A5
Ceratophyllum demersum community
Ceratophylletum demersi Hild 1956

Synonymy
Ceratophyllum demersum vegetation Pallis 1911, Ellis 1939, Lambert & Jennings 1951, Lambert 1965, all *p.p.*; *Ceratophylletum demersi* (Pop 1962) den Hartog & Segal 1964.

Constant species
Ceratophyllum demersum, *Elodea canadensis*.

Rare species
Azolla filiculoides, *Potamogeton coloratus*.

Physiognomy
The *Ceratophylletum demersi* is characterised by often dense free-floating masses of *Ceratophyllum demersum*, usually with at least a little, sometimes much, *Elodea canadensis*. Some stands have few other plants, apart from a patchy floating mat of *Lemna minor*, but others are richer, with frequent records for *Ranunculus circinatus*, *Callitriche stagnalis* and one of the other introduced Canadian pondweeds, *E. nuttallii*, with *L. gibba* and *Nuphar lutea* among the floating element.

Sub-communities

***Ranunculus circinatus* sub-community.** Richer stands of the *Ceratophylletum* are included here with, in our data, preferentially frequent *R. circinatus*, one of the easier water-crowfoots to distinguish, with its leaf segments all held rigidly in a single plane (Holmes 1979). *Callitriche stagnalis* is also very common and this is one of the aquatic communities in which the presence of *E. nuttallii* has been increasingly recognised (Simpson 1984). Also among the submerged plants is occasional *Myriophyllum spicatum*, *Potamogeton pectinatus*, the nationally rare *P. coloratus*, a species found only very locally and mostly in eastern England, and *Sparganium emersum*. *Lemna minor* is scarce but *L. gibba* and *L. trisulca* occur, together with occasional *Nuphar lutea* and *Azolla filiculoides*.

***Lemna minor* sub-community.** Apart from *C. demersum* and *E. canadensis*, *L. minor* is the only frequent plant in this sub-community.

Habitat
The *Ceratophylletum demersi* is typical of still or slow-moving, eutrophic waters, mainly in the warmer, south-eastern lowlands of Britain. It is a widespread community of sluggish streams, and pools, dykes and canals, and is perhaps becoming increasingly common in such waters because of eutrophication with agricultural run-off.

C. demersum is largely confined to those parts of the country (Perring & Walters 1962) where there is a mean annual maximum temperature in excess of 28 °C (Conolly & Dahl 1970), but it has a widespread range through Europe, except the Arctic regions, and its association with this part of the country may be as much a reflection of its nutrient requirements as any warmth-dependence. Spence (1967) placed *C. demersum* amongst his 'rich-waters' group of aquatics, occurring in waters of high alkalinity, and various authors have suggested a need for more eutrophic conditions, Ellenberg (1972) emphasising high phosphorus requirement, Goulder & Boatman (1971) dependence on high inorganic nitrogen in the surrounding waters, at least for part of the year. The latter authors thought that this might explain the relative abundance of the plant in the arable regions of Britain, where fertiliser run-off is high, and why *C. demersum* becomes such a problem in dykes and water-courses draining such land (Robson 1967). In Doarks' (1980) survey of Broadland dykes, the species occurred among a group of aquatics most associated with disturbance and eutrophication of waters, and in situations where the bounding land was arable rather than grazing. Oberdorfer (1977) regarded the present distribution of *C. demersum* in southern Germany as largely anthropogenic, reflecting enrichment from agriculture.

It is possible that floristic poverty in this kind of vegetation may be related to competition for available

nutrients, although there could be a simple physical exclusion of associates once *C. demersum* has become firmly established: it grows slowly (Haslam 1978) but can become very luxuriant and dense. Moreover, although it is itself tolerant of turbidity and shading by floating, emergent or overhanging vegetation, which can allow it to colonise waters up to 2 m or so deep and quite overgrown, its own growth may shade out some potential competitors. It may also be able to take good advantage of particular circumstances: its peak of annual growth occurs relatively late, for example, in contrast to the pattern in many *Callitriche* and *Ranunculus* spp. and, after dredging, which perhaps releases nutrients, it can replace *Myriophyllum spicatum* (Haslam 1978). Seasonal variations in the appearance of the *R. circinatus* sub-community can thus be considerable.

