KEY TO BROAD-LEAVED PONDWEEDS (*POTAMOGETON*) 1

(Leaves usually > 1 cm wide, but if less than widest near middle rather than parallel-sided)

Only opaque floating leaves present (or appearing so)	Go to table 1
At least some translucent underwater leaves present	Go to table 2

Table 1 – Only opaque leaves present (or appearing so)

P. natans	***P. polygonifolius***	***P.coloratus***
Flexible lighter coloured stretch of stalk usually present below leaf, allowing the leaf to sit on the water surface at an angle to the stalk	Leaf stalk of uniform colour to base of leaf, with the stalk running in a straight line into the leaf midrib.	
Stipules long, >4 cm, acute/subacute, usually stiff and cloudy translucent, especially when dry	Stipules <6.5 cm, obtuse and sometimes hooded, usually floppy and translucent	
Leaves when held up to light with fine hair-like translucent longitudinal veins but cross veins very inconspicuous	Leaves when held to light with network of longitudinal and cross veins similar in colour or darker than the leaf	
Leaf stalk > 1 times as long as blade	Leaf stalk >0.5 times as long as blade (rarely <0.5 in 1-2-unopened leaves)	Leaf stalk 0.1-0.5 times as long as blade (rarely >0.5 on underwater leaves in deep water)
Leaf stalk of even width throughout, with the blade sometimes decurrent onto stalk for a few mm.	Leaf stalk at apex slightly less than 2 x width at base with blade sometimes decurrent onto stalk for a few mm.	Leaf stalk at apex more than 2 x width at base, with blade decurrent onto stalk for up to 1.5 cm.
Fruits 3.8-5.0 mm	Fruits 1.9-2.6 mm	Fruits 1.5-1.9 mm
Long leaf-stalk-like "phyllodes" produced underwater	May produce translucent underwater leaves	May produce translucent underwater leaves and floating leaves often not fully opaque

Notes: *P. gramineus*, *P. alpinus*, *P. nodosus*, *P. x nitens* and *P. x sparganifolius* also produce floating leaves and very rarely may lack translucent leaves when stranded on the draw-down zone when water levels have fallen.

P. x sparganifolius may superficially appear to lack underwater leaves but these are like the leaf-stalk-like phyllodes of *P.natans* but with a narrow strip of translucent tissue along much of their length.

KEY TO BROAD-LEAVED PONDWEEDS (*POTAMOGETON*) 2

(Leaves usually > 1 cm wide, but if less than widest near middle rather than parallel-sided)

Table 2 – Some translucent underwater leaves present

	Leaf tip of translucent leaves acute to mucronate	**Leaf tip of translucent leaves obtuse to rounded (can be tapered but tip itself is obtuse)**
Translucent leaves without stalks, with rounded often somewhat clasping bases	*Groenlandia densa* - all leaves opposite (Also *P.x nitens, P.x salicifolius*)	*P.perfoliatus* - stipules small and very soon decaying (i.e. usually absent). Leaves usually elliptic. *P.praelongus* - stipules > 1 cm., persistent, milky translucent especially when dry. Leaves oblong-lanceolate. *P.crispus* - leaves oblong with strongly toothed , edges. Stem flattened and grooved on broad face. (Also *P.x nitens, P.x salicifolius*)
Translucent leaves without stalks, with tapered (cuneate) bases *	*P.gramineus* - Stipules short, to 2.5 cm on main stem, to 1 cm on side branches, often rolled along length into a spike. Leaves often have upwardly curved sides but arch downwards lengthways. (May have opaque floating leaves) (Also *P.x angustifloius, P. x salicifolius, P.x sparganifolius*)	*P. alpinus* - leaf midrib with very broad air channels (occupying much of leaf base). (May have opaque floating leaves.) *P.epihydrus* - leaves flimsy and ribbon-like, > 18 times as long as wide, width < 1.1 cm. (Floating leaves usually present) (Rare. Western Isles, Lancs/Yorks canals) *P.crispus* - leaves oblong with strongly toothed , edges. Stem flattened and grooved on broad face. (Also *P.x salicifolius)*
Translucent leaves stalked	*P. lucens* - leaf stalk <1 cm *P. nodosus* - leaf stalk > 3 cm (Rare, southern England) (May have opaque floating leaves)	*P.polygonifolius* - leaves lanceolate with tapered base; leaf stalk > 0.5 x leaf length (Usually has opaque floating leaves) *P.coloratus* - some leaves ovate with rounded or truncate bases; leaf stalk usually < 0.5 x leaf length (Sometimes has semi-opaque floating leaves)

* Note: Species which produce floating leaves may produce a few stalked translucent leaves near the water surface.

