Common problems with identification in *Epilobium* (willowherbs)

BOB LEANEY

Willowherbs (*Epilobium* spp.) cause frequent problems during field identification, partly because of great variation in leaf shape (which most botanists use as their first spotting feature) and partly because of difficulties with interpretation of standard identification characters such as stigma type, stem shape and stem indumentum.

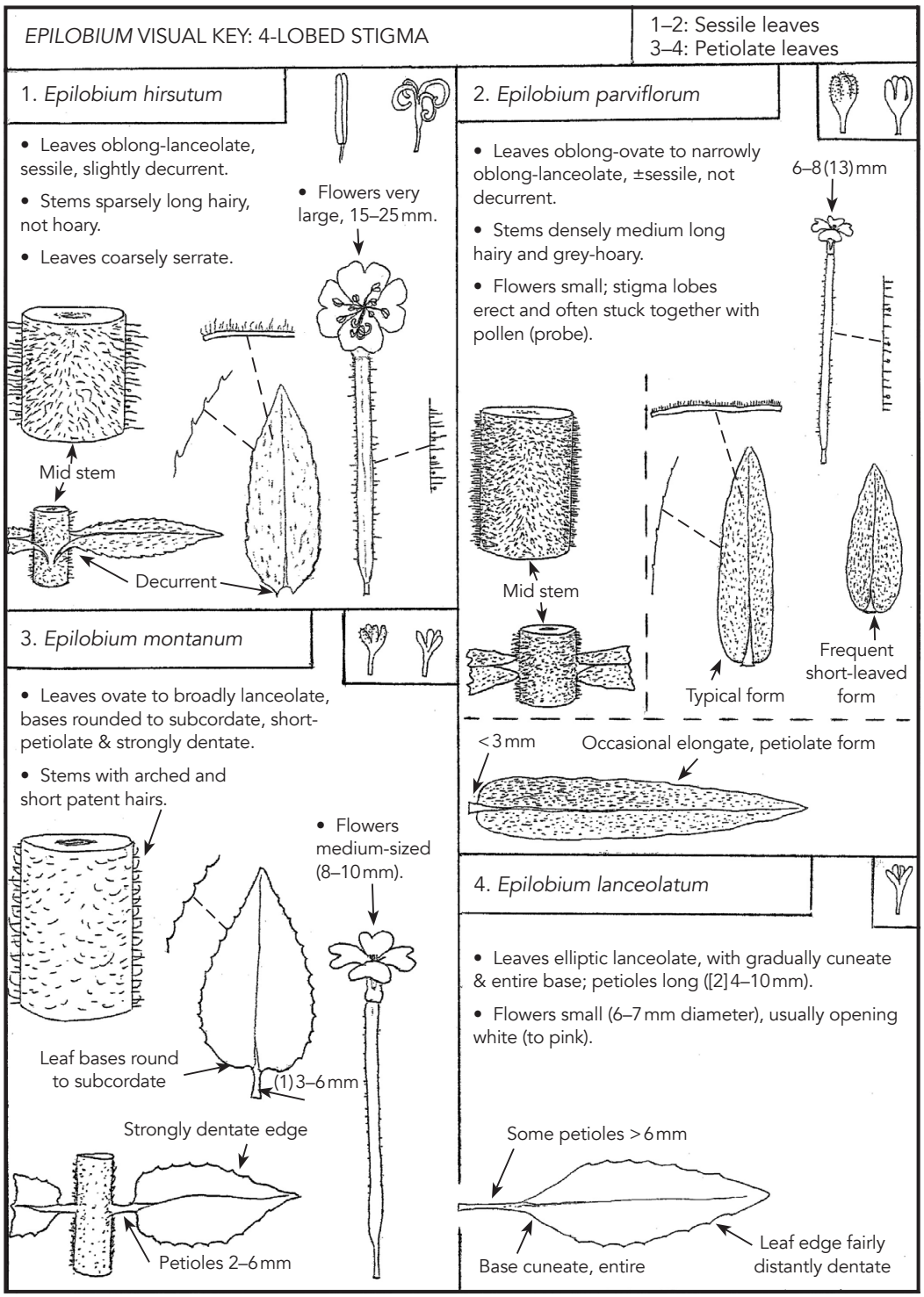
Over a period of about ten years I have kept problem plants found during recording for pressing or photocopying, drawing important identification characters on the same sheet. Especially crucial is stem indumentum, used in standard keys and descriptions (Clapham, Tutin and Moore, 1987; Sell and Murrell, 2009; Stace 2019), but which seems never to have been properly illustrated, at least in easily accessible publications. Findings are presented in this article in the form of a 'visual key', which is not designed to replace standard keys, but rather to aid in their interpretation. Hopefully the discussion and drawings will lead to more accurate recording and more appropriate decisions as to which specimens to send to the referee.

