

## NORFOLK BIODIVERSITY ACTION PLAN

**Baltic Stonewort *Chara baltica***  
**Bearded Stonewort *Chara canescens***  
**Convergent Stonewort *Chara connivens***  
**Intermediate Stonewort *Chara intermedia***  
**Starry Stonewort *Nitellopsis obtusa***

These plants are in a taxonomic class of their own. Although they look like vascular aquatic plants, they are in fact green algae. Stoneworts favor clean water, particularly if it is calcareous or brackish. The Broads is one of the most important sites in the UK for stoneworts.

Ref 2/S5	Tranche 2	Species Action Plan 5
Plan Author:	Broads Authority	
Plan Co-ordinator:	Waterbodies Topic Group	
Plan Leader:	Broads Authority	
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Stage:	Final	

### 1. CURRENT STATUS

#### National Status

- Starry Stonewort (*Nitellopsis obtusa*) occurs in the Broads and a recent record from a gravel pit in Gloucestershire.
- Convergent Stonewort (*Chara connivens*) has been recorded at two sites in Devon and the Broads and at two sites in East Sussex.
- Bearded Stonewort (*Chara canescens*) is restricted to three sites near Peterborough, Cambridgeshire and the Outer Hebrides. It was previously recorded in 11 sites, including Norfolk.
- Baltic Stonewort (*Chara baltica*) is currently known from five sites coastal sites, which are the Broads, three in the Western Isles and one site in Anglesey.
- Intermediate Stonewort (*Chara intermedia*) is currently known from six sites in the Broads only; its presence is subject to extreme fluctuations.

#### Norfolk Status

- Starry, Intermediate, Convergent and Baltic Stoneworts are all found within the Upper Thurne Broads in the Northern Broads. During the late nineties, there has been a gradual increase in stoneworts. However, since 2000, a sharp decline in Hickling has resulted in complete loss in this broad in 2007. Martham and Blackfleet Broads remain the sole stronghold for these four stonewort species. There are old records for Bearded Stonewort from Hickling Broad; however, it has not been found since 1965 and before then in 1954. It is now thought to be extinct in Norfolk.
- Norfolk is the stronghold for four of these stonewort species (Starry, Intermediate, Convergent and Baltic), in the UK and Europe. Survey data from 2007 showed that the Martham Broads had the best populations; however, these populations are vulnerable, as they were the only sites where these stoneworts were recorded in the Broads. Growth of these four stonewort species was healthy and vigorous within the clear water of Martham Broads but was declining with increasing areas of bare sediment due to complete die-off (from 2006-2007). In 2007, there were no stoneworts in Hickling Broad. Horsey Mere and Heigham Sound also had almost total absence in 2007.

- Growth depends on many complex factors and population stability may be related to salinity. Intermediate, Baltic and Starry Stonewort are larger plants and therefore have the highest biomass, whereas Convergent Stonewort is smaller and tends to be out-competed by the larger species. No new records for the Bearded Stonewort exist despite extensive surveys been carried out by the Broads Authority in recent years.

## **2. CURRENT FACTORS IN NORFOLK CAUSING LOSS OR DECLINE**

The threats to the species are not fully known but are likely to include:

- Nutrient enrichment from diffuse and point source pollution.
- Water pollution from toxic substances such as copper and biocides in antifouling paints.
- High salinity and ochre concentration as a result of deep drainage in the catchment and saline incursion as a result of drainage, sea level rise and climate change. Although stoneworts are tolerant of brackish conditions, performance has been shown to decline if salinity levels increase.

## **3. CURRENT ACTION IN NORFOLK**

- In 2003/04, an extensive research programme began in the Upper Thurne area, comprising of five PhDs, one MSc and a NERC-funded research project. The results will inform the catchment and lake management required for the Upper Thurne for improved water quality and quantity. Cranfield is focusing on the surface and groundwater hydrology, hydrodynamics of the catchment and pollutants entering the system; Stirling is carrying out remote sensing to trace pollutants; UEA is focusing on nitrogen dynamics in the surrounding wetland; and NERC research is examining the role of salinity in the stability of aquatic plants in shallow lakes and the impact of nitrogen on aquatic plant species diversity.
- Scenarios to reduce the input of pollutants from the drained catchment plan are to be scoped by the Water Management Alliance (formerly KLCIDB), BA and NE. A feasibility study is planned to look at the achievability and practicality of these scenarios.
- Regular monitoring and occasional searches for stonewort species take place in all of the Broads in the Upper Thurne, which is currently the key area for stoneworts in the Broads. Regular monitoring and occasional searches also occur in around 25-35 of the 63 broads on an annual basis.
- Results from a further PhD, based at UEA and funded by Plantlife, EA and BA, on the autecology of stoneworts are being incorporated into management actions.
- A management plan for the Upper Thurne Broads has been written by the Upper Thurne Working Group, which has representatives from all key stakeholders.
- Several AMP schemes aim to reduce nutrient inputs from sewage treatment works at Whitlingham and Walcott and to minimise the impact of storm overflow discharge at Sutton Staithe.
- The School of Biological Sciences at the University of East Anglia currently possesses nursery populations of *Chara canescens*, *Chara connivens*, *Chara intermedia* and *Nitellopsis obtusa*. The populations are cultured in aquaria and used for generating cuttings for laboratory experiments and re-establishment trials.

