

## The occurrence of *Lemna minuscula* Herter in the British Isles

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### ABSTRACT

The occurrence of the alien duckweed, *Lemna minuscula*, in the British Isles is reported and the details of the localities listed. The characters differentiating this species from other native duckweeds are discussed.

### INTRODUCTION

The number of species recorded as aliens in the British flora now numbers several thousand, but of these only a tiny minority could claim to have become thoroughly naturalised over a wide area. The colonisation of a few, such as *Senecio squalidus* and *Veronica filiformis*, has been well documented, but the majority of even these are characteristic of disturbed or secondary habitats. It is thus all the more remarkable that a hitherto unknown alien species has recently been discovered in Britain, which not only seems to be widespread, but is thoroughly established in native communities. Furthermore, in view of the current revival of domestic interest in the alien flora, there is some irony in the fact that its discoverer was a visiting botanist and, moreover, that it was found in an area which over the years could boast of having had more than its fair share of competent field workers! Great credit is therefore due to Professor Elias Landolt, of Zurich, who on 2nd September 1977 collected material of a duckweed from a ditch running parallel to the River Cam, on Coe Fen, just a few hundred yards from Cambridge city centre, v.c. 29, and showed it to be the first British record for *Lemna minuscula*, a species native to the warmer regions of both North and South America. Since the publication of this record (Landolt 1979) *L. minuscula* has been detected in a further 10 vice-counties, in a total of 23 separate localities. It is clearly a well established member of the British flora that has gone unrecognised for many years. This paper details these records, and discusses the morphological characters used to distinguish it from the other native duckweeds.

### DESCRIPTION OF *L. MINUSCULA*

*L. MINUSCULA* Herter, *Rev. Sudamer. Bot.* 9: 185 (1954).

*L. minima* Philippi, *Linnaea* 29: 45 (1857), non Thuill. ex P. Beauv. (1816).

(*L. minuta* Kunth (1816) is sometimes given as the earliest valid name for *L. minuscula* (e.g. Kartesz & Kartesz 1980), but this is incorrect as it is a later homonym of *L. minuta* Raf. (1808)).

Free-floating aquatic. Fronds usually pale green,  $\pm$  translucent, solitary or cohering in twos or threes, 1.0-3.0 mm long, each with a solitary root, its root sheath unwinged. Outline of frond usually elliptic, sometimes oblong or obovate, often symmetrical about the long axis, margins entire. Veins absent or, more usually, with one short vein not extending beyond the larger-celled

(aerenchymatous) tissue. Upper surface often with a longitudinal ridge which forms a slight point at the obtuse apex, and appearing as a pale line to the naked eye. Lower surface  $\pm$  flat or slightly convex, the aerenchymatous tissue often restricted to the area around the root base and centre of the frond, leaving a broad border of smaller cells. Seed elongate. (Flowering has not been observed in the British Isles). Chromosome number  $2n=40$  (from British material, see Urbanska-Worytkiewicz 1980).

#### DIAGNOSTIC CHARACTERS OF *L. MINUSCULA*

In comparison with other British members of the Lemnaceae, the solitary root immediately separates *L. minuscula* from the rootless *Wolffia arrhiza* and also from *Spirodela polyrhiza*, which always has two or more roots per frond, as well as having at least three veins. *L. gibba* in its typical gibbous state is easily separated, but in plants in which this character is poorly developed one has to rely on the larger size of both the frond and the aerenchymatous cells in *L. gibba*, its possession of 3(-5) veins and sometimes the presence of reddish or brownish pigment on the upper surface of the frond. Differentiation from *L. minor* can be more of a problem, and it is with this species that most confusion has arisen. Table 1 sets out the characters which may help in separating these two species, and they are both illustrated in Fig. 1.