Epilobium palustre (Marsh Willowherb). *John Norton*

The species dealt with will be the usual eight native species found in southern Britain, with only passing reference to *E. lanceolatum* (sufficient to separate it from *E. roseum*). I have not dealt with the two alpine natives, or the mainly northern New Zealand aliens. However, the Norfolk Flora Group has several times found *Epilobium brachycarpum* in recent years, easily recognised by its panicled flowers with tiny, deeply bifid petals, minute linear leaves, short, slightly curved fruits and exceptionally fine, wiry stems.

I have said something about recognising possible hybrids, as hybrids between the usual native taxa are frequent (see Kitchener in *Plant Crib* [Rich & Jermy, 1998]; Stace et al., 2015).

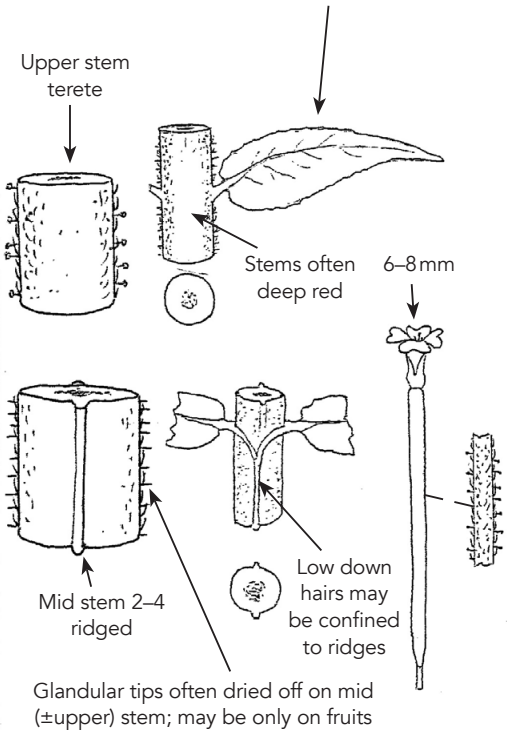
The discussion on *E. lamyi* (or *E. tetragonum* subsp. *lamyi*), which hardly seems to exist in its full blown form in Norfolk, is based mainly on the BSBI *Epilobium* workshop handout, available online (Kitchener, 2015).

