FLOWERING IN BRITISH *LEMNA*: A RARE, CYCLIC OR SIMPLY OVERLOOKED PHENOMENON?

JON BRAMLEY

(J. L. Bramley, Research Student, Ecology Research Group, Canterbury Christ Church College, Canterbury, Kent CT1 1QU, England.)

Introduction

The Lemnaceae (or duckweeds) are a family of aquatic plants which float on or just below the surface of fresh waterbodies. All species of this family show extreme reduction in morphology and appear as small, generally adhering, pad-like fronds which may or may not be differentiated and may or may not have roots (Daubs 1965; Stace 1991). Duckweeds are a very successful group and are a common feature of many rivers, ditches, canals and still waterbodies world-wide, being unknown only from Antarctica, Iceland and Greenland (Landolt 1986). They can grow in great abundance, particularly under high nutrient conditions, and may completely cover the water surface of slow-moving or still waterbodies (De Groot et al. 1987).

The family consists of 4 genera and 35 species of which 3 genera and 6 species can be found in Britain (Landolt 1986). In Britain two genera, *Spirodela* Schleiden and *Wolffia* Horkel ex Schleiden, are each represented by a single species, while the genus *Lemna* L. is represented by four species (Stace 1991); these are commonly known as ivy-leaved, fat, common and least duckweeds *(L. trisulca* L., *L. gibba* L., *L. minor* L. and *L. minuta* Kunth. respectively). All six species have a wide distribution throughout the British Isles (Perring & Walters 1982; Leslie & Walters 1983) and the range of one, the alien *L. minuta,* appears to be increasing (Oliver 1993; Philp 1996).

Reproduction in *Lemna*

It is largely presumed that reproduction in British *Lemna,* as in other British Lemnaceae, is almost entirely asexual, with new daughter fronds being produced from the side pouches of older mother fronds. In this way populations are known to be able to double their numbers in 2 to 3 days under favourable conditions (Clatworth & Harper 1962). Sexual reproduction is considered to be a rather rare event or even absent (Hillman 1961; Landolt 1986) and because of this rarity the sexual features of *Lemna,* such as anthers and fruit, are often considered to be of little taxonomic value (Leslie & Walters 1983) and are sometimes completely overlooked (Quigley 1986). Genetic diversity is largely thought to be maintained by somatic mutations and by the multiple origins of clones (Vasseur et al. 1993).

Observations of flowering

It was with some surprise, therefore, that widespread flowering was observed in all British *Lemna* during the summer of 1995. Initial observations in Shropshire during June recorded flowers in *minor* and *trisulca,* with fruit production in *trisulca. L. gibba, minor* and *minuta* were noted as being in flower on several occasions in Kent, during July and August, probable fruit production occurring in both species. On occasions, in both Shropshire and Kent, several thousand fronds were flowering simultaneously and often two or more species were seen flowering together. To what extent these events are truly representative of the sexual reproduction rate of British *Lemna* on a year-to-year basis, or simply reflect the unusually high summer temperatures of 1995, is unclear. However it seems likely that flowers (Figs 1 and 2) may have been under-recorded in the past and the potentially significant role for sexual reproduction in this genus could have been overlooked.

If sexual reproduction is a common feature in the life cycle of British *Lemna,* be it as a widespread annual event or an episodic occurrence according to environmental factors, it may prove to be as important as somatic mutation in maintaining genetic diversity within the genus. Sexual reproduction and the subsequent production of seed also gives an added dimension to the generally recognised life cycle of these duckweeds. For example, temporary waterbodies could be recolonised from seeds within the seed-bank rather than from the chance introduction of viable fronds, and unfavourable environmental conditions at the water surface such as ice or competition could be avoided by seeds lying on the bottom sediment. (As far as I am aware, neither *Spirodela polyrhiza* (L.) Schleiden nor *Wolffia arrhiza* (L.) Horkel have been recorded in flower in Britain, but they do both form turions, which are small rootless fronds of high starch content that sink, and these could play a similar functional role in the life-cycle of these plants as the seeds may do in *Lemna).*

If flowering does occur relatively often in British *Lemna* there may also be important taxonomic benefits, because sexual features such as anthers, pollen and fruit are useful aids in species delimitation in what otherwise can be a very difficult genus (Landolt 1986; Stace 1991).