The most common hybrids are:
P.x nitens which is similar to *P.gramineus* but has leaves with broader, more rounded bases (more obvious on main stems rather than side branches).
P.x angustifolius (previously *zizii*) is intermediate between *P.gramineus* and *P.lucens*. It has the very shiny appearance of *P.lucens* but lacks leaf stalks, while the leaves and stipules are larger than in *P.gramineus*.
P.x salicifolius has the very shiny appearance of *P.lucens* but lacks leaf stalks and has quite broad based leaves .
P.x sparganifolius is very like *P.natans* but the underwater leaf-stalk-like phyllodes have a very narrow strip of translucent tissue along the sides.

Nick Stewart
Updated May 2020

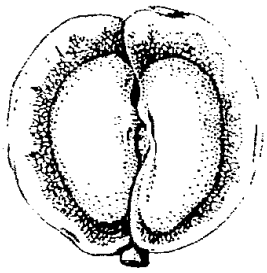
KEY TO NARROW-LEAVED PONDWEED *POTAMOGETON* SPECIES

STIPULES TUBULAR	**STIPULES OPEN WITH OVERLAPPING EDGES**
1a Base of leaf sheathing (like a grass), leaves made up of two tubes	
P.filiformis – Leaves grass green, abruptly pointed tip. Stem branched only at base. Fruits nearly symmetrical with sessile style	*P.pectinatus* – Leaves usually olive-green to brownish, with finely pointed tip. Stem branched all of way to water surface. Fruits asymmetrical with beaked style (Also *Ruppia* species lack the stipule continuing as a "ligule" at the top of the sheath and have minutely toothed leaf tips. They are restricted to brackish water)
1b Base of leaf arising directly from node, blade flat and solid	
2a Leaves less than 2 mm wide	
3a Leaves tapered for some distance to narrowly acute tip	
P.rutilus – brownish, fairly stiff. Stipules quite tough and go whitish when dried	*P.trichoides* – midrib very strong, occupying more than a third of leaf base
3b Leaves abruptly pointed to acute or obtuse tip	
P.pusillus – must check stipules. Nodal glands usually small to absent. Air channels beside midrib usually narrow	*P.berchtoldii* – must check stipules. Nodal glands usually well formed. Air channels beside midrib usually well developed (Note: young *P.natans* without floating leaves could key out here. It has long solid phyllodes without papery tissue and stipules >4 cm long)
2b Leaves more than 2 mm wide	
4a Leaf tips not toothed	
5a Leaves with veins but lacking parenchymous strands	
P.friesii – Leaves with strongly mucronate tip. Stipules with strong veins on either side which often pull apart when old leaving v-shaped stipule. Stem strongly flattened (sharp edged)	*P.obtusifolius* – Leaves with blunt tip or sometimes slightly pointed. Stipules with weak veins and floppy. Stem moderately flattened (rounded edges).
5b Leaves with veins and numerous parenchymous (appear as fine lines running along leaf between veins)	
	P.acutifolius – Leaves with 3 veins. Flower stalks <3cm. 4-6 flowers in head each with 1 carpel. Fruits often with a tooth on the shorter edge. *P.compressus* – Leaves with five veins (though outer pair faint). Flower stalks >3cm. 10-20 flowers in head, mostly with 2 carpels. Fruit without tooth on shorter edge.
4b Leaf tips sharply toothed	
	P.crispus – stem grooved on both sides. The leaves can be narrow and not crisped, resembling *P.obtusifolius* !