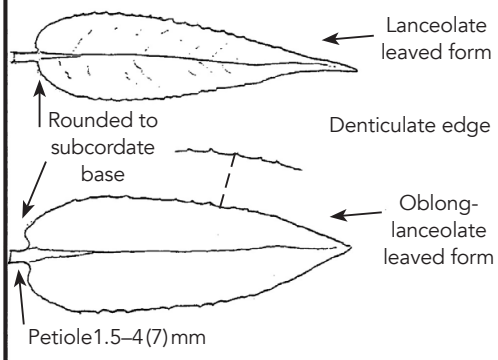

EPILOBIUM VISUAL KEY: 4-LOBED STIGMA
1–2: Sessile leaves
3–4: Petiolate leaves
1. *Epilobium hirsutum*
• Leaves oblong-lanceolate, sessile, slightly decurrent.
• Stems sparsely long hairy, not hoary.
• Leaves coarsely serrate.
• Flowers very large, 15–25 mm.
Mid stem
Decurrent
2. *Epilobium parviflorum*
• Leaves oblong-ovate to narrowly oblong-lanceolate, ±sessile, not decurrent.
• Stems densely medium long hairy and grey-hoary.
• Flowers small; stigma lobes erect and often stuck together with pollen (probe).
6–8(13) mm
Mid stem
Typical form
Frequent short-leaved form
3. *Epilobium montanum*
• Leaves ovate to broadly lanceolate, bases rounded to subcordate, short-petiolate & strongly dentate.
• Stems with arched and short patent hairs.
• Flowers medium-sized (8–10 mm).
Leaf bases round to subcordate
(1)3–6 mm
Strongly dentate edge
Petioles 2–6 mm
< 3 mm
Occasional elongate, petiolate form
4. *Epilobium lanceolatum*
• Leaves elliptic lanceolate, with gradually cuneate & entire base; petioles long ([2]4–10 mm).
• Flowers small (6–7 mm diameter), usually opening white (to pink).
Some petioles > 6 mm
Base cuneate, entire
Leaf edge fairly distantly dentate

EPILOBIUM VISUAL KEY: CLUBBED STIGMA | 1–2: Petiolate leaves

1. *Epilobium ciliatum*

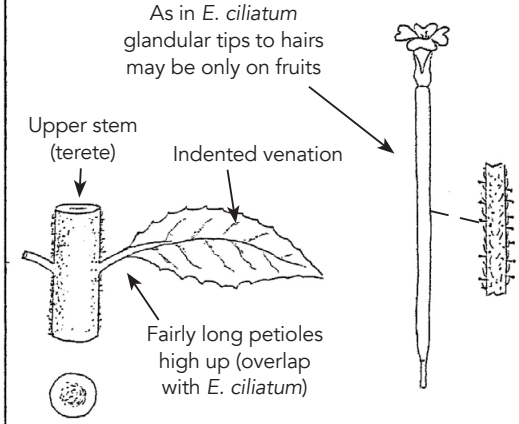
- Leaves lanceolate to oblong-lanceolate, base rounded to subcordate; edge (usually distantly) denticulate; petioles short (1.5–4[7]mm).
- Flowers occasionally open white (to pink).
- Stems often deep red; leaves reddish, shiny.

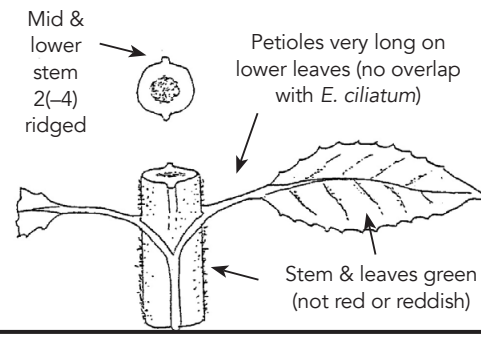




2. *Epilobium roseum*

- Leaves elliptic-lanceolate, base cuneate, edge closely denticulate.
- Petioles very long (4–15[20]mm), especially near base of plant.
- Flowers usually open white.
- Stem shape, ridging and indumentum much as in *E. ciliatum*.
- Stems and leaves not shiny red or reddish tinged.