Conclusion

No literature has been traced giving details of flowering under natural conditions in British *Lemna,* though there are articles dealing with this phenomenon elsewhere in the world (Seager 1929; Hicks 1932; Brooks 1940; Martinsson 1984; Landolt 1986). In these cases, flowering fronds appear to make up ca. 4% of the summer populations and, although mass flowering is noted on one occasion after environmental change (Hicks 1932), none of these studies looked at the possibility of flowering on biennial or longer cycles. It

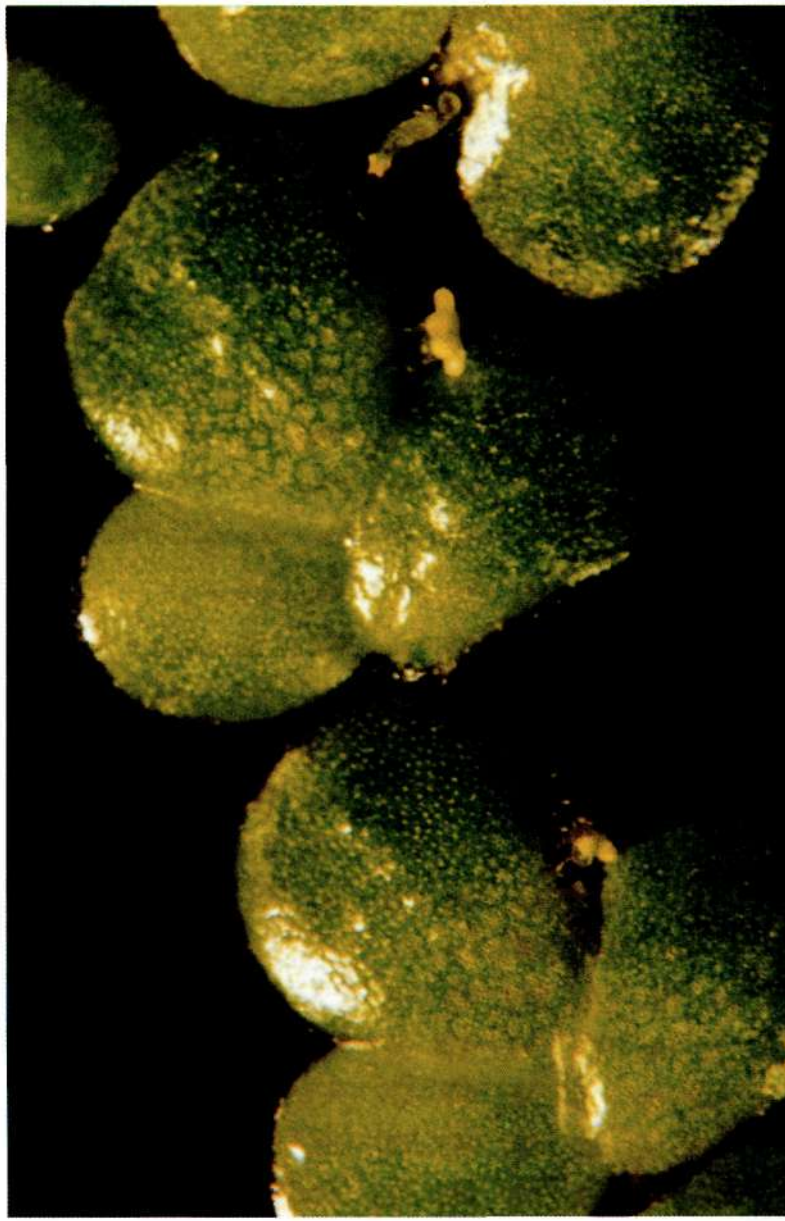

FIG. 1. *Lemna gibba* in flower, showing frond colonies; yellow anthers and at least one stigma are visible (magnification x 10)

