SPECIES DOSSIER

Creating ponds and lakes for stoneworts

MILLION PONDS PROJECT

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. What are stoneworts?

Stoneworts are a very ancient group of aquatic plants: they are complex algae that look similar to higher plants. Unfortunately many species are now rare, mainly because of water pollution. Out of our 28 native species of stonewort in the UK, over half are listed in the Red Data Book or are Nationally Scarce.

This leaflet explains how to design ponds and lakes so they are stonewort-friendly to help protect this much-threatened group (Box 1).

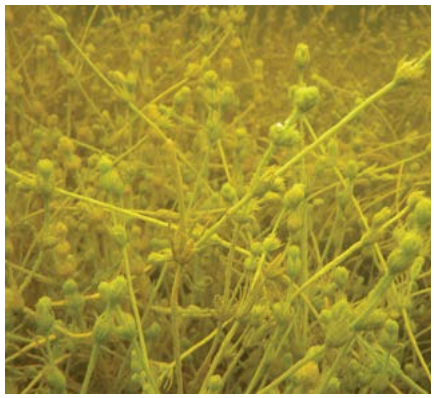

Figure 1. ▲ Bristly Stonewort ▲ Hedgehog Stonewort

2. Making ponds and lakes stonewort-friendly

Stoneworts live in many types of ponds and lakes: small and large, permanent and temporary, freshwater or brackish. But whatever the waterbody, stonewort species like two things:

- Clean water, and
- Mineral substrates: bare sand, gravel or clay (sometimes peat, e.g. Dwarf Stonewort).

Designing stonewort-friendly waterbodies is mainly about making sure these two characteristics can be retained for the long term, without requiring management effort.

Ponds and lakes formed from mineral extraction provide particularly good opportunities for stonewort habitat creation. Information on how to create and manage mineral extraction sites for stoneworts is given in Box 1.

Information on broad habitat requirements for BAP stoneworts and those associated with gravel pits is given in Table 1.

Key messages

- Good water quality is critical. Keep away topsoil, floodwater, stream or ditch inputs, large geese and gull populations, and fishing practices that add nutrients.
- On mineral sites, ensure waterbodies have stonewort-friendly afteruses.
- Create large numbers of bars and shoals on the margins and bottom of lakes and pools – these will help to keep some areas free of organic sediments.
- Avoid tree shade, or design sites so that shoals extend beyond the tree-overhang zone.
- Encourage wave-wash on some shores of larger lakes.
- One size will not fit all: create mosaics of lakes and pools.
- If invasive plants like Elodea species are likely to dominate, maximise the area of shallows <70cm deep, where Elodea species are less common.
- Do not plant up – leave ponds to colonise naturally so that stonewort habitat is maintained for longer.

3. Clean water

Stoneworts thrive in clear, unpolluted water. One of the main reasons that many stoneworts are rare is the scarcity of clean water in the British countryside.

To create clean water ponds and lakes:

- Make sure ponds have a clean water source such as groundwater, rainwater or clean water surface run-off.
- Avoid any stream and ditch inflows into ponds or lakes (these bring in pollutants, including silt).
- Minimise flooding from rivers.
- Don't allow water to drain in from arable crops, urban areas or roads (either from piped drains or surface-water).
- Prevent any sewage outlets feeding into lakes or pools.
- Try to minimise the presence of large numbers of geese and gulls.
- Don't add topsoil to waterbody margins during restoration.
- Where possible, ensure the waterbody surroundings are semi-natural (e.g. unfertilised grassland, wood, scrub or heath).

For further information, consult Factsheet 5 of the Pond Creation Toolkit: Locating ponds and finding a clean water source.

4. Inorganic substrates

Stoneworts like to root into bare mineral sediments like clay, sand or fine gravel. They do not like the organic-rich sediment that builds up on the bottom of maturing lakes and ponds, and this is why fallen tree leaves can be a particular problem along the margins.

Stoneworts are often abundant in new ponds and lakes, where there is lots of bare substrate, but often decline and then disappear over the first 5-10 years as silt levels build up.

In larger ponds and lakes, good design can help to maintain stonewort populations in the long term by keeping areas free of sediment. The key is to use underwater shoals and wave-wash to maintain this.

Bars, banks and wrinkles

Underwater bars and shoals are a particularly useful design feature for stoneworts (Figure 1). They work because fine sediments fall off these high areas into deeper water, leaving the top and sides with the bare substrate that is ideal for stoneworts.

