Guidelines for selection of biological SSSIs

Part 2: Detailed Guidelines for Habitats and Species Groups

Chapter 15 Charophytes (Stoneworts)

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Cite as: Hatton-Ellis, T., Taylor, I., Lawrie, E. & Maggs, C.A. 2020. *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 15 Charophytes (Stoneworts).* Joint Nature Conservation Committee, Peterborough.

Cover note

This chapter is the final element of the Guidelines that supersede Chapter 12 of *Guidelines for selection of biological SSSIs* concerning non-vascular plants (Hodgetts 1992). Following the provision of separate Guidelines for fungi, bryophytes and lichens (Chapters 12-14), this chapter now covers only charophytes. In future other groups of freshwater algae may be added if information is available.

This chapter was prepared by Tristan Hatton-Ellis (Natural Resources Wales), Ian Taylor (Natural England), Ewan Lawrie (NatureScot) and Christine Maggs (JNCC), with helpful input from Sam Bosanquet (NRW) and Ruth Hall (NE). It provides detailed guidance for use in selecting sites for charophytes (stoneworts) throughout Great Britain to recommend for notification as SSSIs. The chapter should be used in conjunction with Part 1 of the SSSI Selection Guidelines (Bainbridge *et al.* 2013), which details the overarching rationale, operational approach and criteria for selection of SSSIs.

The main changes from the previous guidelines (Hodgetts 1992) are:
- complete update to the taxonomy and nomenclature of charophytes;
- replacement of the scoring system for combinations of charophytes with a new approach based on individual species assessments;
- inclusion of evaluation of threat status in Red Lists; and
- removal of Schedule 8 status as a basis for selection.

The SSSI guidance for open water habitats in general (natural, semi-natural, artificial and brackish) is provided in Chapters 6 (Freshwater Habitats) and 1c (Saline Lagoons).

This chapter has been subjected to appropriate levels of evidence quality assurance. It is compliant with the JNCC Evidence Quality Assurance Policy 2020 and has been subjected to external peer review by Prof. Juliet Brodie (Natural History Museum) and Nick Stewart (National Stoneworts Recorder).

1. Introduction

1.1 Taxonomic scope and nomenclature

These guidelines cover the charophytes (common name stoneworts) which are currently placed in the Plant Kingdom as Class Charophyceae in the Phylum Charophyta (Guiry and Guiry 2020; http://www.algaebase.org). In Great Britain, 28 native species are currently recognized in five genera (Stewart 2004; Appendix 1). The nomenclature used for charophytes here follows Guiry and Guiry (2020). Multiple taxonomic changes to the classification of species and subspecies of the charophytes have resulted in the current accepted list for the British Isles but it is clear that further work is needed to resolve the taxonomy and nomenclature of British species (Schneider *et al*. 2016).

1.2 Ecology

1.2.1 Stoneworts are complex, multicellular algae with a branched structure that occur in temporary or permanent lakes, ponds and ditches, including seasonally flooded habitats, and in brackish conditions (Stewart 2004). Five genera occur in Britain (Stewart and Church 1992): *Chara*, *Lamprothamnium*, *Nitella*, *Nitellopsis*, and *Tolypella*. They are sensitive to nutrient pollution and can therefore be indicators of good water quality (Stewart 1996; Lambert 2009; Lambert and Davy 2011; Poikane *et al.* 2018). Some of the most important habitats are often in association with groundwater-fed semi-natural systems such as dunes and lowland fens. Some coastal habitats including saline lagoons (see Rees *et al*. 2019; JNCC undated) are also important. As well as more natural habitats, abandoned brick pits and flooded gravel pits and quarries can be important havens for rare stonewort species.

1.2.2 In favourable conditions, some stoneworts can dominate the macrophyte community. This is particularly marked in marl lakes and the Habitats Directive Annex 1 Habitat '3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.', both of which may be SSSI qualifying habitats in their own right (Mainstone *et al*. 2018). However, extensive stonewort beds may also occur in other lake types. Where they dominate in this way, stoneworts are important for ecosystem structure and function, removing nutrients from the water column and fixing them in the sediment, and providing cover for other aquatic organisms (Van den Berg & Coops 1999; Rodrigo *et al.* 2007). In lakes, this tends to result in very high-water clarity.

1.2.3 Some sites important for stoneworts will have been selected on the basis of habitat and vegetation types. Many stonewort species require calcareous habitats, and this is where the highest species richness is likely; however, some species require base-poor habitats. A few species, notably *Lamprothamnium papulosum*, tolerate or require brackish conditions.

