Nationally Scarce. On wet cart tracks, in ditches, temporary ponds and peaty pools. In the field, *R. tripartitus* behaves as a winter annual; it starts flowering in March and usually dies during April or May, perhaps due to inability to compete with later growing aquatic plants.

R. baudotii Godr.

Annual or perennial, prostrate in terrestrial state or spreading-erect under water. Leaves laminar or divided into capillary segments. Laminar leaves occasionally lacking, alternate; stipules suborbicular to orbicular, adnate to petiole for more or less than half their length, apex obtuse; often truncate at base, deeply 3- or rarely 5-lobed; lobes cuneate, sinus more than two thirds as long as lobe; margin crenate or rarely dentate. Capillary leaves always present, alternate; petiole 5-20 mm long; lamina obconical to subglobose; segments rigid, divergent. Leaves intermediate between laminar and capillary occasionally present. Pedicels in fruit longer than petioles of opposed laminar leaves. Sepals 2.5-4.5 mm long spreading or reflexed, usually blue-tipped. Petals 5.5-10 mm long, broadly obovate, contiguous during anthesis; nectar-pits lunate. Stamens 10-20. Carpels (16-)33-39(-60), glabrous, frequently winged when dry. Receptacle hairy, elongating in fruit.

Ranunculus baudotii has been recorded mainly in coastal districts, but also inland near salt deposits. In still or slowly flowing, usually brackish, water. Often found in borrow-dykes behind sea walls, in the ditches of coastal grazing marshes, and in temporary pools. Usually in open and disturbed habitats.

Key to *R. peltatus*, *R. aquatilis*, *R. fluitans*, and subspecies and varieties of *R. penicillatus* (Webster 1991).

- 1 Plants heterophyllous capillary leaves produced all the year round, submerged shoots producing laminar leaves during the summer in response to long photoperiods 2
- 1 Plants homophyllous capillary leaves produced all year round, laminar leaves never produced even by submerged shoots in summer; capillary leaves sorter than, equalling or exceeding corresponding internodes on mature stems; leaf segments rigid or flaccid, divergent or sub-parallel 4

2 Capillary leaves exceeding corresponding internodes on mature stems; leaf segments flaccid, subparallel *R. penicillatus* subsp. *penicillatus* var. *penicillatus*

- 2 Capillary leaves shorter than internodes on mature stem (becoming longer than internodes in summer); leaf segments rigid, with divergent segments (becoming flaccid and sub-parallel in winter)
- 3 Laminar leaves normally dentate; pedicels in fruit shorter than petioles of opposed laminar leaves and normally shorter than 50 mm; petals 5-10 mm; nectar-pits circular *R. aquatilis*

3

- 3 Laminar leaves normally crenate; pedicels in fruit longer than the petioles of the opposed laminar leaves and normally longer than 50 mm; petals 10-20 mm; nectar pits pyriform *R. peltatus*
- 4 Leaves invariably flaccid, and longer than the internodes; leaves never more than four times divided; receptacle glabrous, or only sparsely pubescent *R. fluitans*
- 4 Leaves rigid or flaccid, shorter than, equalling, or exceeding internodes; leaves normally at least six times divided; receptacle densely hairy 5

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- 5 Leaves rigid or flaccid; segments 30-350, divergent or sub-parallel; leaf shape obconical whether rigid or flaccid, rigid leaves having an untidy appearance; leaves 48-385 mm, shorter than, equalling, or exceeding corresponding internode on mature stems and occasionally up to four times its length; petioles 12-148 mm long*R. penicillatus* subsp. *pseudofluitans* var. *pseudofluitans*
- 5 Leaves normally rigid (semi-rigid or flaccid in winter), with divergent segments; segments rarely less than 100, frequently exceeding 400, and occasionally over 900; leaf shape when rigid invariably globose or reniform, leaves becoming obconical only when flaccid; leaves normally 30-70 mm, occasionally up to 132 mm in winter, usually shorter than the corresponding internode and never exceeding twice their length; petioles 5-15 mm, rarely to 20 mm (up to 32 mm in winter) *R. penicillatus* subsp. *pseudofluitans* var. *vertumnus*

R. peltatus Schrank

Annual or perennial, caespitose in terrestrial state or spreading-erect under water. Leaves laminar or divided into capillary segments. Laminar leaves occasionally lacking, alternate; stipules oblong to triangular, adnate to petiole for three quarters of their length or more, apex obtuse; petioles rarely exceeding 70 mm long; lamina up to 40 mm wide, reniform to orbicular, occasionally 3-7-lobed; lobes broadly cuneate, sinus usually less than two thirds the length of the lamina; margin crenate. Capillary leaves mostly present, alternate; petiole 5-25 mm long; lamina globose to obconical; segments rigid or flaccid, divergent. Leaves intermediate between laminar and capillary rare. Pedicels in fruit rarely less than 50 mm long, longer than petioles of opposed laminar leaves. Sepals 3-6 mm long, spreading, caducous. Petals (9-)12-15(-21) mm long, broadly obovate, contiguous during anthesis; nectar-pits elongate, more or less pyriform. Stamens 15-30. Carpels (25-)30-40(-80), hairy when immature, occasionally glabrous when mature; style lateral to subterminal. Receptacle hairy, remaining globose in fruit.