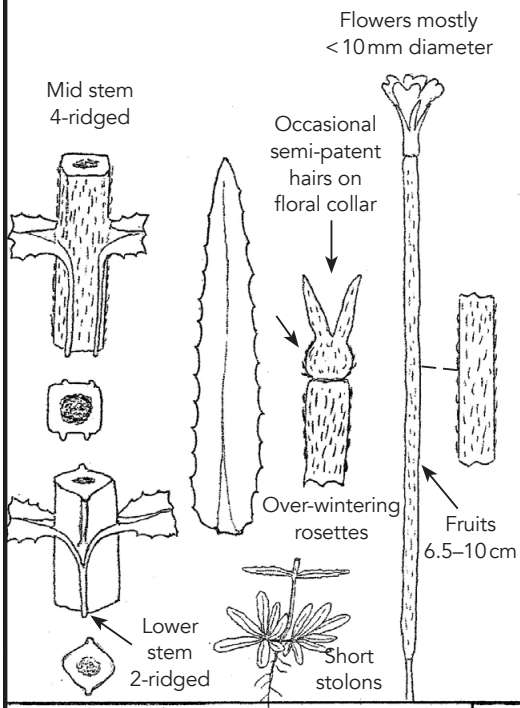


EPILOBIUM VISUAL KEY: CLUBBED STIGMA

3–6: (Sub) sessile leaves

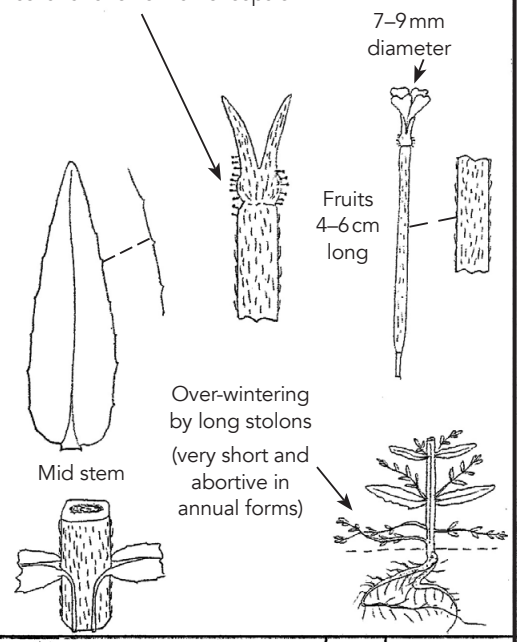
3. *Epilobium tetragonum* subsp. *tetragonum*

- Fruits very long (mostly > 7 cm).
- Leaves narrowly oblong to oblong-lanceolate, strongly dentate.
- Stems squarish and 2–4 ridged from base to mid-zone; terete above.
- All hairs strictly appressed eglandular.



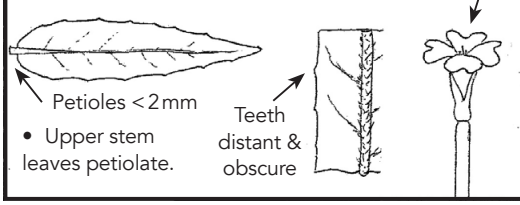
5. *Epilobium obscurum*

- Fruits very short.
- Leaves elliptic-lanceolate, obscurely and distantly dentate.
- Stems squarish and obscurely 2–4 ridged at base and mid-zone.
- Hairs on stems and fruits strictly appressed eglandular, like *E. tetragonum*, except for patent glandular hairs on floral collar and lower half of sepals.



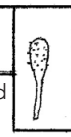
4. *Epilobium tetragonum* subsp. *lamyi*

- Flowers larger and rose (not flesh) pink.
- Leaves greyer green and more lanceolate.
- No decurrence of leaves onto stem.
- Stem shape and ridging as in *E. obscurum*.

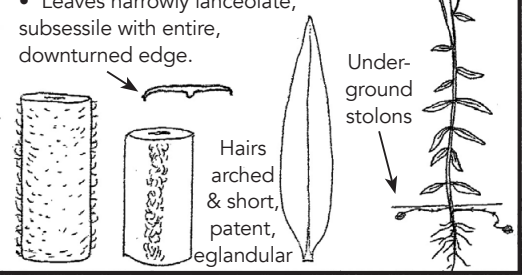


- Upper stem leaves petiolate.

6. *Epilobium palustre*



- Usually a slender, small-leaved plant with terete stems.
- Leaves narrowly lanceolate, subsessile with entire, downturned edge.



Vegetative identification

On the whole, one should not attempt a vegetative identification without considerable experience and even then many plants should be left unidentified, especially when they are only a few inches in height. At this stage the leaves are often very atypical and there is usually no stem indumentum, even in the hairiest taxa such as *E. hirsutum* and *E. parviflorum*.

E. hirsutum should be identifiable very early on because it has unique, coarsely serrate leaf margins and decurrent leaf bases – several other taxa have sessile leaves, but leaves are only clearly decurrent in *E. hirsutum*. With experience *E. parviflorum* may also be identifiable at the young vegetative stage from the combination of dense hoary stem hairiness and sub-entire leaf margin.