## 4. ACTION PLAN OBJECTIVES AND TARGETS

### National

#### Nitellopsis obtusa

- Maintain populations of this species in ten extant sites.
- Establish viable populations at five extant sites by 2010.
- Establish and maintain one new metapopulation (outside the Norfolk Broads) by 2010.
- Re-establish populations at one historic site through habitat restoration by 2010.

#### Chara connivens

- Maintain populations of this species at eight extant sites.
- Establish viable populations at four extant sites by 2010.

#### Chara canescens

- Maintain, and where appropriate enhance, existing populations and, where appropriate, restore populations at former sites.
- Maintain the range and number of sites including, where appropriate, through introduction to adjacent localities where existing localities become unsuitable.

#### Chara baltica

- Maintain, and where appropriate enhance, existing populations and, where appropriate, restore populations at former sites.
- Maintain the range and number of sites including, where appropriate, through introduction to adjacent localities where existing localities become unsuitable.

#### Chara intermedia

- On new national BAP species list; targets and actions to be confirmed.

### Norfolk

The Norfolk Stonewort Action Plan brings together actions for five separate stonewort species. It should be noted that despite the Bearded Stonewort being considered extinct in Norfolk, it remains within the Norfolk BAP because of the capacity of stonewort populations to regenerate from oospores stored in the sediment under the right habitat conditions.

- Maintain and enhance the population of Starry Stonewort, Convergent Stonewort, Baltic Stonewort and Intermediate Stonewort in three Upper Thurne Broads (Martham North and South and Blackfleet Broads), with no loss of species. By 2012, all waterbodies should contain self sustaining, extensive populations of these BAP stoneworts. Seven out of ten sample points should include these stoneworts. Stonewort beds should cover a minimum of 50 percent of the euphotic zone, with beds being confluent.
- Promote expansion of one or more of the following stoneworts: Starry, Convergent, Baltic and Intermediate, to thirteen broads by 2012 (Heigham Sound, Horsey Mere, Hickling, Mautby Decoy, Upton, Strumpshaw, Cockshoot, Ormesby, Barton, Alderfen, Cromes, Buckenham and Haddingham Broads). A further six broads should be home to populations of these stoneworts by 2015 (Barnby, Little, Ormesby Little, Rollesby Belaugh and Bridge Broads). In addition, the range should be expanded to two newly created waterbodies (Whitlingham and Thorpe Marshes Broads) by 2012. Most of these waterbodies listed have more common non-BAP stoneworts present; the aim is to encourage annual occurrence of the rarer BAP stoneworts. Expansion will be mainly facilitated through habitat improvements, such as nutrient removal and biomanipulation, although reintroduction into suitable broads

should be considered where appropriate.

- By 2012, establish one experimental population of one or more of the following stoneworts: Starry, Convergent, Baltic and Intermediate, in a waterbody outside Broadland, which is less likely to be affected by sea level rise and coastal breach.
- Re-establish a population of Bearded Stonewort at one, suitable historic site in Norfolk through habitat restoration or re-introduction by 2012.

NATIONAL ACTION <sup>1</sup>		NORFOLK ACTION	ACTION BY:	PARTNERS:
<b>5.1</b>	<b>Policy and Legislation</b>			
<b>5.1.1</b>	Review/establish water quality objectives and associated nutrient standards at all extant stonewort sites, taking into account the requirements of these and other threatened aquatic species.	Use research and monitoring data, SAC favourable condition tables, SSSI lake condition assessment and WFD targets to define target condition.  Maintain and improve water quality standards in occupied waters. Identify and encourage better water quality standards in non-occupied waters.	BA, NE, EA  BA, NE, EA	
<b>5.1.2</b>	Ensure that the LEAP process and Water Level Management Plans take full account of the requirements of these species. The findings of 5.5.3 should be used to set water quality objectives and nutrient standards within these plans.	Use research to set water quality objectives and nutrient standards. (NB: LEAPs - Local Environment Agency Plans - no longer exist).  Ensure the next round of Review of Consents and CAMS includes a methodology for considering water resources from the crag in the tidal areas of the Broads.	WMA  EA	EA, BA, NE  NE, BA
<b>5.2</b>	<b>Site Safeguard and Management</b>			
<b>5.2.1</b>	Provide optimum conditions for growth and colonisation by this species, including removal of mud selectively on the larger Broads, and excavation of new sites.	Provide optimum conditions for a suite of species within and beyond the Broads, including the removal of mud from within existing waterbodies, and excavation of new sites (turf ponds) where it does not conflict with carbon, fen and wet woodland objectives.	BA, NE, NWT, SWT, Landowners	

<sup>1</sup> As this column amalgamates several national plans, the wording varies slightly from that within the individual national SAPs.