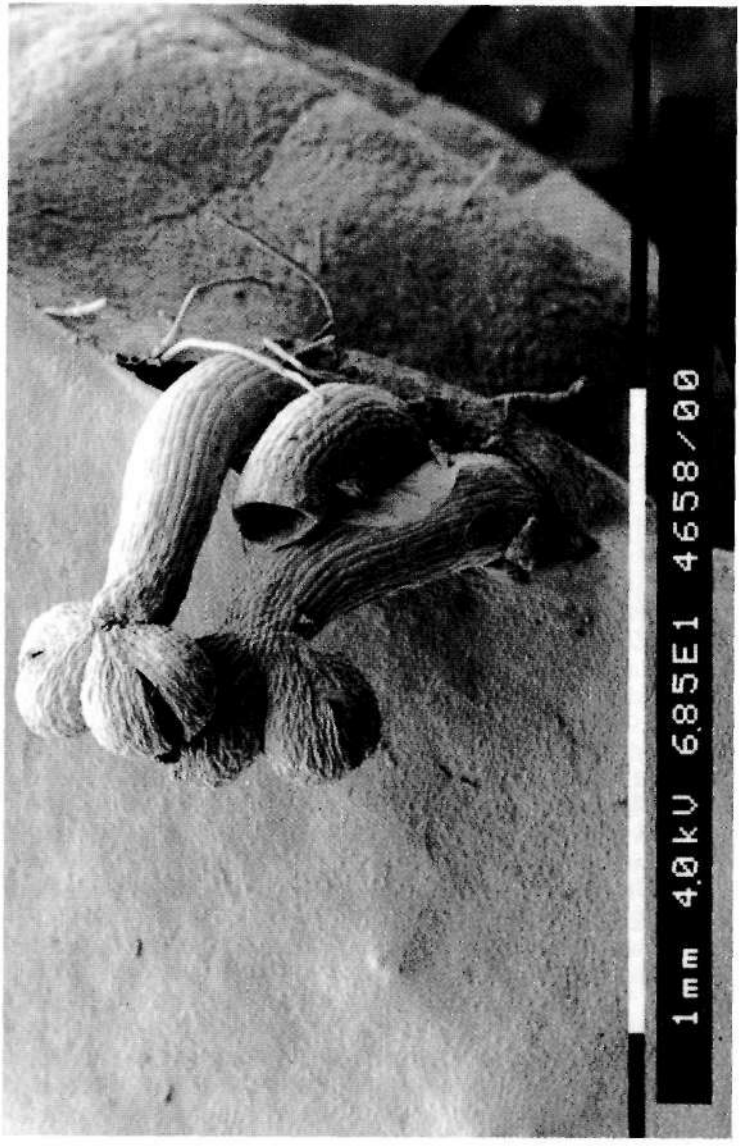

FIG. 2. *Lemna gibba* in flower. Scanning electron microscope photograph showing a single style between two stamens; anthers, filaments and a funnel-shaped stigma are visible. (Note: in the Lemnaceae, flowers are variously interpreted and this photograph could be described as showing one flower only or one female and two male flowers). The white bar represents 1 mm.

seems likely, therefore, that only time and further observations will indicate the relative importance of annual and episodic flowering in the life cycle of British *Lemna*.

References

Brooks, J. S. (1940). *The cytology and morphology of the Lemnaceae.* PhD Thesis. Cornell University.

Clatworthy, J. N. & Harper, J. L. (1962). The comparative biology of closely related species living in the same area. 5. Inter- and intraspecific interference within cultures of *Lemna* spp. and *Salvinia natans. Journal of Experimental Botany,* 13, 307-324.

Daubs, E. H. (1965). *A Monograph of the Lemnaceae.* The University of Illinois Press.

De Groot, W. T., De Jong, F. M. W. & Van Den Berg, M. M. H. E. (1987). Population dynamics of duckweed cover in polder ditches. *Archiv fur Hydrobiologie,* **109,** 601-618.

Hicks, L. E. (1932). Flower production in the Lemnaceae. *Ohio Journal of Science,* 32, 115-131.

Hillman, W. S. (1961). The Lemnaceae, or duckweeds. A review of the descriptive and experimental literature. *Biological Reviews,* 27, 221-287.

Landolt, E. (1986). *The Family of Lemnaceae - A Monographic Study, Volume 1.* Veroffentlichungen Des Geobotanischen Instituttes ETH, Stiftung Rubel, Zurich 71.

Leslie, A. C. & Walters, S. M. (1983). The occurrence of *Lemna minuscular* Herter in the British Isles. *Watsonia,* 14, 243-248.

Martinsson, K. (1984). Bloomningen hos *Lemna minor*, andmat. *Svensk Botanisk Tidskrift,* 78, 9-15.

Oliver, J. E. (1991). Spread of *Lemna minuscular in Wiltshire. Botanical Society of the British Isles, News,* 58, 10.

Perring, F. H. & Walters, S. M. (1982). *Atlas of the British Flora. Botanical Society of the British Isles.*

Philp, E. G. (1996). Distribution maps of some species recorded from Kent. *Bulletin of the Kent Field Club,* 41, 42.

Quigley, M. (1986). *Herbaceous Flowering Aquatic Plants.* Blackwell Habitat Field Guides. Oxford, England.

Seager, A. (1929). The flowering of Lemnaceae. *Bulletin of Torrey Botanical Club,* 56, 351-358.

Stace, C. (1991). *New Flora of the British Isles.* Cambridge University Press.

Vasseur, L., Aarssen, L. W. & Bennett, T. (1993). Allozymic variation in local apomictic populations of *Lemna minor* (Lemnaceae). *American Journal of Botany,* 80, 974-979.