Notes

A TERRESTRIAL FORM OF *CALLITRICHE TRUNCATA* GUSS. SUBSP. *OCCIDENTALIS* (ROUY) BRAUN-BLANQUET (CALLITRICHACEAE)

The distribution and ecology of the Callitrichaceae (water-starworts) is poorly understood in Britain, due mainly to difficulties in identification caused by their high morphological plasticity (Wigginton & Graham 1981; Preston & Croft 1997; Lansdown 1998). The taxonomy of the genus in Europe was clarified by H. D. Schotsman in a series of articles (e.g. Schotsman 1967; Schotsman 1972; Schotsman & Andreas 1974; Schotsman 1977). However, most identification features are microscopic and without ripe fruit it is difficult to identify some specimens without counting the chromosomes. Seven taxa have been reliably recorded in Britain: *Callitriche brutia* Petagna, *C. hamulata* Kütz. ex W. D. J. Koch, *C. hermaphroditica* L., *C. obtusangula* Le Gall, *C. platycarpa* Kütz., *C. stagnalis* Scop. and *C. truncata* Guss. subsp. *occidentalis* (Rouy) Braun-Blanquet (Preston & Croft 1997).

Most of the British *Callitriche* species have two distinct growth forms: an aquatic form generally growing in water (but sometimes exposed by falling water levels) and in some species, producing a rosette of coriaceous leaves if the shoot reaches the surface; and a terrestrial form with short, rigid leaves, generally growing on damp mud (although it can be re-submerged e.g. in tidal reaches of rivers or after heavy rain).

Of the British taxa, two (*C. hermaphroditica* and *C. truncata* subsp. *occidentalis*) were separated into a distinct group (Group 1) by Schotsman (1967) and have frequently been described as having common features which are not shared by other members of the genus. They have translucent submerged leaves, floating rosettes are not produced and there is no known morphologically distinct terrestrial form. In all the *Callitriche* species, stomata are only produced on rosette and terrestrial leaves; as a consequence, stomata have not been recorded on either species.

HABITAT

I found the terrestrial form of *C. truncata* subsp. *occidentalis* in the Cerisières on the Tour du Valat estate in the eastern part of the Carmargue, Bouches du Rhône, southern France in November 1996. The Carmargue represents the delta of the River Rhône with fine, sandy calcareous soils grading southwards into sand dunes. The Cerisières are a complex of small pools up to 0·8 m deep, which dry out during the summer and within which there is a high degree of water level fluctuation during the autumn. Although the pools derive from fresh rainwater, the soils in the area are saline and, over time, standing water becomes mildly brackish as salts are released from the soil (Molina 1996). The vegetation surrounding the pools is mainly *Salicornia* heath, with scattered scrub dominated by *Phillyrea angustifolia* L., and stands of *Tamarix gallica* L. bordering many of the pools. *C. truncata* subsp. *occidentalis* is abundant to dominant in the water, with *Zannichellia pedunculata* Reichenb., *Potamogeton pusillus* L., *Myriophyllum spicatum* L., *Chara vulgaris* L. and *Tolypella glomerata* (Desv.) Leonh. The pools are surrounded by an expanse of wet mud with the aquatic form of *C. truncata* subsp. *occidentalis* and scattered herbs such as *Oenanthe lachenalii* C. C. Gmel. and *Ranunculus sceleratus* L. Where the border of the wet mud grades into *Salicornia* heath, there is a zone 2–3 m wide with abundant plants of the terrestrial form of *C. truncata* subsp. *occidentalis*.

Plants toward the wetter edge of this zone show basal leaves characteristic of the aquatic form, with the apical leaf pairs characteristic of the terrestrial form, while those furthest from the water have fairly uniform small, coriaceous leaves.

In July 1997 I visited Anglesey (v.c. 52) with A. M. Walker and J. E. Smith. We located abundant *C. truncata* subsp. *occidentalis* in its aquatic form in the lake and a stream flowing into the lake from the north-west, which constitute the first records for v.c. 52. In addition, we located a number of plants in the terrestrial form on the margin of a small pond adjacent to the N. W. corner of the lake (grid reference SH/383.701). The plants were very sparse on bare mud with scattered plants of *Ranunculus hederaceus* L. and *Juncus articulatus* L.

MORPHOLOGY

The following description is based on fresh material collected from the Cerisières on the Tour du Valat estate and from near Llyn Coron, Anglesey. (Specimens from Anglesey are lodged at **NMW**.) Roots silvery white, to 16 mm long, adventitious at all except 3–5 apical nodes and arising from the nodes immediately below and between the leaf bases. Stems creeping and flattened, to 35 mm long (n = 10), with only the apical 3–5 nodes held away from the substrate; similar to aquatic form, in that it has few major branches (Barry & Wade 1984), but with more frequent shoots arising in the leaf axils bearing 1–3 pairs of leaves. Leaves opposite, short and truncate to bluntly emarginate, 1·7–4·7 × 0·5–1·2 mm (n = 22), opaque, more or less rigid, with abundant stomata. Axillary hairs abundant, as described by Schotsman (1967), complex, fan-shaped, 2–3-seriate, composed of two basal cells and a number of lines 5–6 cells high; irregularly arranged. Leaf and stem hairs absent. No flowers located. A plant grown in an aquarium where the water level gradually declined through evaporation produced broader leaves at the surface but no rosette and subsequently produced a pair of emergent, terrestrial leaves.