Distributed throughout most of Britain and Ireland, but absent from much of Scotland and parts of Wales and Ireland. Often found in temporary or disturbed aquatic habitats such as ponds, drainage ditches, newly dug pits, slowly flowing canals, and small streams, but also in more permanent water in larger streams and small rivers. Often found near the source of chalk streams in habitats which dry out for part of the year, where *R. penicillatus* subsp. *pseudofluitans* is at a competitive disadvantage.

R. aquatilis L.

Annual or perennial, caespitose in terrestrial state or spreading-erect under water. Leaves laminar or divided into capillary segments. Laminar leaves occasionally lacking, alternate; stipules triangular, adnate to petiole for three quarters or more their length; petiole up to 90 mm long; lamina up to 30 mm wide, reniform to orbicular, 5- or occasionally 3- or 7-lobed; lobes broadly cuneate, sinus usually less than two thirds the length of the lamina; margin dentate. Capillary leaves invariably present, alternate; petiole up to 25 mm long; lamina globoid; segments rigid or flaccid, divergent. Leaves intermediate between laminar and capillary rare. Pedicels in fruit rarely exceeding 50 mm, shorter than the petiole of the opposed laminar leaf. Sepals 3-5 mm long, spreading, caducous. Petals 5-10 mm long, broadly obovate, contiguous during anthesis; nectar-pits circular, more or less cup-shaped. Stamens 14-22. Carpels (21)32-36(49) hairy when immature, occasionally glabrous when mature; style subterminal. Receptacle hairy, remaining globose in fruit.

Ranunculus aquatilis probably occurs throughout much of Britain, becoming scarcer in Scotland and from the Irish midlands westwards to County Mayo (*Aquatic Plants*). However, the name was previously loosely applied, and records must be based on *R. aquatilis* sensu stricto. Often in similar habitats to *R. peltatus*, i.e. temporary or disturbed aquatic habitats including ponds, ditches and streams, but the two species have not, apparently, been recorded growing together. *Ranunculus aquatilis* is less a plant of streams and more a plant of pools than *R. peltatus*, and has often been recorded from farm ponds, indicating that it may prefer more eutrophic habitats.

R. penicillatus (Dumort.) Bab.

Long-lived perennial, stem up to 3 m long in flowing water. Capillary leaves invariably present; laminar leaves present or absent. Stipules suborbicular to ovate, adnate to petiole for three quarters or more of their length. Capillary leaves shorter than, equalling, or exceeding corresponding internode on mature stem; petiole 5-148 mm long; lamina elongate-obconical to globose, 23-284 mm long; segments (26-) 100-934, rigid or flaccid, sub-parallel or divergent. Pedicel in fruit 50-100 mm long. Sepals 3-7 mm long, spreading. Petals (5-)10-15(-22) mm long, broadly obovate, contiguous during anthesis; nectar-pits elongate, more or less pyriform. Stamens (8-)20-40. Carpels (15-)50-80, hairy or glabrous; style lateral to subterminal. Receptacle distinctly hairy, remaining globose in fruit.

a) R. penicillatus subsp. penicillatus

Laminar leaves alternate when present; petiole 50-100 mm long; lamina up to 46 mm wide and 25 mm long, reniform to suborbicular, occasionally cuneate at base, 3- or 5-lobed; lobes cuneate, sinus two thirds the length of the lamina or less. Margin of lobes entire, crenate or dentate, frequently with capillary appendages. Capillary leaves invariably flaccid, exceeding the corresponding internode on mature stem; petiole 5-60 mm long; lamina elongate-obconical, 70-215 mm long, segments 100-150, sub-parallel. Pedicel in fruit usually longer than petioles of opposed laminar leaves.

Ranunculus penicillatus subsp. *penicillatus* has a western distribution in Britain and Ireland, and is not a common plant (*Aquatic Plants*). It generally occurs over base-poor rocks although in the Irish midlands, it also occurs over carboniferous limestone. The rivers which subsp. *penicillatus* occupies in Britain are base-poor, but in Ireland it spreads into more base-rich habitats, perhaps due to the general absence of competition from subsp. *pseudofluitans*. *R. penicillatus* subsp. *penicillatus* usually grows in rivers, but it is also capable of growing in streams, ditches, loughs and the Grand Canal in Dublin.

b) *R. penicillatus* subsp. *pseudofluitans* (Syme) S. D. Webster Laminar leaves invariably lacking.