Bars can be created at all water depths down to about 3m (4m in clear-water lakes). Below this there will probably be too little light for stonewort growth. There is currently too little information to make detailed recommendation on the optimal size, shape and slope of bars and shoals. Expert opinion suggests that bars of 1-5+ m width are valuable, and rounded shapes are more stable than flat tops. Some allowance should also be made for subsidence and erosion, particularly in shallow water where bars and shoals need stability against wave wash.

In general, the more underwater bars and shoals the better. Ideally the bottom and sides of all new large ponds and lakes should be covered in a mosaic of features of varying size, slopes, heights and depths. These undulations help diversify ponds and lakes for all wildlife.

Note that underwater bars and banks should only be created in large ponds or lakes. In small ponds they can present a hazard to anybody entering the water to carry out survey or management work.

Problem: Stoneworts are often lost as organic sediments build up in mature lakes.

Answer: Create bars and shoals at all depths to keep areas free of organic sediments.

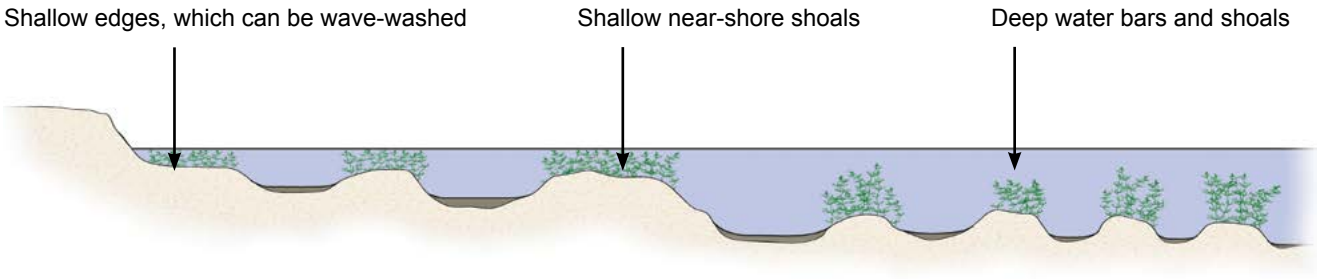

Figure 2. Make underwater shoals to help maintain inorganic sediments.

Box 1. Creating stonewort habitat on mineral extraction sites

Many of our native stonewort species can be found growing in disused mineral workings such as clay, sand and gravel pits (see Box 3). Gravel pit complexes such as the Lower Windrush Valley and the Cotswolds Water Park are designated as Important Stonewort Areas of national significance.

Gravel pit ponds and lakes have the advantage that they are often fed by groundwater, which is some of the cleanest water in lowland Britain. For stoneworts, the main aim should be to keep this water clean!

Afteruse and water quality

A gravel pit lake's afteruse will fundamentally affect water quality and how suitable this is for stoneworts (Figure 2). Nature conservation afteruses are good, as long as marginal trees are managed around lakes and ponds, or these have extensive shallows (Figure 3). Sailing and game fisheries can work well because the water usually remains clear. Intensive coarse fisheries can be poor, because the fish and other management practices often create cloudy, turbid water.

Motorised sports, such as water or jet-skiing can also increase turbidity, especially at the edge where the waves they create stir up bottom sediment. Intense wave wash can be physically damaging, destroying any plant growth at the margin. However, stoneworts may benefit from some wave action, and where gravel pit lakes have shallow embayments, or there are ski exclusion zones, it may sometimes be possible to combine stonewort growth and motorised watersports.

Stoneworts are also extremely sensitive to chemicals contained in anti-fouling paints used on recreational sea-going craft to stop algae and molluscs causing drag. The paints have been shown to occur in seasonal spikes in freshwaters water when boats are floated in the spring and summer, and then latterly the metallic component of the paints accumulate within sediments, which causes the plants to die through poisoning.

Even where the main waterbody is likely to be compromised by unsuitable afteruses, don't forget that stoneworts live in waterbodies of all sizes. So, if possible create small clean water ponds around a main lake – even ponds 25 m^2 in surface area, or smaller, can benefit stoneworts.