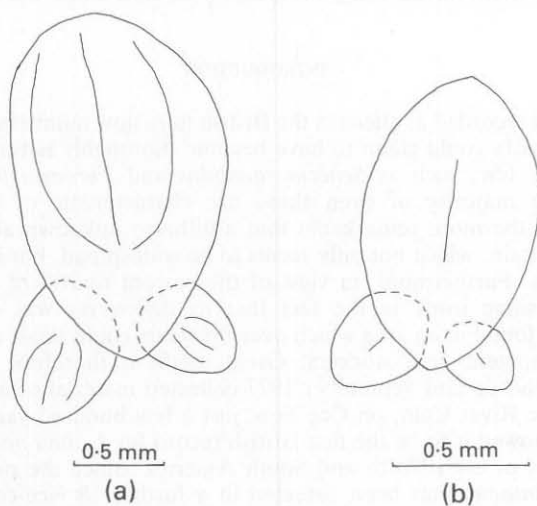


FIGURE 1. Frond outlines and veining in *Lemna minor* (a) and *L. minuscula* (b).

Landolt (1979, 1980) rightly places great emphasis on the vein number in order to separate *L. minuscula* and *L. minor*, and this does appear to be the only absolutely reliable character. However, although admirable in theory, it can be very difficult to apply in practice, especially in the field. In particular the solitary vein in *L. minuscula* is often so faint that it really is impossible to detect under field conditions. On the other hand, with a little practice it is usually possible to see the veins in *L. minor* by holding the frond so that light is transmitted through it but so that the face of the frond is not at right angles to the main light source. On some occasions even this will give unconvincing results, especially with populations of small *L. minor*, and to resolve such cases it is necessary to clear the fronds. This may be effected by boiling them for about 30 seconds in lactophenol, after which they become completely colourless and translucent. The veins can then be discerned with no difficulty.

TABLE 1. COMPARISON OF *L. MINOR* L. AND *L. MINUSCULA* HERTER

	<i>L. minor</i>	<i>L. minuscula</i>
Number of veins	3	(0-)1
Fronde length	(2.0-)3.0-5.0 mm	1.0-3.0 mm
Fronde colour	Dark green, opaque	Pale green, $\pm$ translucent
Fronde shape	Tends to be obovate and often asymmetrical	Tends to be elliptic and symmetrical
Fronde apex	Obtuse, usually rounded and without a point	Obtuse, usually with a slight, but distinct, point
Upper surface	Usually without a ridge, smoothly rounded	With a longitudinal ridge, often visible to the naked eye as a pale line
Lower surface	Aerenchymatous tissue often extending almost to the edge of the frond, leaving a very narrow border of smaller cells	Aerenchymatous tissue often restricted to the root base and centre of the frond, leaving a wide border of smaller cells
Seed shape*	Obovate	Elongate

\* not observed on British material

Individually the other vegetative characters listed in Table 1 should be regarded as guides rather than definitive indicators. In common with most other aquatic plants, many of the vegetative characters in Lemnaceae are subject to a great deal of phenotypic plasticity, depending on a range of environmental factors. The difficulty encountered by many field workers in recent years in differentiating the naturalised species of *Elodea* on vegetative characters alone will no doubt have brought this point home. In *Lemna* the rarity of flowering in this country precludes the use of any reproductive characters, although there would appear to be little to offer in this respect, other than seed shape, judging by previous accounts (e.g. Daubs 1965, Thompson 1898).

Nevertheless it would be a mistake to give the impression that these characters are of little worth, since most are usually exhibited by the majority of plants in a population of a given species. Small plants of either species are likely to be the most troublesome, as the characters associated with frond shape are then often obscured. This may especially be the case with plants collected in the winter or from heavily shaded sites. Frond size in particular must be treated with caution because, although when they are grown under identical conditions *L. minuscula* is always smaller than *L. minor*, there is a distinct overlap, and populations of the latter with uniformly small fronds are sometimes seen.