Both varieties within subsp. *pseudofluitans* are found in rivers and streams mainly over calcareous or base-rich substrates. Both have a centre of distribution in southern England, becoming scarcer further north. (See Table above under Capillary leaves for comparison).

i) *R. penicillatus* subsp. *pseudofluitans* var. *pseudofluitans* (Syme) S. D. Webster Capillary leaves shorter than, equalling or exceeding the corresponding internode on mature stem; petiole 12-148 mm long; lamina elongate-obconical, 50-284 mm long, segments occasionally as few as 26 in winter and in poor growth conditions, but normally 70-347, rigid or flaccid, sub-parallel or divergent.

Var. *pseudofluitans* is widely distributed throughout Britain but there is only one Irish record, from County Antrim, V.c. H39 (Webster 1991; *Aquatic Plants*). It occurs mainly in rivers and streams, but it has also occasionally been reported from ditches, pools and lakes and, once, from a canal. Like subsp. *penicillatus*, var. *pseudofluitans* is frequently the dominant macrophyte over large stretches of river. The rivers which var. *pseudofluitans* occupies are generally base-rich, but it occasionally occurs in less base-rich rivers, notably the Tweed and the Usk.

ii) R. penicillatus subsp. pseudofluitans var. vertumnus C. D. K. Cook

Capillary leaves normally shorter, and never exceeding twice the length of the corresponding internode on mature stem; petiole 5-32 mm long; lamina globose when rigid becoming obconical when flaccid,

normally 23-70 mm long, but occasionally reaching 105 mm in winter. Segments 100-934, normally rigid and divergent, becoming flaccid during winter months and in shaded conditions.

Var. *vertumnus* has a similar distribution to var. *pseudofluitans* but it is scarcer and more local throughout the distributional range and records from Scotland and Ireland are completely lacking. Like var. *pseudofluitans*, in southern England var. *vertumnus* occurs principally over chalk, and also over other, mainly base-rich, substrates. Further north it occurs over Carboniferous Limestone and New Red Sandstone. Var. *vertumnus* is occasionally found growing side by side with var. *pseudofluitans*, and the two varieties have frequently been recorded from the same river system. However, they appear to have different ecological ranges; var. *vertumnus* has been more frequently recorded from smaller streams and canals, pools and ditches, and its ecological range may be determined more by a requirement for clear, rather than flowing, water.

R. trichophyllus Chaix

Annual or perennial, caespitose in terrestrial state or spreading-erect under water. Leaves divided into capillary segments, laminar leaves absent; stipules oblong to ovate, adnate to petiole for two thirds or more their length; petiole up to 40 mm long; lamina globose to obconical; segments rigid or flaccid, divergent. Pedicels in fruit 11-48 mm long. Sepals 2.5-3.5 mm long, spreading, caducous. Petals 3.5-5.5 mm long, ovate to obovate, not contiguous during anthesis; nectar-pits lunate. Stamens 9-15. Carpels 16-33, hairy when immature, occasionally glabrous when mature; style subterminal. Receptacle hairy, remaining globose in fruit.

Scattered throughout much of Britain and Ireland, but with a centre of distribution in Fenland; becoming scarcer on the south-west peninsula of England, in central Scotland and in the extreme north and south of Ireland. In still or slowly flowing water in temporary or disturbed aquatic habitats such as ponds, ditches or small streams, both in eutrophic and oligotrophic water.

R. circinatus Sibth.

Long-lived perennial or occasionally annual (Salisbury 1960); stems 5-300 cm. Leaves divided into capillary segments. Laminar leaves absent; stipules ovate, adnate to petiole for three quarters or more their length, apex obtuse; petiole 2-5(-10) mm long; lamina circular to semi-circular; segments rigid, divergent, lying in one plane. Pedicels in fruit 20-100 mm long. Sepals rarely exceeding 6 mm long, spreading. Petals rarely exceeding 10 mm long, obovate, contiguous during anthesis; nectar pits lunate. Stamens (5-)20-24(-27). Carpels (30-)42-48(-56), hairy when immature, occasionally glabrous when mature; style lateral. Receptacle hairy.

Ranunculus circinatus is mainly found in southern, central, and eastern England, with progressively fewer records in Wales and further north. It is scarce in Ireland. It is found in areas of permanent water in lakes, gravel pits and slowly flowing rivers and canals. It is usually found in eutrophic waters but is occasionally found in oligotrophic conditions, normally in water 1-3 m deep.