Zonation and succession

In shaded stretches of sluggish, eutrophic waters in the British lowlands, the *Ceratophylletum demersi* can dominate to the virtual exclusion of other kinds of aquatic vegetation, especially by mid- to late summer. In many tree-lined drainage ditches, for example, and in slow-moving streams receiving run-off from intensive agricultural land, the more species-poor sub-community may just be associated with stands of *Elodea* and a surface mat of the *Lemnetum minoris* or *Lemnetum gibbae* where conditions are not so shady. The *Potamogeton pectinatus* community can also figure in these simpler zonations, particular where the waters are strongly enriched or polluted.

More varied sequences or mosaics involving the *Ceratophylletum demersi* are seen in clean and well-lit, standing or sluggish waters. Here, in pools, ditches and streams in the lowlands, it can occur, often as the richer *Ranunculus* sub-community, beneath *Spirodela-Hydrocharis* mats or, in a few localities in Broadland, among the *Hydrocharis-Stratiotes* vegetation. Floating-leaved *Nuphar lutea* stands can also occur, particularly where the *Ceratophylletum* extends into deeper, slow-moving waters. Then, among the submerged aquatic element, the community may pass to the *Potamogeton-M. spicatum* vegetation, typically yielding to this assemblage, or to festoons of *Callitriche stagnalis*, in more quick-moving streams.

Associated swamps are varied, but more mesophytic emergents such as *Phragmites*, *Typha latifolia*, *Glyceria maxima* and *Sparganium erectum* are the usual dominants around open waters with the *Ceratophylletum*, and fragments of the community may persist for some time as these thicken up during terrestrialisation of silting ditches and pools.

Distribution

The community occurs widely throughout its range and often with local abundance.

Affinities

C. demersum is a frequent and sometimes abundant member of a variety of more eutrophic communities in which submerged aquatics figure prominently, but it seems sensible to distinguish stands like these where it gives the prevailing character to the vegetation. The poverty of the assemblage has sometimes been recognised in the characterisation of societies, like the *Ceratophyllum demersum*-Gesellschaft (Oberdorfer 1977), while other authorities have erected a *Ceratophylletum demersi* (Hild 1956, Pop 1962, Den Hartog & Segal 1964, Westhoff & den Held 1969). Generally, such vegetation types have been placed among the fine-leaved *Potamogeton* communities of the Parvopotamion alliance in the Potametea.

Floristic table A5

	a	b	5
Ceratophyllum demersum	V (3–7)	V (6–10)	V (3–10)
Elodea canadensis	IV (1–7)	IV (2–7)	IV (1–7)
Ranunculus circinatus	IV (2–7)		III (2–7)
Callitriche stagnalis	III (2–5)		II (2–5)
Elodea nuttallii	III (2–9)		II (2–9)
Lemna gibba	III (3–8)	I (2)	II (2–8)
Nuphar lutea	III (3–6)		I (3–6)
Myriophyllum spicatum	II (3–7)		I (3–7)
Potamogeton pectinatus	II (1–3)		I (1–3)
Sparganium emersum	II (2–5)		I (2–5)
Lemna trisulca	II (1–3)	I (1)	I (1–3)
Azolla filiculoides	II (5–6)		I (5–6)
Potamogeton coloratus	I (2)		I (2)
Nasturtium officinale	I (1)		I (1)
Myosotis scorpioides	I (1)		I (1)
Sagittaria sagittifolia	I (2)		I (2)
Lemna minor	I (7)	V (2–5)	III (2–7)
Number of samples	13	5	18
Number of species/sample	5 (2–9)	3 (2–6)	4 (2–9)

a *Ranunculus circinatus* sub-community
b *Lemna minor* sub-community
5 *Ceratophyllum demersum* community (total)

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