Can be good	Often poor
Nature conservation (if marginal trees are managed)	Intensive fisheries (especially carp and other coarse fisheries)
Sailing	Motorised watersports (but possible to reduce problems through design)
Canoeing	Stock ponds
Low intensity fisheries (particularly game fishing)	Silt ponds

Figure 2. Gravel pit lake afteruse and suitability for stoneworts.

Submerged bars and trees

Trees can be a particular problem for stoneworts: they often grow around mature lakes, creating shade and dropping leaves into the water. Both prevent stonewort growth in the shallow edge zone, an area that can be very rich in stoneworts. A simple answer is to create shallow underwater bars around 3-10 m out from the bank, beyond the zone of overhanging trees (Figure 3). An alternative is to create shallows that extend beyond the tree overhang zone.

Problem: Wooded margins are common around mature lakes, causing problems with stonewort growth.

Answer: Create shoals beyond the tree-overhang zone where stoneworts can grow.

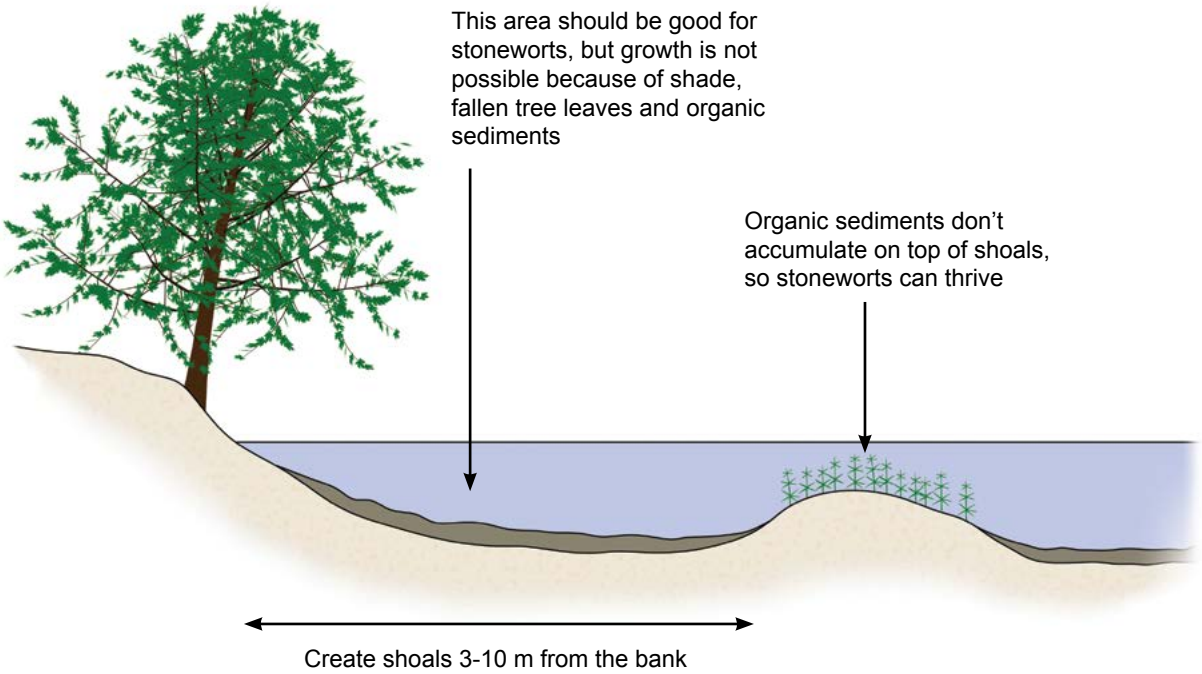

Figure 3. Near-bank bars solve tree shade problems.

Using wave-wash and exposed shores

Larger waterbodies, with a long fetch, often have wave-washed shores. This can help stoneworts by winnowing out the fine organic sediments to leave bare sand or clay substrates in the near-shore area. It can also help by eroding banks: providing more inorganic sediment. To help design these beneficial processes:

- Do not break the fetch (i.e. avoid creating central islands, which slacken wind energy).
- Create open landscapes, e.g. grazed grassland rather than sheltered tree-lined or wooded margins.
- Design areas of active erosion (e.g. headlands) on banks that take the brunt of the prevailing wind and wave wash: often the north-east bank.

For further information, consult Factsheet 4 of the Pond Creation Toolkit: Pond design (in particular Figure 13).

Creating new ponds – and using the spoil

In very small ponds without wave-wash, and with no room to make bars, it may be difficult to retain stoneworts in the long term. If funding and land is available the answer is to create new ponds every once in a while.