R. fluitans Lam.

Since this is a highly plastic species separate descriptions of the aquatic arid terrestrial states were given by Cook (1966).

AQUATIC STATE: Long-lived perennial; stems up to 6 m long, internodes up to 35 cm long. Leaves divided into capillary segments, rarely less than 8 cm long, laminar leaves absent; stipules oblong to ovate, adnate to petiole for three quarters of their length or more; petiole up to 220 mm long (usually long in winter and short in summer); lamina up to 250 mm long, elongate-obconical; segments few, very

long, firm, sub-parallel, rarely more than 4 times forked. Pedicel in fruit 40-100 mm long. Sepals 4-6.5 mm long, spreading. Petals 5-10, 7-13 mm long, broadly obovate, contiguous during anthesis; nectar pits elongate-ovate to pyriform. Stamens 20-35. Carpels 34-63, sparsely pubescent when immature, frequently glabrous when mature; style lateral. Receptacle glabrous or very nearly so.

TERRESTRIAL STATE: Annual, rarely exceeding 60 mm tall, internodes 0.5-10 mm long. Leaves divided into capillary segments 15-45 mm long; segments rigid, sub-parallel, distinctly flattened, often apiculate at the tips. Flowers very rare, similar but smaller than aquatic state, almost invariably sterile.

Ranunculus fluitans is usually found in permanently flowing water but occasionally colonizes almost stationary water in large drainage ditches where it rarely flowers. It requires a fairly stable substratum and is normally confined to larger rivers with pebble-covered bottoms. Holmes (1979) states that pure forms of *R. fluitans* are known only from England, E Wales and one site in Northern Ireland. In England, it has a mainly central and northern distribution but is also found in the southern counties. Holmes (1979) has reported that *R. fluitans* is intolerant of pollution and has declined in abundance, often being replaced by the more resilient *Potamogeton pectinatus*. Thus, there is a need for existing records to be re-assessed as it may be rarer than was previously thought.

Hybrids

Accounts largely follow Cook (1975), but see also Webster (1986, 1990).

R. ´ bachii Wirtgen (R. fluitans ´ R. trichophyllus or R. aquatilis)

It is not possible to distinguish between *R*. *fluitans* × *R*. *trichophyllus* and *R*. *fluitans* × *R*. *aquatilis*. The hybrids are similar to *R*. *penicillatus* subsp. *pseudofluitans* but are highly sterile and have capillary leaves with a distinctly aberrant appearance, often with rather few, short, capillary segments. The hybrids spread vegetatively. They are almost confined to flowing water and have replaced *R*. *fluitans* in several river systems (map in *Aquatic Plants*). *R*. *fluitans* × *R*. *trichophyllus* is triploid (2n=24) and *R*. *fluitans* × *R*. *aquatilis* pentaploid (2n=40). Parts of the *R*. *penicillatus* group (probably *R*. *penicillatus* subsp. *pseudofluitans*) are thought to be derived from these hybrids or similar plants.

R. ´ kelchoensis S. D. Webster (R. fluitans ´ R. peltatus)

This hybrid is morphologically intermediate between both parents except that the receptacle is hairy and that it develops some leaves that are intermediate between laminar and capillary. In summer, it develops some laminar leaves that resemble those of *R. peltatus*. It is very robust (usually rather larger than either parent) and is sterile. It has been recorded in V.c. 4, 32, 36, 53, 55, 57, 68, 69, 80, 81 & H39.

The hybrid spreads vegetatively and is capable of replacing its parent species. It is pentaploid (2n=40), and this hybrid, or plants like it, are thought to have given rise to some members of the *R. penicillatus* group (probably in subsp. *penicillatus*).



R. ´ novae-forestae S. D. Webster (R. omiophyllus ´ R. tripartitus)

This hybrid resembles *R. tripartitus*, except that the petals are up to 6 mm, the pedicels remain erect at maturity and the laminar leaves are frequently 5-lobed with shallower sinuses and curved lobes. The plants frequently lack capillary leaves, and when these are present they consist of somewhat flattened, non-collapsing segments. Populations of this hybrid grow independently of the parents at a number of localities in the New Forest (particularly near Brockenhurst, Holmsley, Setley, Boldre, Beaulieu and Hatchet Pond) and possibly elsewhere in Britain (pers. comm. R. V. Lansdown, 1998). Populations are heterogeneous and include the products of selfing and back-crossing, some of which are impossible to distinguish from *R. tripartitus*. Populations which have been sampled have been shown to be pentaploid (2n=40) and it is thought that they may reproduce agamospermously. Fertility varies from about 7% to about 60%.



R. mpartitus

Silhouettes of Ranunculus leaves (del. R. V. Lansdown, 1997)

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Author S. D. Webster, February 1988, minor updates T. C. G. Rich, 2012.