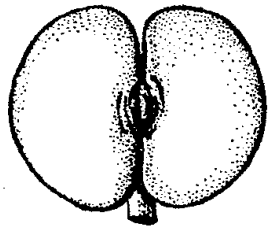
Nick Stewart
Updated May 2020

FRUITS OF WATER STARWORTS (CALLITRICHE)

Leaves mid-green, translucent (Elodea-texture)
No rosettes

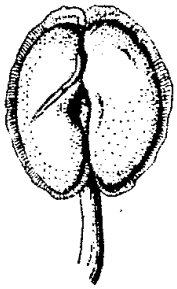


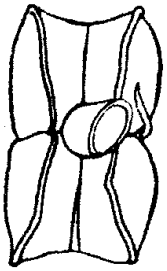
C.hermaphroditica



C.truncata

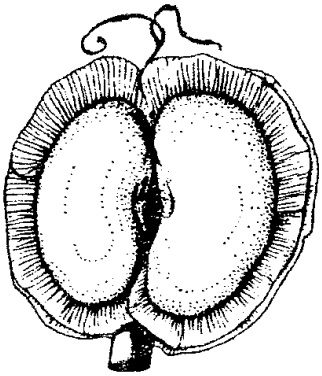
Leaves light green, fairly opaque
Rosettes often produced at water surface

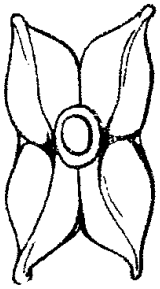




C.brutia (C.hamulata)

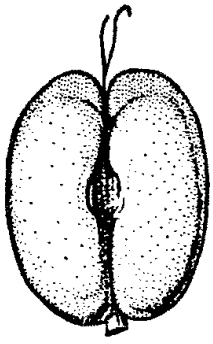
Styles reflexed, emerging from sides of fruit

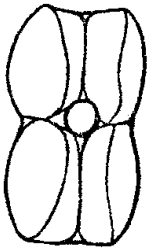




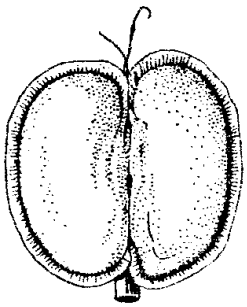
C.stagnalis

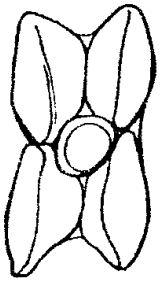
Styles erect, emerging from top of fruit





C.obtusangula





C.platycarpa

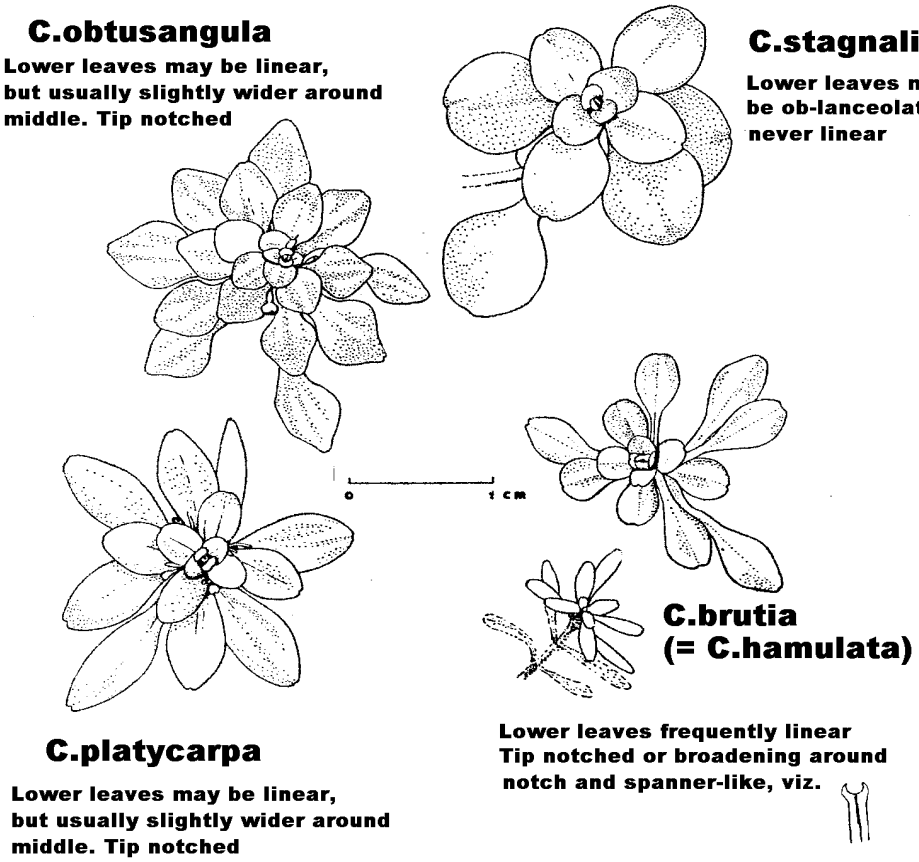
Note also:

C. palustris - Like C. platycarpa/stagnalis but with black fruits winged only in the upper part; very rare in ephemeral pools

C. cophocarpa - Like C. obtusangula but fruits <1.1 mm, as long as wide; not yet recorded in Britain and Ireland but known from central Europe west to Belgium, Denmark and Norway

Drawings reproduced from H.D.Schotsman (1967) Les Callitriches

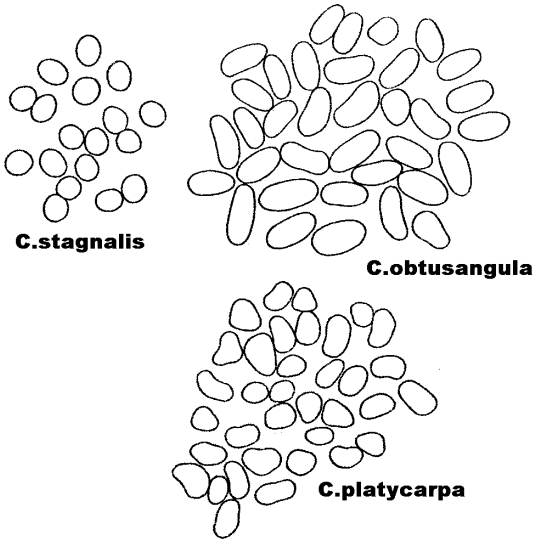
ROSETTES OF WATER STARWORTS (CALLITRICHE)



Drawings from H.D.Schotsman (1967) Les Callitriches

WARNING! - IDENTIFICATIONS SHOULD NOT BE BASED ON LEAF CHARACTERS ALONE; STERILE MATERIAL SHOULD BE RECORDED AS *CALLITRICHE* SP.

POLLEN OF WATER STARWORTS (CALLITRICHE)



Drawings from H.D.Scotsman (1967) Les Callitriches

Revised Nick Stewart July 2018

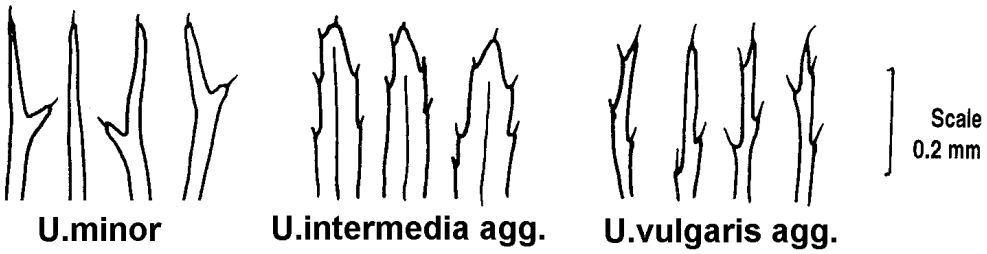
VEGETATIVE CHARACTERS OF *MYRIOPHYLLUM*

NOTES: Measurements refer to leaves near the middle of the stem. Avoid leaves close to the flowers and avoid terrestrial material. In both situations the leaves are often stiffer, shorter and with fewer leaflets

	M.alterniflorum	M.spicatum	M.verticillatum	M.aquaticum (submerged leaves)
Colour	Often dark green but may be brown or reddish	Brown or reddish, particularly stems	Green, usually light to mid green. Never with red colours	Leaves brown to purplish brown, becoming almost black when decaying. Stems and sometimes leaf midribs green
Leaf length	3-26 mm	18-31 mm	15-45 mm	30-40 mm
Number of leaflets	6-18	13-41	15-35	20-32
Leaves in whorl	3-4	(3-)4(-5)	4-5(-6)	5-6
Floppiness of leaves when out of water	Mostly collapsing like paint brush	More rigid like wet feathers	Mostly collapsing but can produce more rigid leaves on stems protruding above water surface	Mostly collapsing but some rigidity close to midrib when fresh. Often reflexed along stem when old
Leaves v. internodes	0.5-2	0.5-1.5(-2.3)	1.4-4(-6.5)	1.5-4
Turions	Absent	Absent	Often present in late summer. Club-shaped	Absent

Nick Stewart updated April 2015.