In my opinion *E. tetragonum* can also be identified very early on because it has very short stolons and thus produces very characteristic clusters of overwintering basal rosettes. The leaves of these overlapping rosettes tend to be narrowly elliptic or oblanceolate rather than strap-like and can still be found at a later stage when the typical stem leaves, stem indumentum and floral characters can be checked on.

Identification at the flowering and fruiting stage

Identification in the usual eight taxa encountered in southern Britain involves three or four stages: (i) stigma type: clubbed or 4-lobed; (ii) fruit length; (iii) leaf characters (overall shape, basal shape, leaf margin dissection, petiole length, type of leaf insertion into the stem); (iv) a final stage of checking the stem indumentum with a lens.

The first two stages are best accomplished by picking a fruit with a flower on and the third by downwardly stripping off a mid stem leaf. The fourth stage is often neglected because of reluctance to pick a whole plant, but since the characteristic stem hairs are to be found on the upper stem, picking a branch should suffice. The indumentum on the fruits may be a useful proxy for stem indumentum in this situation, but with some provisos (see illustrations).

Stigma type

Here the main problem is found in *E. montanum* and especially *E. parviflorum*, where the four short lobes are often stuck together by pollen in the vertical position to give the appearance of a club, albeit a rather broad one, more resembling the 'fist-shaped' stigma of hybrids between clubbed and 4-lobed taxa. If the stigma is truly 4-lobed it should be quite easy to probe apart the stuck together lobes with a thumbnail.

Fruit length

One common quandary is whether or not fruit length can be used at the flowering stage. On the whole this is an unfounded worry: for instance, at the flowering stage *E. tetragonum* should already have its characteristically long fruits, with some over 7 cm, and *E. obscurum* should have fruits only 3–5 (6.5) cm long. However, it is important to realise that very late flowering plants will often have atypically short fruits.

Leaf and petiole characters

If one strips a mid-stem leaf downwardly from the stem one will remove the whole petiole if present,

Epilobium tetragonum is recognised by its very long fruits and strap-shaped mid-stem leaves. *Bob Leaney*

or show the nature of the leaf insertion if the leaf is sessile. In *E. hirsutum* (or some of its hybrids) the leaf decurrence will be seen as two downwardly directed, shortly triangular strips of tissue, one from each leaf edge, with no petiole visible between. In *E. tetragonum* and *E. obscurum* the leaf base will usually be seen to be sessile and amplexicaul, without any decurrent segments on each side of any petiole, but occasionally the leaf base will be seen to be subsessile (i.e. very shortly petiolate) with a minute extension of the broad basal part of the midrib.

In *E. parviflorum* the leaf is usually also sessile or subsessile but I have found otherwise very typical examples of this taxon with well developed petioles up to 3mm long – usually this is in the long, strap-leaved forms rather than in forms with short elliptic-lanceolate leaves – the lengthening of the petiole being part of the leaf elongation. In these long petiolate plants there was no evidence of hybridity to suggest crossing with a petiolate taxon (see below).

Short petioles are characteristic of *E. montanum*, *E. ciliatum* and long petioles of *E. roseum* (also of *E. lanceolatum* in the south-west of the country). In *E. montanum* the petioles are c.2–6 mm long, with some overlap with the other two taxa, but the 4-lobed stigma and characteristic broadly ovate, regularly serrate and subcordate based leaves usually make the determination easy enough.

E. ciliatum and *E. roseum* both have clubbed stigmas, a not very distinctive and variable leaf shape, and identical stem indumentum. *E. ciliatum* is usually said to have petioles 2–4 mm long, but I have found individuals quite frequently with petioles 5–6 (–7) mm long, without obvious evidence of hybridity. Usually most petioles in *E. roseum* are longer at 4–15 (20) mm, but if one finds an awkward plant with all petioles 5–7mm long one should check the leaf base, which is always truncate-subcordate in *E. ciliatum* and broadly cuneate to rounded in *E. roseum*.