These new ponds can have an additional benefit: the spoil produced (not topsoil) can often be used to re-profile larger waterbodies nearby, creating new submerged banks, bars and spits where stoneworts can grow.

5. Competition with other plants

Stoneworts are easily out-competed by aggressive alien plants. Nuttall's Waterweed and its relatives (Elodea species, Lagarosiphon etc.) can be a particular problem, both for stoneworts and other native aquatic plants. The large central area of lakes and ponds is often completely wasted as an area for stonewort growth because Elodea colonises and takes over. Even on the edges, rafts of wind-blown plants can pile up against the shore, shading stoneworts out. Where this happens, the real growth area available for stoneworts can be tiny even in very large lakes.

There are no easy answers to Elodea problems, but some measures can help:

- Keep the water as clean and nutrient-poor as possible, this allows other native aquatics to thrive, and keeps Elodea at bay.
- Elodea is less vigorous in water <70 cm deep, so create large areas of shallows at the edge and above underwater bars (Figure 4).
- Don't use herbicide – it probably encourages Elodea growth in the long term and preferentially knocks out the weaker species.
- Create a mosaic of smaller waterbodies around large lakes – Elodea won't thrive in all of them.

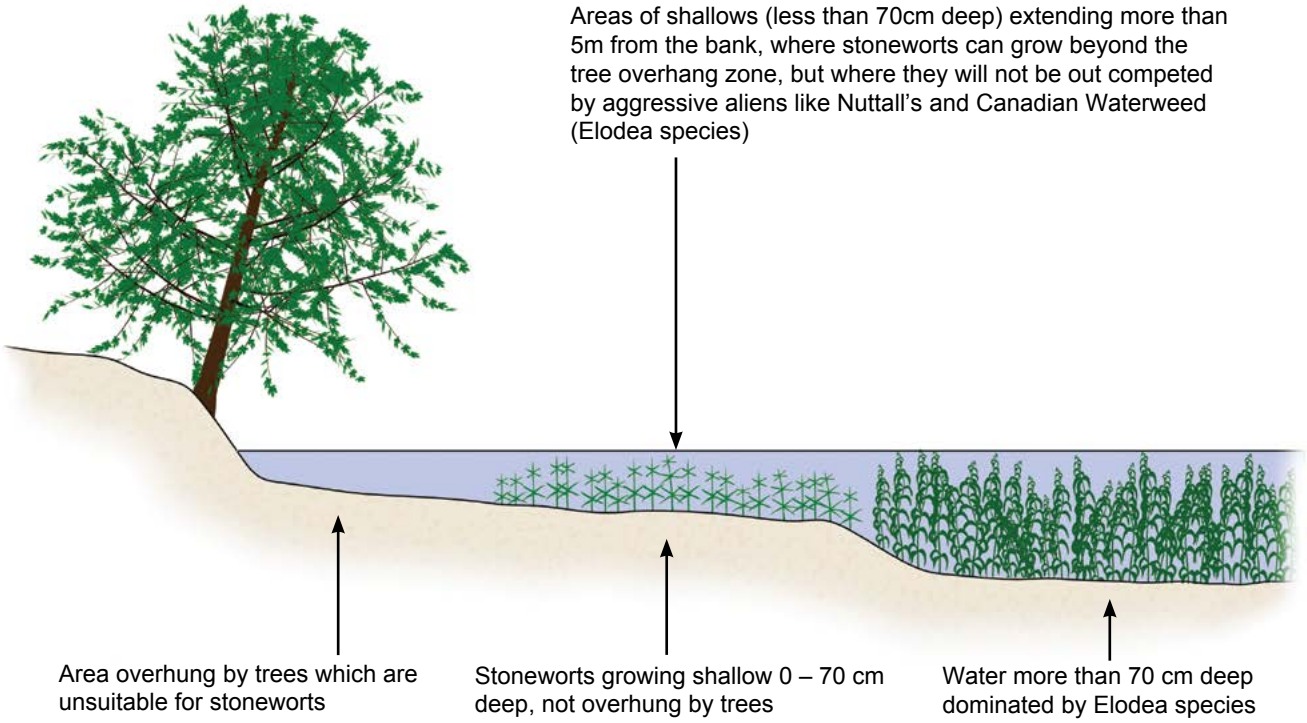

Figure 4. Make extensive shallow water areas to prevent **Elodea** domination.