#### OTHER SIMILAR ALIEN SPECIES

*L. valdiviana* Philippi is the only other species with a single-nerved frond that could be confused with *L. minuscula*. It may be told by its longer nerve, which reaches at least three-quarters of the distance from the node to the apex (i.e. well beyond the aerenchymatous tissue) and by its longer, narrower fronds which are often very asymmetrical. It was listed and described as a naturalised alien in south-western France by Lawalrée (1980) in the final volume of *Flora Europaea*, but although the description is indeed of *L. valdiviana* the plants concerned have since been shown to be *L. minuscula*. Lawalrée lists one other alien duckweed in Europe, *L. perpusilla* Torrey, from rice fields in northern Italy. This not only has a 3-veined frond but the roots have a winged sheath.

A key to all the species of the Lemnaceae, including *Lemna*, *Spirodela*, *Wolffia* and *Wolffiella*, is given by Landolt (1980).

#### ECOLOGY AND DISTRIBUTION

*L. minuscula* has been reported from a wide range of freshwater habitats—in ponds, ditches, canals and rivers—and in this respect does not differ from the native species. However, its occurrence, in the absence of all other duckweeds, in the flooded peat diggings at Holme Fen, Hunts., v.c. 31,

TABLE 2. KNOWN LOCALITIES FOR *L. MINUSCULA* IN THE BRITISH ISLES  
 Those localities from which the authors have seen material are indicated by an exclamation mark (!)

v.c. 13 W. Sussex:	Abundant in the disused Chichester Canal to the south-west of Chichester, GR 40/840.012, M. Briggs, September 1980! Abundant in ditch by River Arun, Arundel, GR 50/026.068, T. C. G. Rich, 29 September 1981.
v.c. 14 E. Sussex:	Abundant in pond by 'Twin Sisters', near Iden, GR 51/912.236, D. Robson, comm. E. G. & L. B. Burt, November 1980! Also in stream below pond, for a short distance.
v.c. 15 E. Kent:	Abundant in River Stour, Thannington, near Canterbury, GR 61/132.569, T. C. G. Rich, September 1981!
v.c. 16 W. Kent:	Abundant in an arm of the River Medway, just to the north of the main channel, Branbridges, East Peckham, GR 51/673.485, A. C. Leslie, 14 November 1981! <b>Herb. A. C. L.</b>
v.c. 17 Surrey:	Abundant on north side of River Wey and in an adjacent old oxbow, just north-east of sewage works, Wisley, GR 51/062.598, A. C. Leslie, 12 September 1980! <b>Herb. A. C. L.</b> Abundant in old mill pond, Ockham Mill, Ockham, GR 51/055.579, A. C. Leslie, 15 September 1980! Abundant in the disused Basingstoke Canal, west of St Johns, Woking, GR 41/969.573, A. C. & J. F. Leslie, 1 January 1981! North-east side of pond, Whitmoor Common, Worplesdon, GR 41/983.538, E. C. Wallace, 14 February 1981! <b>Herb. A. C. Leslie.</b> Pond by farm track, south of Cranleigh, GR 51/063.355, J. E. Smith & S. Wenham, June 1981. Two ponds in Blockfield Wood, south-east of Lingfield, GR 51/417.401 & 416.407, J. E. Smith & S. Wenham, July 1981.
v.c. 19 N. Essex:	Shallow ditch, Burnt Mill, west of Harlow Town Station, Harlow, GR 52/438.112, P. J. Wanstall & K. J. Adams, 13 October 1978!
v.c. 20 Herts.:	Very sparingly in the Grand Union Canal, south-west of lock, Croxley Green, GR 51/080.951, K. W. Page, 1 August 1981! Also scattered between here and the lock at 51/088.963, in the River Gade at 51/082.952 (both A. C. Leslie, November 1981!) and in a ditch by the River Gade at 51/091.963 (M. V. Marsden, November 1931!) Frequent along banks and in side channels leading into the River Colne, Moor Park, GR 51/077-8.941, A. C. Leslie, 21 November 1981!
v.c. 21 Middlesex:	River Ash, Shepperton, GR 51/081.685, S. Wenham, 6 July 1981! <b>Herb. A. C. Leslie.</b> Near bridge over the River Colne, Staines Moor, Staines, GR 51/035.724, E. Brooks, July 1981 (conf. J. E. Smith). South end of ornamental water, Hampton Court Gardens, GR 51/158.682, S. Wenham, July 1981. Pond in Bushey Park, GR 51/167.697, S. Wenham, July 1981.
v.c. 29 Cambs.:	Sparingly in ditch running parallel to the River Cam, Coe Fen, Cambridge, GR 52/447.577, E. Landolt, 2 September 1977. Confirmed in same locality, G. Crompton & S. M. Walters, 2 September 1980! CGE.
v.c. 31 Hunts.:	Abundant on shoreline of flooded peat diggings, Holme Fen (N.N.R.), GR 52/192.893, S. M. Walters, 1 August 1981! <b>Herb. A. C. Leslie.</b>
v.c. 51 Flints.:	Plentiful by pier on north side of Llyn Helyg, GR 33/115.775, A. O. Chater, R. W. David & G. Wynne, 31 September 1981! <b>Herb. A. C. Leslie.</b>

