A2
Lemna minor community
Lemnetum minoris Soó 1947

Synonymy
Lemnetum minoris (Oberdorfer 1957) Müll. & Gors 1970; Societie van *Lemna minor* Westhoff & den Held 1969.

Constant species
Lemna minor.

Rare species
Azolla filiculoides, *Lemna minuscula*.

Physiognomy
The *Lemnetum minoris* consists essentially of floating mats of *Lemna minor*, the small thalli often very numerous and densely crowded, but usually forming a single layer on the water surface. There are no other constants and, indeed, associates of any kind are often very few, their abundance being local or ephemeral or indicating a shift to different kinds of vegetation. *L. gibba*, for example, is generally scarce, though it can oust *L. minor* and mixtures of these plants often presage a development of the *Lemnetum gibbae*. Then, at a few places in south-east England, the rare alien duckweed *L. minuscula* has been recorded as an aggressive invader of this vegetation: an introduction from the warmer parts of North and South America, distinguished from our native species by its smaller size and single vein, it seems able to overwhelm other duckweeds, both here and in those other parts of Europe where it has gained a hold (Leslie & Walters 1983). The introduced aquatic fern *Azolla filiculoides*, a native of the tropical Americas, can also be found in this community, its small branching shoots with their pinkish leaves increasing to enormous abundance from time to time and smothering other floating plants with a thick layer of growth.

A distinctive form of the community has locally prominent *L. trisulca* beneath the floating mat of duckweed and some stands are characterised by the periodic occurrence of the aquatic liverworts *Riccia fluitans* and *Ricciocarpus natans*. Apart from this very modest amount of variety, though, most of the floristic differences among the *Lemnetum minoris* reflect the range of submerged aquatic and emergent communities with which it is found.

Sub-communities

Typical sub-community. This includes the most species-poor stands with a generally very abundant, sometimes continuous, cover of *L. minor*.

***Lemna trisulca* sub-community.** The submerged duckweed *L. trisulca* can attain considerable abundance beneath rather more open mats of *L. minor* than usual, with occasional records for a variety of other aquatics such as *Potamogeton lucens*, *P. pectinatus*, *Callitriche stagnalis*, *C. hamulata* and *Myriophyllum spicatum*.

***Riccia fluitans-Ricciocarpus natans* sub-community.** Both these thalloid liverworts, particularly the former, can be found growing terrestrially on the wet muddy margins of open waters and submerged on bottom sediments, but they are usually found floating freely on or near the surface, mixed with *L. minor*, and in the case of *R. natans*, looking rather like the duckweed, with little fragmenting rosettes with pendant scales beneath. The more widespread *R. fluitans* is similarly delicate in its aquatic form but has a much more elongated, bifurcating thallus. One or other of these plants, sometimes both together, can be moderately abundant but they are strikingly irregular in their appearance and disappearance at particular places.

Habitat
The *Lemnetum minoris* is a community of standing or very slow-moving, mesotrophic to eutrophic waters, circumneutral to slightly base-poor in reaction, throughout most of lowland Britain. It is extremely common over the still surfaces of ponds and lakes and the edges or sluggish reaches of streams, and in ditches

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and canals, and can also make an appearance in ephemeral moist habitats like rain-filled ruts and on puddled ground.

L. minor has a somewhat more widespread distribution through this country than does *L. gibba*, though its range is still related to a requirement for moderately warm temperatures. It is almost ubiquitous through the English lowlands, and occurs extensively at lower altitudes in Wales and southern Scotland, with more sporadic records in the coastal lowlands further north (Perring & Walters 1962), being largely absent from those parts of Britain where the mean annual maximum air temperature is less than 25 °C (Conolly & Dahl 1970). It also seems to be less nutrient- and base-demanding than *L. gibba* (Landolt 1975) and, when it has an opportunity to grow in the absence of the more aggressive floating duckweeds, it can spread rapidly to exploit congenial conditions, making a quick response to intermittent periods of negligible flow in moving waters and to the appearance of ephemeral habitats (Haslam 1978). When grown alone, it is the most productive of all the duckweeds, though it yields in mixed cultures to *L. gibba* (Harper 1961, Clatworthy & Harper 1962) and even, in the wild, to the more diminutive *L. minuscula* (Leslie & Walters 1983). Thus, where it is prone to invasion by these species, or by floating macrophytes, the community often has a short-lived period of abundance, though it can persist long in more fragmentary fashion among a variety of subsequent vegetation types.

Floating on the surface, *L. minor* can tolerate turbidity, though in such conditions the community is often of the Typical impoverished form which occurs throughout the range. The *L. trisulca* sub-community, on the other hand, is characteristic of clear waters, sometimes quite deep, and rather more strictly confined to the lowlands of England. It can also extend into places where there is a little more surface wind disturbance than usual, something which hinders the development of a continuous mat of *L. minor*, thus letting more light through. The *Riccia-Ricciocarpus* sub-community, by contrast, prefers very sheltered situations, though it will tolerate shading from emergents or marginal woodland, which again can restrict the dominance of *L. minor* (Oberdorfer 1977) and it seems to occur in waters that are more calcareous than usual. Both liverworts, particularly *R. natans*, are concentrated in south-east England.