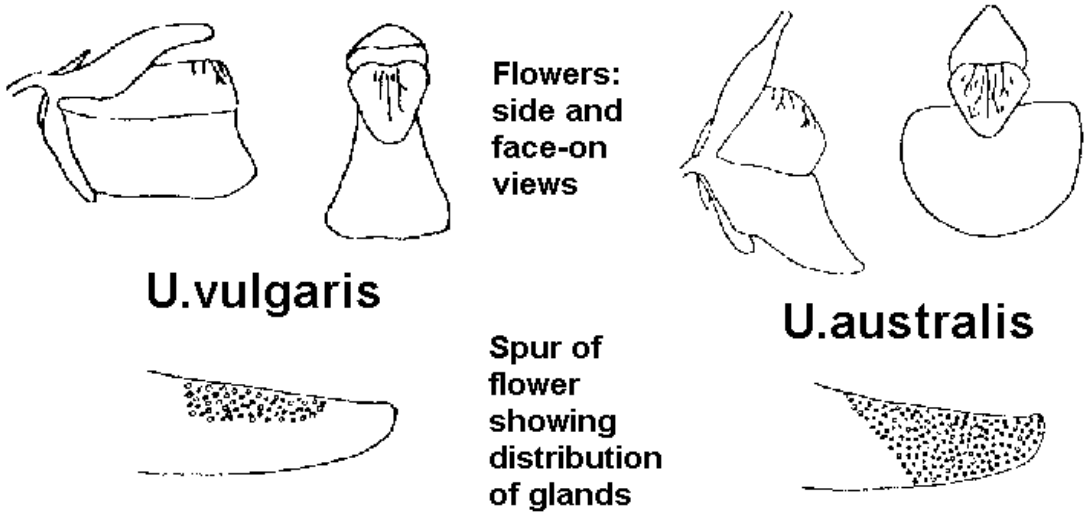
KEY TO BLADDERWORT *UTRICULARIA* SPECIES



Leaf segments of bladderworts

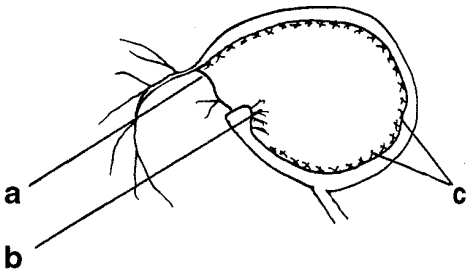
	U.minor	**U.intermedia agg (= U.intermedia, U.stygia, U.ochroleuca)**	**U.vulgaris agg. (= U.vulgaris, U.australis)**
Leaf teeth	Leaves untoothed, with bristles only on segment tips	Leaves toothed, with bristles on teeth and segment tips	
Leaf segment cross-section	Oval	Flattened	Oval
Location of bladders	Some on green leaves, some on separate colourless shoots	All on separate colourless shoots buried in mud. None (or rarely one or two) on green leaves.	All on green leaves. No colorless shoots.

Flower features of U.vulgaris and U.australis



BLADDERWORTS *UTRICULARIA*: LOOKING AT QUADRIFID HAIRS

Quadrifid hairs are specialised hairs that cover the insides of the bladders that secrete enzymes to digest trapped animals and make it more difficult for them to escape out of the bladders. They have four arms with two longer arms and two shorter arms, the two longer ones pointing away from the trap door.



T.S. though a bladder. (a) trap opening, (b) bifid hairs, (c) quadrifid hairs.

The angles between arms of the quadrifid hairs are a useful diagnostic tool and they can be viewed quite easily at magnification x50-x100. However, it is important to note that;

(a) the angles vary across the bladder with those on the long edge having a much narrower angle between the small pair of hairs and those on the short edge have a much wider angle between the short pair of hairs. It is therefore important to look at the quadrifid hairs across the middle of the faces.