Alien aquatic plants are not the only problem for stoneworts. In shallow areas, stoneworts can also be out-competed by our native marginal and swamp plants. This is one of the many reasons why it's not a good idea to deliberately plant-up new sites with common reed, or other marginal plants. Marginal plants are good at colonising new water bodies and will arrive naturally over time. But planting up destroys the brief opportunity – often of only a few years duration – when the edges of these new ponds and lakes will support stoneworts.

Further reading

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Table1. Pond creation for stoneworts: broad habitat requirements for BAP stoneworts and those associated with gravel pit lakes.

Common name	Scientific name	BAP species	Associated with mineral sites?	Broad habitat requirements	Conservation status and distribution information
Baltic Stonewort	Chara baltica	Yes	Yes	A perennial of mildly brackish ditches, quarry pools, dune slack pools, lagoons and lakes on sandy or marly substrates with low organic content, in water up to 2.5 m depth.	Vulnerable species with restricted distribution. Known from sites in Norfolk, Anglesey and the Outer Hebrides.
Bearded Stonewort	Chara canescens	Yes	Yes	A species of clear brackish water up to 2.5 m deep in lagoons, lakes and ponds by the coast, on calcareous sandy or marly edges of waterbodies, usually associated with sand dunes, or on muddy substrates.	Endangered species with very restricted distribution. Peterborough brick pits (abandoned clay pits) in Cambridgeshire support the only English population, and the site is unusual in being inland. Also Outer Hebrides, Co. Londonderry.
Bird's Nest Stonewort	Tolypella nidifica	Yes	Yes	Brackish lakes and lagoons with salinity 5-20 ppt. A poor competitor and needs open conditions e.g. due to wave turbulence.	Endangered species with very restricted distribution. Outer Hebrides, Orkney.
Bristly Stonewort	Chara hispida		Yes	A species of alkaline water found in a wide range of waterbody types including lakes, ponds, peat pits, ditches and slow-running water.	Occasional species, relatively widespread but most frequent in East Anglia.
Clustered Stonewort	Tolypella glomerata		Yes	Mostly a species of alkaline water in shallow pools and lake edges, often in places that dry out in summer. A poor competitor, often in recently disturbed ditches and ponds.	Nationally Scarce species. Widely scattered in areas of calcareous geology, including sand dunes.
Common Stonewort	Chara vulgaris		Yes	Found in every kind of freshwater habitats from puddles to large lakes.	Frequent species, widespread.
Convergent Stonewort	Chara connivens	Yes	Yes	A species of alkaline permanent still water bodies such as lakes, ponds and ditches, where it grows on sandy or marly substrates in depths of up to 3 m.	Vulnerable species with restricted distribution. Known from sites, mainly close to the sea, in Devon, Cumbria and Norfolk.

Common name	Scientific name	BAP species	Associated with mineral sites?	Broad habitat requirements	Conservation status and distribution information
Dark Stonewort	Nitella opaca		Yes	In a wide range of waterbody types from lakes to ponds, rivers and canals. Typically in acid water but also in low nutrient calcareous water.	Frequent species, widespread.
Delicate Stonewort	Chara virgata		Yes	Found in a wide range of waterbody types, from small ponds to lakes. This species is able to tolerate more acidic conditions than other Chara species.	Frequent species, widespread.
Dwarf Stonewort	Nitella tenuissima	Yes		Found in calcareous fenland, where it occurs in shallow peaty pools and ditches in depths of up to 1 m. Management for this species has been creating shallow pools in peat.	Endangered species with very restricted distribution. Main stronghold is on Anglesey, also at Wicken Fen in Cambridgeshire.
Foxtail Stonewort	Lamprothamnium papulosum	Yes		Grows on sandy or silty substrates in depths of up to 2 m in brackish coastal lagoons or lagoon-like habitats. It is often found in areas where there is some disturbance from animals, or in shallow water where fluctuations in the water level result in more open vegetation. It does not tolerate strong wave-action.	Near threatened species with restricted distribution. In England it occurs at brackish coastal sites in Dorset, Hampshire, Isle of Wight and West Sussex. Also in Outer Hebrides.
Fragile Stonewort	Chara globularis		Yes	Wide range of standing freshwater habitats, from small ponds to lakes.	Occasional species, relatively widespread.
Great Tassel Stonewort	Tolypella prolifera	Yes		Slow-moving alkaline water in ditches with clean water and more rarely rivers, lakes and canals. Generally found in shallow water, it benefits from periodic disturbance such as ditch clearances.	Endangered species with very restricted distribution. It has been confirmed at only six sites in England since 1970; in Cambridgeshire, Gloucestershire, Somerset, Surrey and Sussex.