suggests that it may be more tolerant of such oligotrophic conditions. The report by Lüönd (1980) that *L. minuscula* has a significantly broader range of tolerance of nitrate concentration than *L. minor* lends support to this supposition. Generally wherever it occurs it is in considerable quantity, either in open water or amongst emergent vegetation, sometimes to the exclusion of other free-floating aquatics. More usually it is accompanied by one or more of the other duckweeds, or occasionally by the aquatic thallose liverwort *Riccia fluitans* or another American alien, *Azolla filiculoides*. In the disused Basingstoke Canal, at the point where it passes through the district of St Johns, Woking, Surrey, v.c.17, the *Azolla* and *L. minuscula* are a particularly attractive combination in winter, the water fern in its pink autumn and winter colours filling the centre of the canal, flanked on either side by bands of pale green duckweed.

In cultivation there is some evidence to suggest that *L. minuscula*, despite its small size, is more aggressive. In pans which contain a mixture with *L. minor*, *L. gibba* and *Spirodela polyrhiza*, the *L. minuscula* eventually overgrows all the other species, forcing them down below the water surface.

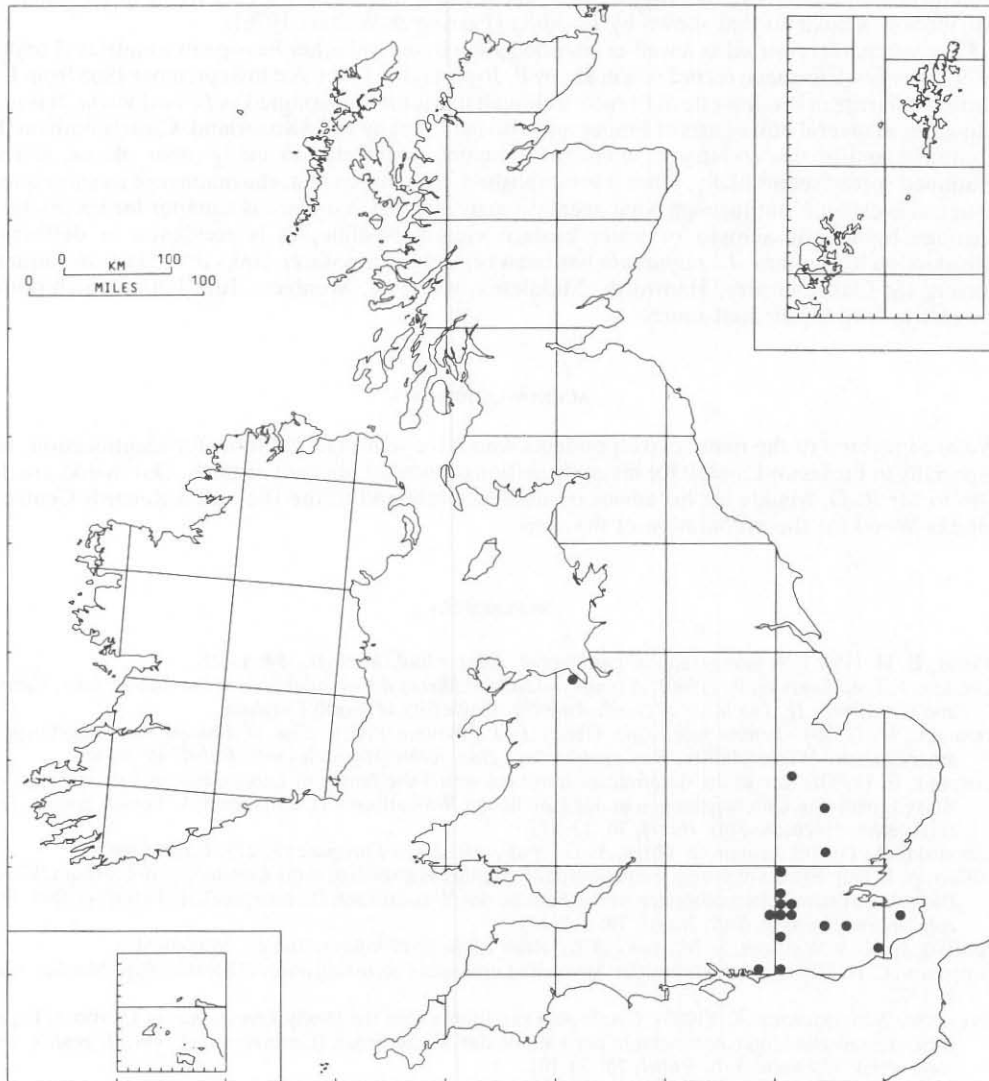


FIGURE 2. Distribution of *Lemna minuscula* in the British Isles.

This would clearly be an important factor in its successful colonisation in this country, and recalls the startling population explosion of *Elodea canadensis* after its introduction into Britain in 1842 and the similar, if less spectacular, spread of *E. nuttallii* in recent years.