1.2.4 Whilst all charophytes can potentially thrive in natural waterbodies, the widespread decline in quality of standing waters and the lack of landscape processes creating new water bodies or resetting successional processes means that for some stonewort species the largest or only populations may be in artificial waterbodies e.g. gravel pits or highly managed water bodies such as reservoirs.

1.2.5 The combination of effective dispersal of oospores and their ability to form a persistent spore bank (Bonis & Grillas 2002) means that stoneworts are often the first colonizers of newly created habitats and newly restored habitats. The persistent spore bank provides opportunities to rejuvenate charophytes in water bodies where they have

previously been present. Consequently, sites with only old records may still be suitable for designation if the potential exists for habitat restoration.

1.2.6 Some stonewort species prefer open habitats with little organic matter. Such conditions are often common in newly created or restored habitats and those with frequent disturbance. Disturbance can be by natural processes such as wave action in lakes, seasonal drying out, grazing, or even fire or through active management such as scraping/ dredging or water drawdown. As many of these disturbances have the greatest impact on the shallow edges of a water body this is often where such stoneworts thrive. Cutting or coppicing of surrounding vegetation also reduces the build up of organic sediment which helps maintain suitable conditions in the shallows. Natural bioturbation can be important for the maintenance of populations of the rare *Tolypella nidifica* (Angus *et al.* 2015).

1.2.7 The preference for such conditions by some stoneworts means that they may be present in a water body for only a limited time unless the preferred conditions can be maintained as described above. This can be seen after pond restoration or in newly created gravel pits where stoneworts initially dominate, but then vascular plants often begin to take over and organic sediments build up with time. This can also lead to a decline in water quality in water bodies with inputs from groundwater as the sediment can reduce these inputs. Consequently, it is important to consider the sustainability of sites for stoneworts and whether the species can persist there in the long term. Sites with multiple water bodies may present opportunities for rotational management.

1.3 Species distributions

The distribution of the stoneworts is relatively well known in the British Isles, based on maps published in Stewart and Church (1992), and more recently in Stewart (2004). Welsh distributions have been comprehensively reviewed (Stewart & Hatton-Ellis 2020).

No stoneworts are known to be endemic in Great Britain (GB).

1.4 Threatened status

1.4.1 This important phylum of mostly freshwater algae is the most threatened group of freshwater macrophytes across Europe (Auderset Joye and Rey-Boissezon 2015). The 1992 Red Data book (Stewart and Church 1992) reported that 17 of the 30 then-recognized species in Britain were threatened. More broadly, studies have reported a general decline in stonewort abundance in lakes at the expense of more nutrient tolerant macrophytes and/or phytoplankton (Davidson *et al.* 2005; Davidson *et al.* 2012; Goldsmith *et al.* 2013; Wiik *et al.* 2014). As with other aquatic species stoneworts are susceptible to climate change. The effects of climate change in lakes are similar to those of eutrophication, magnifying the impact of nutrients and directly promoting algal blooms (Noges *et al.* 2014). Species reliant upon coastal sites are at risk of habitat loss due to sea level changes and the effect of increased storminess on coastal processes (Holman *et al*. 2009). Increased storminess may increase nutrient enrichment through transport of sediment. On the other hand, climate change may also be implicated in the spread of some species (Stewart and Hatton-Ellis 2014) and increased drying out of some sites may also be beneficial by reducing or preventing build-up of organic matter.

1.4.2 Current designations for stoneworts are presented in Appendix 1, including recent Red List status assessments of stoneworts in Wales (Stewart & Hatton-Ellis 2020). These statuses will change as work is completed so the latest red list and other designations should be consulted for the current position at any point in time.

2. Site selection requirements

2.1 General considerations

2.1.1 As is the case for vascular plants, particular attention in site selection has to be given to the rarer and more threatened species.

2.1.2 Charophytes are not homogeneously distributed within GB resulting in the need to accept differing scales for thresholds when considering sites for selection. For those species which have highly aggregated distributions it will usually be most appropriate to consider the relative significance of sites in the GB or country context. For those which are more widely distributed, such as many of the Scarce species, the Area of Search (see section 4.13 of Bainbridge *et al.* 2013) may provide a more relevant scale for comparison.

The main requirements for site selection are as follows.

2.2 Rarity and threat

2.2.1 Particular attention in site selection has to be given to the rarer and more threatened species. The IUCN Regional Red Listing process provides a structured and evidence-based approach to defining threat categories based on specified analyses of declines in range or population and severe stochastic risk due to extreme rarity. Such analyses may be undertaken at the GB or country level. Range restricted taxa are assessed as either Rare or Scarce[1] and, again, such assessments may be made at either GB or country level[2] (Stroh 2013).