A few years ago we had a brief invasion of *E. roseum* in Norwich and then more occasionally in other towns nearby, lasting only for 2–3 years and probably arriving on vehicle wheels from London, where this taxon seems to be a frequent street weed. The white early flower colour was a very good spotting feature, together with a tendency to an elliptic rather than lanceolate leaf shape and a more indented leaf venation, when compared with *E. ciliatum*.

E. ciliatum (and *E. lanceolatum*) can also show a white early flower colour (Kitchener, 2015). However, in the Norwich population one found that white flowered plants with petioles 1–4(7) mm long, but no longer, had truncate to subcordate leaf bases (i.e. *E. ciliatum*), whereas plants with at least some longer petioles (7–10 (–20) mm), had broadly cuneate to rounded leaf bases (*E. roseum*).

Leaf base shape is therefore a very useful way of separating *E. roseum* from *E. ciliatum*. *E. lanceolatum* has a similar basal leaf shape to *E. roseum*, very long petioles and sometimes a white early flower colour, but is readily distinguished by its 4-lobed stigma.

When assessing petiole length it is important to look at the right level on the plant – it is the lower leaves that usually have the diagnostic long petioles. The first example of *E. roseum* I found in Norwich was a large population in a gravelly car park at a very early stage of growth, with only a short main stem and no branching at all. These plants had an extraordinarily non-*Epilobium* appearance, with broadly elliptic leaves and all petioles 10–15 mm or even up to 20 mm long. I grew one plant on and by the flowering stage the lowermost leaves left on the plant, on the bases of the main branches, had a more typical shape for *E. roseum*, with petioles c.5–10 mm long, more in the usually quoted range. The leaves higher up did not show petioles any longer than can occur in *E. ciliatum.*

Stem ridging

It is not usually realised that 2–4 stem ridges can occur in *E. ciliatum* and *E. roseum*, as well as in *E. tetragonum* and *E. obscurum* – in all four case the number of ridges will depend on the level of the stem and the upper stem will be terete. Stem ridging is best looked for just below a node. It should also be realised that in *E. ciliatum* the ridges may be surmounted, or replaced by, a line of hairs.

Stem indumentum

Here too it is important to look at the right level on the plant. The lower half or so of the main stem and the lower parts of the branches are usually glabrous or show only a sparse and atypical indumentum, so always examine the upper third of the plant. The fruits usually have the same indumentum as the upper stems but not always – for instance on the fruits of *E. hirsutum* and *E. parviflorum* the predominant hair type seen may be the very short glandular hairs that are obscured on the stems by the long and dense eglandular hairs.

The eight usual species one finds on recording sessions in the south divide nicely into four pairs as regards stem indumentum (see illustrations):

(i) Fine patent, eglandular hairs plus very short inconspicuous glandular hairs: *E. hirsutum*, *E. parviflorum.*

(ii) Strictly appressed hairs only: *E. tetragonum*, *E. obscurum* (glandular hairs on floral collar as well).

(iii) Semi-appressed eglandular hairs plus fairly long patent glandular hairs: *E. ciliatum*, *E. roseum*.

(iv) Curved or arched eglandular hairs and short patent hairs: *E. montanum*, *E. palustre*.

These stem indumentum pairings are easy to remember and should enable the great majority of flowering willowherbs to be reliably identified in the field, along with stigma type, fruit length and leaf characters.

In the case of *E. hirsutum* and *E. parviflorum* the fairly long, fine, eglandular stem hairs are surprisingly the same on examination with a lens, and it is mainly the denseness of the hairs in *E. parviflorum* which gives the diagnostic 'hoary' appearance.

E. tetragonum and *E. obscurum* have identical very closely appressed stem hairs, and exactly the same hairs are to be found on the fruits. In *E. obscurum* the diagnostic patent glandular hairs are always confined to the floral collar and lower third to lower half of the calyx lobes, with usually none on the fruits (occasionally on the uppermost few millimetres).