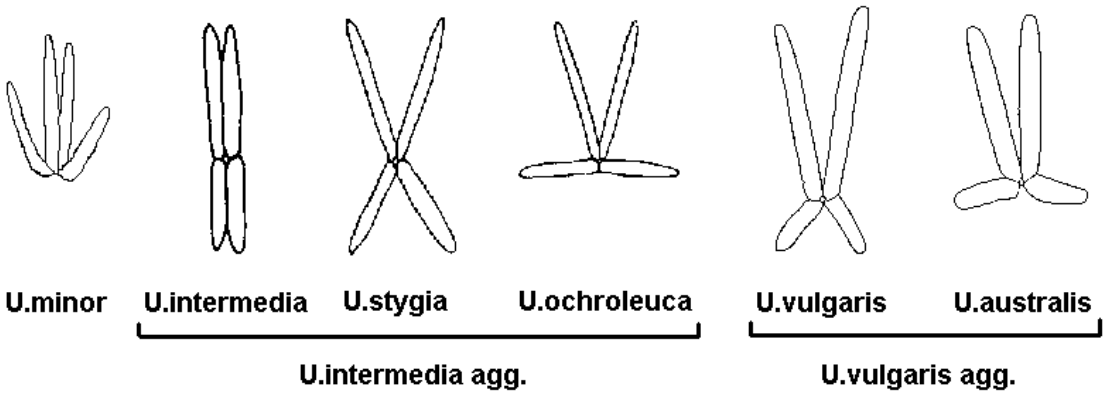
(b) even in the middle of the faces there is some variation and it is important to take an average of at least 5 hairs and preferably to look at several bladders.

How to look:

Choose a well-formed but fairly clean bladder, i.e. one that greyish without much trapped silt or animals. Detach it and place it on a microscope slide. Under a viewing microsope (i.e. c.x20), cut with a sharp blade along the long edge of the bladder. When fresh and water filled, the bladders have enough rigidity that a quick cut will cut most of the way across. Open out the two halves like a butterfly with the inner surface upwards, avoiding touching the inner surface as much as possible as the hairs can be brushed off. Put a cover slip over and press down gently, tapping the cover slip, if necessary, to displace trapped air bubbles. If there is insufficient water to fill the space under the cover slip add drops at the edge of the cover slip. Place under the microscope and examine the hairs in the middle of the faces.

Nick Stewart
29 June 2008

BLADDERWORT *UTRICULARIA*: QUADRIFID HAIRS



		intermedia agg			vulgaris agg.	
	minor	**intermedia**	**stygia**	**ochroleuca**	**vulgaris**	**australis**
Ratio of long to short arms	1.2-2	1.2-2	1.2-2	1.2-2	1.8-2.8	1.8-2.8
Angle between short arms (degrees)	(212-) 243-300 (-324)	(2-) 6-21 (-37)	(30-) 52-97 (-140)	(117-) 146-197 (-228)	(48-) 86-131 (-175)	(52-) 101-157 (-174)

Notes:

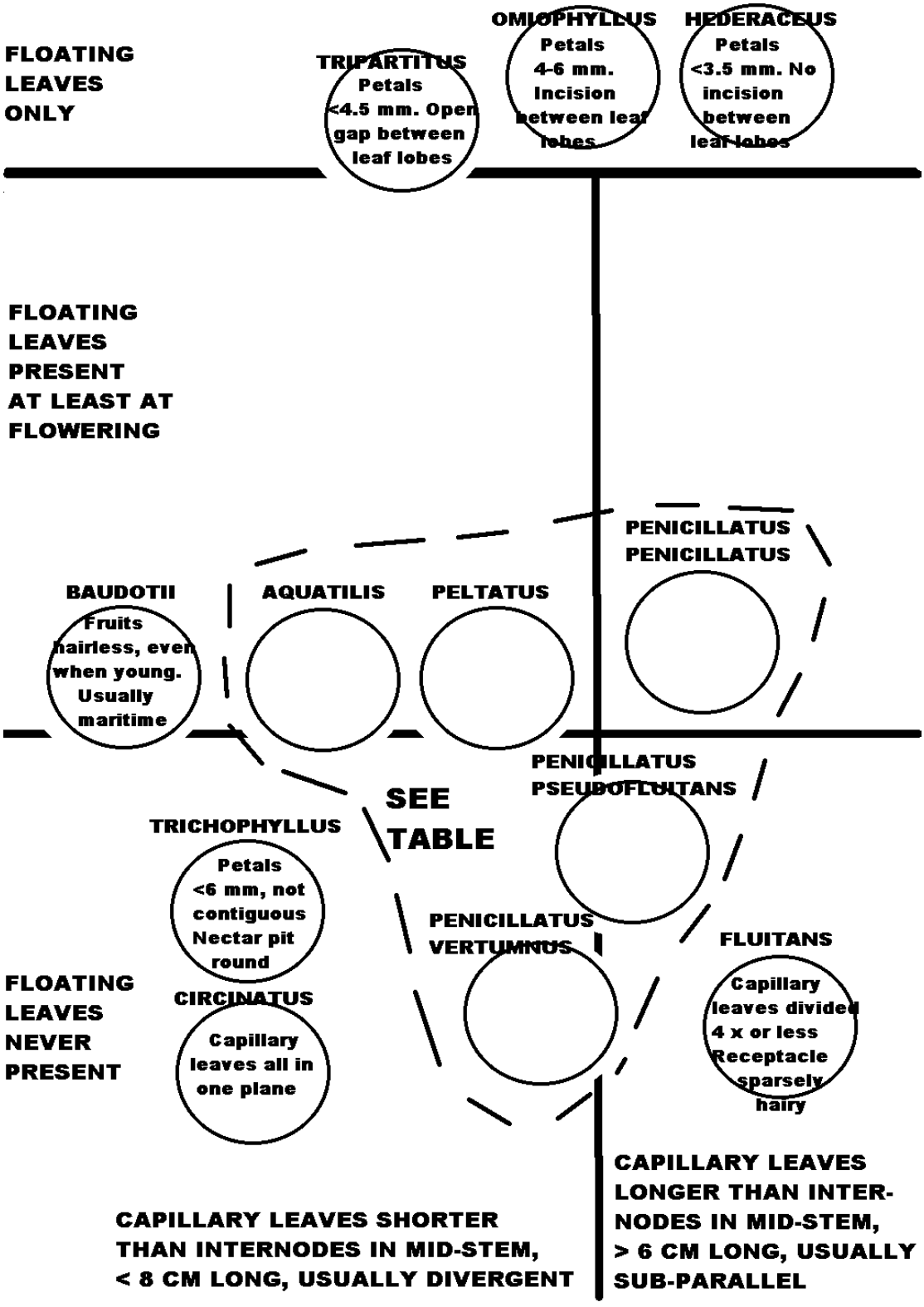
In the U.intermedia aggregate, the ranges are sufficiently distinct for identification. However, in the U.vulgaris aggregate, the overlap is so great that the quadrifid hairs cannot be used for reliable identification.

In the U.intermedia group, U.stygia is much the most common. U.intermedia s.s. occurs in East Anglia (rare) and central Ireland (possibly frequent), while U.ochroleuca may be restricted to N.E.Scotland.

In the U.vulgaris group, U.vulgaris s.s. seems to be more restricted to calcareous fens while U.australis tends to be in acid to neutral waters. However, the rarity of flowers in many areas makes it difficult to be sure of the distributions.

Nick Stewart
29/6/2008

SUMMARY OF WATER CROWFOOTS (RANUNCULUS)



KEY FEATURES OF RANUNCULUS AQUATILIS/ PELTATUS/ PENICILLATUS GROUP

	aquatilis	peltatus	penicillatus vertumnus	penicillatus pseudofluitans	penicillatus penicillatus
Laminar leaves produced	**Usually**	**Usually**	**No**	**No**	**Yes**
Peduncle in fruit compared to opposed laminar petiole	**Shorter**	**Longer**			**Longer**
Petal size	**6-10 mm**	**11-16 mm**	**11-16 mm**	**11-16 mm**	**11-16 mm**
Nectar pit	**Round**	**Elongate**	**Elongate**	**Elongate**	**Elongate**
Capillary leaves shorter or longer than internodes	**Shorter**	**Shorter**	**Usually shorter**	**Shorter or longer**	**Longer**
Capillary leaf length	**3-8 cm**	**3-8 cm**	**2.5-10 cm**	**6-20 cm**	**7.5-30 cm**
Capillary leaves rigid at least in summer	**Rigid or flaccid**	**Rigid or flaccid**	**Rigid and globose in overall shape**	**Rigid or flaccid. When rigid, overall shape ob-conical**	**Flaccid**

Nick Stewart
Updated August 2006