Zonation and succession

The *Lemnetum minoris* is most often seen as floating vegetation beyond or among the marginal swamps of still, mesotrophic to eutrophic open waters. It can be the only kind of aquatic community in the early stages of colonisation, but is frequently found with other floating or submerged macrophyte vegetation and can persist in surface mosaics and among encroaching emergents, even under the canopy of developing swampy woodland. In more disturbed habitats, it can recover quickly when periods of sluggish flow recur, and it can take brief advantage of temporarily wet conditions in much curtailed successions. In polluted waters, where more sensitive aquatic vegetation does not succeed it, the *Lemnetum minoris* may become a more persistent feature.

Fragmentary covers of this vegetation can develop after rain along rutted pathways and on trampled ground, and indeed more terrestrial stands of the *Riccia-Ricciocarpus* sub-community can be a rather striking feature of such habitats. In such situations, though, as in temporary water bodies of larger size, streams which have only intermittent periods of sluggish flow, and ditches which are regularly cleaned out, the *Lemnetum minoris* remains a sporadic or ephemeral vegetation type. Here, the zonation often comprises at most a patchy mat of duckweed among Glycerio-Sparganion water-margin communities, with clumps of species such as *Glyceria fluitans*, *Nasturtium officinale*, *Apium nodiflorum* and *Callitriche stagnalis*, or more persistent patches of the *Sparganietum erecti*, *Acoretum calami*, *Typhetum latifoliae*, the *Glycerietum maximae* or *Sagittaria* vegetation.

In more permanent and undisturbed water bodies, the *Lemnetum minoris* can be found persisting among the emergent shoots of swamp communities like the *Phragmitetum*, the *Glycerietum maximae*, the *Caricetum paniculatae* and the *Caricetum acutiformis*, advancing in active succession. And where conditions are more sheltered it can extend out to form an integral part of the aquatic assemblages they are replacing, the *L. trisulca* sub-community being sometimes found in depths of 2–3 m where the waters are clear. Other richer duckweed vegetation of the *Spirodela-Hydrocharis* community can occur with the *Lemnetum minoris* or it may be succeeded by the *Hydrocharis-Stratiotes* community, or floating-leaved vegetation with *Potamogeton natans*, *Polygonum amphibium* or *Nymphaea alba*. Beneath the duckweed mat, there can be stands of the *Elodea canadensis* community, the *Ceratophyllum demersi*, the *Ceratophyllum submersi* and various fine-leaved *Potamogeton* vegetation.

Polluted waters may have a more permanent cover of Typical *Lemnetum minoris*, although in such conditions the community is often replaced by the *Lemnetum gibbae*.

Distribution

The *Lemnetum minoris* occurs widely throughout lowland Britain, becoming more scarce towards the north. The *L. trisulca* sub-community and, more especially, the *Riccia-Ricciocarpus* sub-community are more south-eastern in their distribution.

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Affinities

In Tüxen's (1974) monograph on duckweed vegetation, there is no such community as a *Lemnetum minoris*, the more species-poor mats of the kind included here being considered as immature or impoverished forms of other aquatic assemblages. Other authors, acknowledging the difficulty of defining associations on the basis of single species, have characterised societies of *Lemna minor* (e.g. Westhoff & den Held 1969). In this scheme, we recognise a *Lemnetum minoris* Soó 1947 (see also Oberdorfer 1977) parallel to the *Lemnetum gibbae*, also taking in *Riccia natans* and *Ricciocarpus fluitans* vegetation that is sometimes in Continental schemes separated off into a *Riccietum fluitantis* or *Riccietum rhenanae* (Westhoff & den Held 1969, Ellenberg 1978, Oberdorfer 1977). Such communities have traditionally been grouped in the Lemnetea, usually in a Lemnion minoris alliance.

Floristic table A2

	a	b	c	2
Lemna minor	V (7–10)	V (3–9)	4 (5–9)	V (3–10)
Bidens tripartita	I (3)			I (3)
Apium nodiflorum	I (1)			I (1)
Lemna trisulca		V (2–10)	2 (3–8)	II (2–10)
Potamogeton lucens		I (4)		I (4)
Potamogeton pectinatus		I (3)		1 (3)
Callitriche intermedia		I (2)		I (2)
Myriophyllum spicatum		I (2)		I (2)
Lemna gibba		I (5)		I (5)
Ranunculus peltatus		I (3)		I (3)
Ceratophyllum demersum		I (4)		I (4)
Berula erecta		I (3)		I (3)
Alisma plantago-aquatica		I (2)		I (2)
Riccia fluitans			3 (2–9)	I (2–9)
Ricciocarpus natans			1 (2)	I (2)
Callitriche stagnalis	I (5)	I (3)	I (4)	I (3–5)
Potamogeton natans	I (3)	I (4)		I (3–4)
Number of samples	14	7	4	25
Number of species/sample	1 (1–3)	3 (2–6)	3 (3–4)	2 (1–6)

a Typical sub-community
b *Lemna trisulca* sub-community
c *Riccia fluitans-Ricciocarpus natans* sub-community
2 *Lemna minor* community (total)

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