Our group has found two main problems with using stem indumentum in the field: in *E. montanum* and *E. palustre*, where we have had difficulties interpreting the usual descriptions; and the meaning of 'glandular hairs' in *E. ciliatum* and *E. roseum.* It is not uncommon to find suspected *E. montanum* at the pre-flowering stage with atypically narrow leaves, needing a check on the stem indumentum to separate it from *E. ciliatum*. In this situation the group has found it difficult to correlate what is actually seen in the field with the standard descriptions. To my mind the '± appressed' eglandular hairs (Stace, 2019) or 'short curved hairs' (Clapham, Tutin & Moore, 1987) of *E. montanum* are better described as 'arched', in that they emerge at right angles to the stem and have a straight, patent position before slowly curving to point in a direction either parallel to the stem or obliquely upwards. Moreover, the patent hairs mentioned also by Stace (but not by CTM) do not appear to me to be glandular, are no longer than the arched hairs and difficult to see. In *E. ciliatum* and *E. roseum* they are definitely glandular and protrude much beyond the semi-appressed hairs.

The stem indumentum in *E. palustre* is very similar to that in *E. montanum*, except that the arched hairs are rather lower arched. Moreover, the stems are so narrow and the hairs so short that they are very difficult to see in the field. I feel that the Norfolk Flora Group has under-recorded *E. palustre* until recently for this reason, there being very little otherwise to go on except for habit and leaf shape. *E. palustre*, at least the form that we have in Norfolk, more or less confined to fens, is a slender, virtually unbranched and delicate plant with narrowly lanceolate leaves with a downturned and entire edge (see illustration). With experience, this combination of characters, together with a mixture of arched and straight patent hairs, should clinch the determination even at the vegetative stage.

Glandular hairs in *Epilobium*

When examining the stem indumentum of a plant suspected to be *E. ciliatum* it is frequently found that some people can see glandular hairs and some not. This actually should make no difference to the determination because if one sees a mixture of semi-appressed eglandular hairs and fairly long, straight, patent hairs (with or without a glandular tip) this is enough for the identification. However, the fact

that standard descriptions talk of patent glandular hairs and that one often cannot see any glandular tips, can be off-putting. The glandular hairs in *Epilobium* are not like the usual glandular hairs encountered in, say, *Senecio*, *Cerastium* or *Geranium rotundifolium*. These have a separate, spherical cell (the gland) at the top of a single celled stalk. In *Epilobium* the patent hairs are unicellular, with no separate terminal gland cell, although the top of the hair cell is very slightly clubbed – examined under a microscope at 30–60× magnification one can see that there is definitely no cell wall at the base of this very slightly expanded terminal portion. Early on, a glistening drop of glandular secretion is produced around the tip of the hair, but this rapidly dries out. At around the flowering stage patent hairs near the top of the stem or on the fruits will still have drops of secretion and look glandular, whereas the older patent hairs further down will have dried out and look eglandular. At a later stage none will look glandular, for all will have dried out. To my knowledge glossaries never mention this type of glandular hair present in *Epilobium*. I would suggest that it be called a 'unicellular glandular hair'.

Under the microscope *E. roseum* can be seen to have slightly clubbed, blunt-tipped, unicellular glandular hairs on the stem, identical to those seen in *E. ciliatum*. I suspect that the floral collar stalked glands in *E. obscurum* are also of the same type, but the drops of secretion seem larger and do not seem to dry out. This could, however, just be because the floral collar glands are only present for a few days before the flowers drop off, so do not have time to dry out!

Epilobium obscurum

I used to think that *E. obscurum* was a very scarce plant in Norfolk and was therefore surprised to see the dozens of tetrad spots in *A Flora of Norfolk* (Beckett, Bull & Stevenson, 1999), mirrored roughly by the map in the New Atlas (Preston, Pearman & Dines, 2002). My habit prior to these publications was to look for the floral collar glands in *tetragonum* – like willowherbs with elliptic-lanceolate rather than strap-shaped leaves. I was also expecting to find clonal patches of plants connected by stolons, a character made much of in standard descriptions, but which is seldom seen in Norfolk.

In recent years I have begun to use short fruits as well as elliptic-lanceolate leaf shape as spotting features and have checked far more plants for floral collar glands. Doing this I have found many more examples and now realise that *E. obscurum* is quite a common plant, mainly on damp wasteland, shaded woodland rides and fen edge, but much less common in arable than *E. tetragonum*.