IDENTIFICATION OF THE TERRESTRIAL FORM

The terrestrial form of *C. truncata* subsp. *occidentalis* can be distinguished without difficulty from all previously described terrestrial forms of western European *Callitriche* species, on microscopic examination, by the lack of leaf and stem hairs and the multi-seriate axillary hairs. All other terrestrial forms of *Callitriche* species have leaf and stem hairs, while the axillary hairs are in the shape of a fan of a single row of linear cells supported by a short stalk composed of two cells (Fig. 1). In the field, identification may be more difficult; *C. truncata* subsp. *occidentalis* appears to have darker green leaves which are not attached at the base, whereas all the material which I have seen of the terrestrial forms of other *Callitriche* species suggests that the leaves are connate at the base (Fig. 1).

If *C. hermaphroditica* is also found to adopt a terrestrial form, then it is likely to resemble *C. truncata* subsp. *occidentalis* in all these aspects. The only reliable feature distinguishing plants of *C. hermaphroditica* from *C. truncata* subsp. *occidentalis* in the field is the broad wing on the fruit of the former, while the fruit of the latter lacks a wing and is distinctly rounded. As both species are described as only having submerged pollination (Schotsman 1967) and therefore terrestrial plants are unlikely to fruit, it is unlikely that it will be possible to separate the terrestrial forms of these two species in the field.

DISCUSSION

Schotsman (1967) separated the European *Callitriche* species into five distinct groups, based on their morphology and reproductive biology. One aspect cited in this separation is the lack of a known terrestrial form in those species assigned to Group 1 (which includes *C. truncata, C. hermaphroditica, C. pulchra* Schotsman and *C. fassettii* Schotsman, an American species). Although there is no reason to doubt the validity of the grouping, discovery of a terrestrial form of *C. truncata* subsp. *occidentalis* suggests that, in suitable circumstances, the other species in this group may also adopt a terrestrial form.

Until recently, *C. truncata* subsp. *occidentalis* had only been recorded from permanent waterbodies (Barry & Wade 1984) and it is not surprising that the terrestrial form had not been recorded. However Grillas *et al.* (1989) note that in the Carmargue this species is adapted to temporary marshes with an early drying date, in shallow waters where flooding often lasts less than 30 weeks. Grillas (pers. comm., 1996) noted that terrestrial forms of *Callitriche* occur adjacent to waterbodies which support *C. truncata* although the identification of terrestrial plants has not previously been confirmed. Until now, the geographical distributions of *C. hermaphroditica* and *C. truncata* subsp. *occidentalis* were thought to be virtually vicarious. However, *C. hermaphroditica* has been known to occur on Anglesey since at least 1867 (Hegelmaier 1867) and has been collected from Llyn Coron on a number of occasions including as recently as 1975 (R. H. Roberts specimen in **NMW**). In view of the potential confusion of these two species in the field, recorders are therefore encouraged to submit material of plants of these two species for confirmation by the author.