The distribution of localities reported up to the end of 1981 is shown in Fig. 2, and full details of these are given in Table 2. It is now known from 10 English and one Welsh vice-county, in a total of 24 separate sites. Apart from Landolt's record only one of these was made before 1980, that by P. J. Wanstall and K. J. Adams in N. Essex, v.c. 19, in 1978. At the B.S.B.I. Exhibition meeting of that year material was exhibited from this site, but the finders were not entirely confident in their identification and, although this material has been maintained in cultivation, the matter had not been taken further.

The map shows a clear bias of records to southern and eastern England, which could in part be explained by a greater concentration of observers with knowledge of this species in this part of the country. On the other hand, the statement by Landolt (1980) that this is a species favouring a more Mediterranean climate would suggest that the records may reflect a real trend in its potential distribution, similar to that shown by *L. gibba* (Perring & Walters 1976).

*L. minuscula* is reported as a well-established alien in several other European countries (Landolt 1979). The first European record was made by P. Jovet and S. Jovet-Ast in September 1965 from Lac Marion, Biarritz in south-western France, although it was first determined as *L. valdiviana*. It is now known from several other parts of France and also in Germany and Switzerland. Clearly both on the Continent and in this country *L. minuscula* remains undetected in many other places, and its continued spread seems likely. Once it is established in a river system, the manner of its subsequent dispersal is evident, but through what agency it arrives in the first place is a matter for speculation. Carriage by aquatic animals or water birds is clearly possible, as is accidental or deliberate introduction by humans. *L. minuscula* has been reported from water tanks in at least one aquatic nursery (St Clare Nursery, Hanworth, Middlesex, v.c.21, S. Wenham, July 1981), which points towards at least a potential source.

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