E. obscurum in our region tends to be a short, little-branched and delicate plant, usually with 2–4 tiny abortive stolons only a centimetre or less in length arising from just above ground level. Only on three occasions have I found a clone of plants connected by stolons and the taxon seems in our region to be behaving as an annual.

Another problem encountered while deciding between *E. tetragonum* and *E. obscurum* is that *tetragonum* can have one or two semi-patent hairs on the curved base of the floral collar, just above the pod, which can collect dew or rain on their tips and be taken for glands (see illustration). Water drops can also collect on these hairs from condensation if the specimen is taken home in a sealed polythene bag.

Hybrids

A hybrid may be suggested by an unusual combination of characters (especially a mismatch between leaf shape, petiole length and indumentum) or by intermediacy in characters. However, leaf shape and petiole length are so variable that in practice one usually needs to find a clenched fist stigma (in hybrids between clubbed and 4-lobed species), or one of the specific hybrid stigmata (see Kitchener in *Plant Crib*). Of those the most useful in my experience are a much branched candelabra shape, with an abnormally large number of short fruits, producing a preponderance of pale, translucent, sterile achenes.

One of the best ways to find *Epilobium* hybrids is to search for large areas of set aside, abandoned arable or land cleared for building, where very large populations of several species have been able to

grow together for a few years. I found one such site with large, intimately mixed populations of *E. tetragonum*, *E. parviflorum* and *E. ciliatum*, where one could quite easily define the parent species, with their little branched habit, from the hybrids with their broad, much branched candelabra shape. All three of the possible hybrids could be recognised by finding intermediacy in leaf shape and stem indumentum, and in the case of *E. parviflorum* hybrids, by the presence of a fist-shaped stigma and leaf hairiness.

In all the plants with a hybrid habit that had newly opened fruits, around 95% of the achenes still sitting in the fruits were about half-sized, near white and translucent, contrasting with one or two fertile achenes that were larger and an opaque dark brown colour. This would seem to be the most crucial evidence of hybridity.

Conclusions

The willowherbs always provide plenty of problems with identification in the field. The most frequent mistake is to jump to conclusions based on leaf shape, without a preliminary look at the stigma, for leaf shape is particularly variable and often misleading.

Another common mistake is to miss the presence of a short petiole. To check on this one must strip off a mid stem leaf. The basal leaf shape should also be checked at the same time.

Stem indumentum can be very useful in this situation and has not been well illustrated, so the accompanying illustrations should be helpful. I have also suggested some alternative descriptive terms for stem indumentum, for in my experience botanists find standard descriptions difficult to interpret, especially in *E. montanum* and *E. palustre*.

It seems not to be common knowledge that 2-4 stem ridges can occur in *E. ciliatum* and *E. roseum*, as well as in *E. tetragonum* and *E. obscurum*. Appreciation of this fact should prevent much confusion.

I hope my observations on petiole length will not cause confusion. Unexpectedly long petioles that don't fit with other characters should always make one expect hybridity – and hybrids are probably quite common. However, I feel it is worth recording that very typical examples of *E. ciliatum* and *E. parviflorum*, without any stigmata of hybridity, do quite frequently have petioles longer than stated in the usual descriptions. In the case of *E. ciliatum* this observation may help prevent misidentification as *E. roseum.*

Finally, the finding that the glandular hairs on the stems of *E. ciliatum* and *E. roseum* are unicellular and that the drop of glandular secretion at their tips is extracellular and dries out in older plants, should prevent pointless searches for glandular hairs in these taxa. It is the combination of semi-appressed hairs and blunt tipped patent hairs, with or without glandular secretions at their tips, that is diagnostic.

Acknowledgements

I would like to thank members of the Norfolk Flora Group for numerous discussions on *Epilobium* identification over the last decade or two and Geoffrey Kitchener (BSBI *Epilobium* referee) for his detailed comments on an earlier version of the visual key and painstaking help with the final draft; measurements are modified from Stace (2019) and Sell & Murrell (2009).

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