Common name	Scientific name	BAP species	Associated with mineral sites?	Broad habitat requirements	Conservation status and distribution information
Hedgehog Stonewort	Chara aculeolata		Yes	Strongly alkaline water in ponds, ditches, clay pits and lake edges in up to 1m depth. Often with other stoneworts and Fen Pondweed. Prefers permanent water but can tolerate short periods of drying out in summer.	Nationally Scarce species. A few sites in East Anglia, Anglesey and Fermanagh. Also single sites in Avon, Yorkshire, Lancashire, Borders, Islay, Co. Down.
Intermediate Stonewort	Chara intermedia	Yes		Alkaline lakes and slow moving rivers. Generally in water over 50cm depth.	Vulnerable species with very restricted distribution. Norfolk Broads.
Lesser Bearded Stonewort	Chara curta		Yes	Grows in calcareous water on peaty or sandy substrates, flooded dune slacks and pools, and more rarely in clay pits, old peat cuttings and ditches. Often in shallow water and able to withstand wave turbulence. May be exposed when water levels drop in summer.	Nationally Scarce species. There are sparsely scattered records from central and eastern England, Cornwall, South Wales, Anglesey, Lancashire, Cumbria, Borders and western and northern Scotland.
Opposite Stonewort	Chara contraria		Yes	Calcareous water. Sometimes occurs in deep waters, but more usually in shallows at the edge of lakes or in pools that dry up during summer.	Occasional species, relatively widespread but most frequent in Thames catchment and East Anglia.
Pointed Stonewort	Nitella mucronata		Yes	A species of ditches, ponds, lakes, peat pits and canals.	Nationally Scarce species. Recorded from central and southern England, eastern Wales, Fermanagh.
Rough Stonewort	Chara aspera		Yes	A species of calcareous sand and peat in ponds, lakes and ditches. Often in shallow water and can tolerate wave turbulence.	Occasional species, but fairly widespread.
Slender Stonewort	Nitella gracilis	Yes		Acid lakes, often in water over 1.5m depth.	Vulnerable species with restricted distribution. Mid and north Wales, Ayrshire, Sutherland.

Common name	Scientific name	BAP species	Associated with mineral sites?	Broad habitat requirements	Conservation status and distribution information
Smooth Stonewort	Nitella flexilis		Yes	Lakes, ponds, canals and ditches, often in neutral to calcareous water.	Nationally Scarce species. Occasional in south-east England, rare but widely scattered elsewhere.
Starry Stonewort	Nitellopsis obtusa	Yes	Yes	A species of calcareous water in deep lakes and slow-running water at low altitudes. It generally grows at depths of between 1 and 6 m and is very rarely found in shallow water.	Vulnerable species with restricted distribution. Recorded from a few localities in Norfolk, Lincolnshire, Surrey, Hampshire, Oxfordshire, Gloucestershire Avon and Glamorgan.
Tassel Stonewort	Tolypella intricata	Yes		A species of alkaline water in pools, canals, ditches, poached edges of ponds and wheel-ruts that are dry during the summer months. Now mainly found in temporary or fluctuating ponds. It benefits from disturbance which keeps down other vegetation, such as cattle disturbance around pools.	Endangered species with very restricted distribution. Strongholds are in Gloucestershire and Oxfordshire, but it is also found in Cambridgeshire, Suffolk, Norfolk, Somerset and Worcestershire.
Translucent Stonewort	Nitella translucens		Yes	A species of ponds, lakes and ditches, usually in acid waters.	Occasional species, relatively widespread. Most frequent in western and northern Britain. Previously also frequent in heathy parts of Hampshire, Surrey and Sussex but decreasing.

For further information about the Million Ponds Project and to consult the Pond Creation Toolkit, please visit **www.freshwaterhabitats.org.uk/projects/million-ponds**

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LOWER WINDRUSH VALLEY PROJECT

This leaflet was written in conjunction with Nick Stewart and with advice from Stephen Lambert, and is based on their original information.