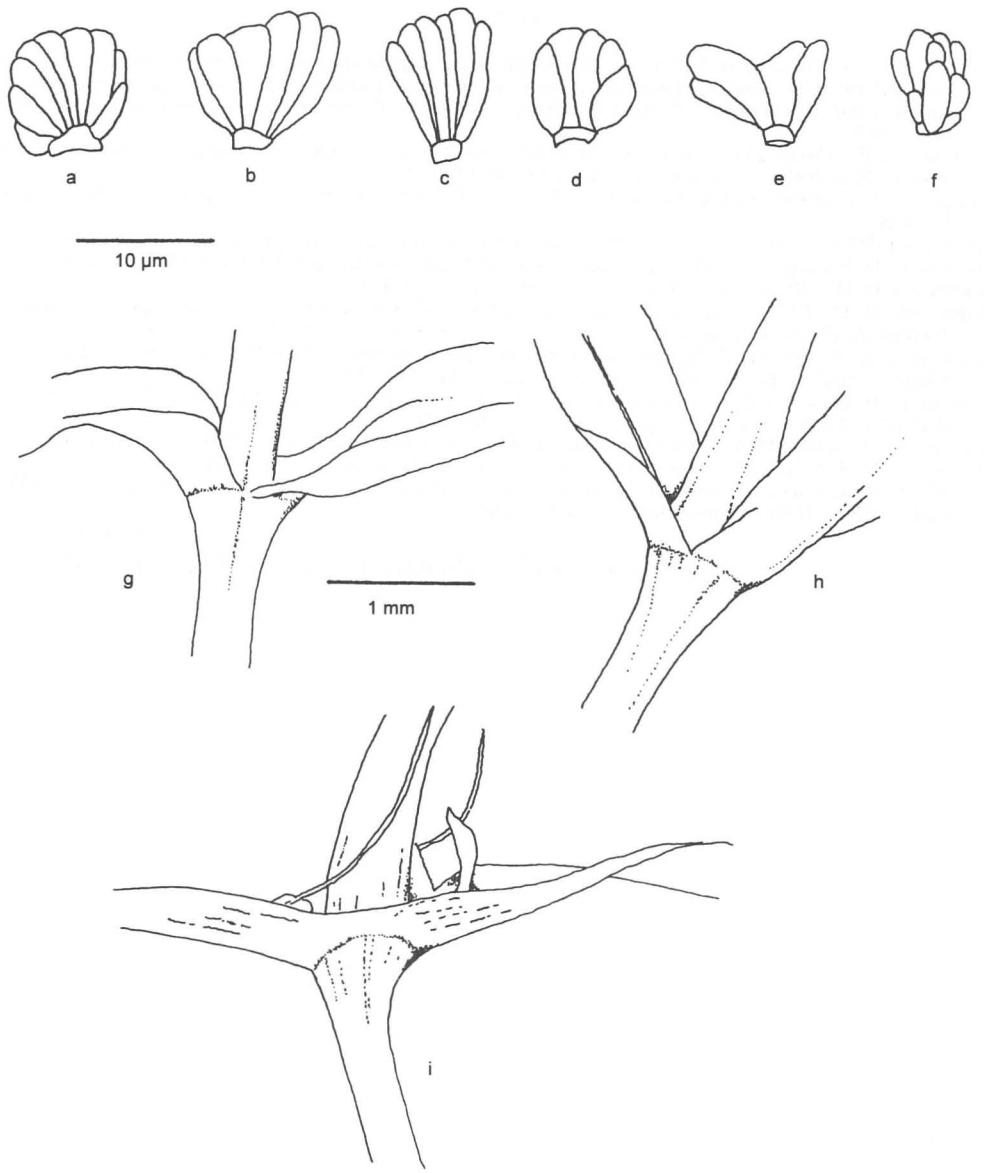

FIGURE 1. Axillary hairs (a–f, scale bar = 10 µm) and leaf-bases (g–i, scale bar = 1 mm) of British *Callitriche* species. a: *C. hamulata*; b: *C. brutia*; c: *C. obtusangula*; d: *C. stagnalis*; e: *C. platycarpa*; f: *C. truncata*; g–h: *C. truncata*; i: *C. stagnalis*.

ACKNOWLEDGMENTS

Thanks are due to Dr Luc Hoffmann of the Station Biologique de la Tour du Valat, for access to the Tour du Valat estate and Biological Station library; to Jean-Laurent Lucchesi, manager of the Marais du Vigueirat Reserve for funding my visit; to Patrick Grillas for suggestion of sites to survey. Nigel Holmes, Chris Preston, Nick Stewart and Tim Pankhurst provided constructive comments on an earlier draft, while Chris Preston and Nick Stewart provided me with valuable background material.

REFERENCES

GRILLAS, P., VAN WIJKE, C. & BATTEDOU, G. (1989). *Impact of flooding date on the biomass and species composition of the submerged macrophyte beds in temporary marshes in the Camargue. Implications for management.* in LEFEUVRE ed. 3ème Conférence Internationale sur les Zones Humides, Rennes 19–23 Sept. 1988.

HEGELMAIER, F. (1867). Zur Systematik von *Callitriche. Verhandlungen des Botanischen Vereins für die Provinz Brandenburg und die angrenzenden Länder* **9**: 1–41.

LANSDOWN, R. V. (1998). *Callitriche*, in RICH, T. C. G. ed., *Plant crib*. Botanical Society of the British Isles, London.

MOLINA, J. (1996). *Flore de Camargue*. Parc Naturel Régional de Camargue, Bouches du Rhône, France.

PRESTON, C. D. & CROFT, J. M. (1997). *Aquatic plants in Britain and Ireland*. Harley Books, Colchester.

SCHOTSMAN, H. D. (1967). *Les Callitriches*. Editions Paul Lechevalier, Paris.

SCHOTSMAN, H. D. (1972). Note sur la répartition des Callitriches en Sologne et dans les régions limitrophes. *Bulletin du Centre d'Étude et Recherches Scientifiques, Biarritz* **9**: 19–52.

SCHOTSMAN, H. D. (1977). Callitriches de la région Mediterranéenne: Nouvelles observations. *Bulletin du Centre d'Étude et Recherches Scientifiques, Biarritz* **11**: 241–312.

SCHOTSMAN, H. D. & ANDREAS, C. H. (1974). *Callitriche lenisulca* Clav. espèce méconnue. *Bulletin du Centre d'Étude et Recherches Scientifiques, Biarritz* **10**: 285–316.

STEWART, A., PEARMAN, D. A. & PRESTON, C. D. (1994). *Scarce plants in Britain*. JNCC, Peterborough.

WIGGINTON, M. J. & GRAHAM, G. G. (1981). *Guide to the identification of some of the more difficult vascular plant species – with particular application to the Watsonian vice-counties 66–70, Durham, Northumbria and Cumbria.* Nature Conservancy Council, Banbury.

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