2.2.2 Sites are eligible for selection on the basis of individual constituent species if the species:

- is listed as threatened (i.e. CR [critically endangered], EN [endangered] or VU [vulnerable]) on a GB or Country Level Red List or equivalent (e.g. individual species assessment using IUCN criteria).

- is Rare or Scarce. Range-restricted species are susceptible to increased stochastic risk and there is reasonable evidence (e.g. Walker *et al*. 2017) to suggest that SSSI designation can help prevent such species becoming threatened by reducing exposure to at least some of the risk.

- has been listed on the relevant Country's Biodiversity Priority Species List or has a bespoke equivalent assessment as described below.

2.2.3 Where two Red Lists are available (i.e. both at GB and country level), the higher threat risk level applies, reflecting (i) the need to prevent loss of a species at a country level and (ii) the special responsibility of individual GB countries. Red Lists are normally expected to be revised at least every ten years (the Interagency Working Group on Red Lists considers groups not assessed in the last ten years to be a priority for re-assessment).

2.2.4 Where no relevant Red Lists are available, the relevant Country Agency should carry out a bespoke assessment of relevant taxa against IUCN criteria for their country as supporting evidence for any proposed site designation(s).

[1] At the GB level, Rare species are those occurring in 1 to 15 hectads and Scarce species occur in 16 to 100 hectads.

[2] Country-level Rare and Scarce thresholds reflect the same proportions of the country's area as the GB thresholds – so, for example, England Rare species are those found in 1 to 8 hectads and Scarce species in 9 to 52 hectads.

- For species assessed as threatened (CR/EN/VU) and/or Rare (at GB or country level), all sites in a country may be considered candidates for selection.

- For species that are Scarce (at GB or country level) but not threatened, up to three sites per Area of Search (AoS) may be selected. In such cases each site should be chosen to reflect occurrence in different general habitat types as appropriate (e.g. fen systems / dune slacks / lakes) within the AoS.

2.2.5 When prioritising within a country or AoS, the emphasis should be on selecting sites that are sustainable in the long term. Larger populations tend to be more sustainable, but other site-specific factors such as habitat quality and the opportunity for dispersal and restoration may also need to be considered when choosing among candidate sites. The possibility of including satellite populations, metapopulations and areas with potential value as part of the same site may be considered as a means of providing greater resilience.

2.3 Potential value

Most stoneworts can form significant spore banks in sediments, creating the possibility of habitat restoration even where conditions are currently unfavourable (Goldsmith *et al.* 2013; Alderton *et al.* 2017). Therefore, although viability is likely to decline with age, stonewort oospores can potentially remain viable for more than a century. Older records of rare and threatened species can be used to support site designation based on potential value, provided that palaeoecological surveys show that the past record was associated with a substantial population (Walton *et al*. 2020). Sites chosen for restoration in this way should be those that formerly supported species individually qualifying under the rarity and threat criteria. When considering the selection of sites on the basis of their potential value, the criterion set out in section 5.12 of Bainbridge *et al*. (2013) should be applied.

2.4 Defining site boundaries

The boundary for the site should be defined with reference to the relevant SSSI habitat selection guidance, especially freshwaters, coastlands, saline lagoons and fens. The following points are particularly important:

- Many stoneworts require early succession habitat, so the boundary should encompass (where present) the full range of conditions that support the habitat requirements of the species concerned and sufficient space for those conditions to be maintained through natural processes or site management. These conditions often align well with other species features such as invertebrates.
- Most charophytes are sensitive to poor water quality. Consequently, setting site boundaries must take into consideration the protection of water quality where practicable. Ideally a site boundary would include the entire catchment. This may be possible for some water bodies, particularly smaller ones or those that occur within more extensive terrestrial SSSIs. The greater the proportion of the catchment under semi-natural vegetation the greater the chances of maintaining good water quality.
- Some stonewort species depend on groundwater, which is thermally stable and mineral rich. Setting site boundaries must take this into account where practicable by designating groundwater source areas.
- Areas of potential value can be included within the site. These may be areas where creation or restoration of suitable water bodies may occur either through natural processes (ideally) or (in the case of restoration) human activities (see 2.3).
- Sites may include several small non-contiguous areas supporting a metapopulation, to facilitate recolonization from nearby areas, allow rotational management without loss of the feature, and allow management for a wider range of stonewort and other taxa.

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Appendix 1. GB charophyte species and designations (supplied separately).