	<b>NATIONAL ACTION</b>	<b>NORFOLK ACTION</b>	<b>ACTION BY:</b>	<b>PARTNERS:</b>
<b>5.2.2</b>	Consider targeting relevant agri-environment schemes to land adjacent to remaining stonewort sites, seeking to reduce the threat of adverse practices (including fertilizer and herbicide use).	Implement Catchment Sensitive Farming initiative to reduce diffuse pollution inputs into sensitive catchments.	NE, EA, WMA	BA
<b>5.2.3</b>	Ensure that the needs of these species are addressed in the site management plans.	Continue to reduce nutrient loading where possible and set target nutrient levels for the Broads.	Water Companies, EA, NE, BA	BA
<b>5.2.4</b>	Depending on results of 5.5.3, devise and implement measures to minimise the threats of boat pollution, boat wash, and phosphorus pollution.	Promote the extension and improvement to the existing sewerage system in the Broads area, particularly in sensitive areas such as the Ant, Trinity Broads and Upper Thurne catchments.	Water Company, Water Quality Partnership, EA, NE	
		Continue the Environment Agency's Review of Consents Process.	EA, NE	BA
		Ensure that the needs of these species are addressed by water space management plans (2006 – 2011).	NWT, NE, BA, BLG, UTWG	
		Devise and implement good practice for reducing pollution from boats, including antifouling paint and PAHs.	BA, EA	RYA, BMF, NSBA, HBF, Green Blue

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
		Devise and implement measures for reducing diffuse pollution from the Upper Thurne catchment.	BA, WMA, EA, NE	UTWG
		Ensure that dredging <u>and</u> plant cutting activities do not adversely affect the populations of stoneworts.	BA, NE	BLG, UTWG
<b>5.3</b>	<b>Species Management and Protection</b>			
<b>5.3.1</b>	Re-establish colonies as sites become available after habitat restoration, seeking to re-colonise five waterways adjacent to existing colonies.	Allow re-establishment of colonies as sites become available after water quality improvement and/or habitat restoration.	NE, BA	NWT, SWT, Landowners
<b>5.3.2</b>	No national action.	Incorporate the experiences and monitoring results of the weed-cutting programme into BA's Upper Thurne management practices.	BA	NE, NWT, UTWG
<b>5.3.3</b>	No national action.	Implement appropriate recommendations from the research and monitoring programme on an annual basis and on completion of the Upper Thurne research programme in 2007.	BA	NA, NWT, UTWG

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
<b>5.4</b>	<b>Advisory</b>			
<b>5.4.1</b>	Advise relevant landowners and managers of the presence of stoneworts and of appropriate management for conservation.	Ensure that key bodies and landowners are aware of the legal protection afforded to these stoneworts and their conservation requirements.	NE, EA, BA, NWT, WMA	NWT, Landowners
<b>5.4.2</b>	No national action.	Raise awareness among the boat hire industry, sailing clubs and all other significant recreational interests of the presence and significance of these stoneworts.	BA	UTWG, BLG, RYA, BMF, NSBA, Sailing and Boating Clubs
<b>5.4.3</b>	As far as possible, ensure that all relevant agri-environment officers are advised of locations of these species, their importance and of the management needed for their conservation on and adjacent to existing sites.	Provide advice to agri-environment officers in areas where stoneworts occur.	NE, EA, BA, NWT, WMA	DEFRA
<b>5.5</b>	<b>Future Research and Monitoring</b>			
<b>5.5.1</b>	Collate information and survey extant sites and historic sites to gain a more complete understanding of the current distribution and status of all stoneworts.	Continue to research ecological requirements, and determine the water quality and substrate requirements of these species.	BA, UEA, Plantlife International NE, EA	



<b>NATIONAL ACTION</b>		<b>NORFOLK ACTION</b>	<b>ACTION BY:</b>	<b>PARTNERS:</b>
<b>5.5.2</b>	Continue to research ecological requirements, in particular seedling establishment and interspecific competition, and determine the water quality requirements of the species.	Monitor the effects of aquatic plant cutting and turf pond creation on these species.  Determine the success of translocating sediment to establish populations at new sites.	BA  BA, NE, EA	NE, NWT
<b>5.5.3</b>	Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, habitat quality, current management and potential threats.	Survey all known extant populations on an annual basis. Survey the Upper Thurne area every five years, and 25-35 broads annually. Survey key turf ponds and chara dominated ditch systems every five years. Correlate water quality data and stonewort status on an annual review basis and map in GIS.  Identify suitable sites, based on water chemistry and substrate, for translocation of populations outside of Broadland.	BA  UEA, UCL	NE, WMA  BA, NE
<b>5.5.4</b>	Undertake research on autecology including assessment of environmental and anthropogenic impacts.	Implement recommendations of stonewort research and contribute towards the continued investigation into the impact of antifouling paint on stoneworts	UEA, BA	NE, EA

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.5.5	Commission research into the possibility of salinity levels rising in the Norfolk Broads as influxes of sea water become more frequent as a result of sea-level rise. The research should consider the need for measures to ensure that salinity levels do not increase further.	<p>Encourage further research on the ecology and distribution of this species. Liaise with other countries experiencing similar problems with the species, and use this information and experience towards furthering the conservation and species protection.</p> <p>Use data from the Upper Thurne research programme (ending in 2007) and salinity monitoring to test scenarios using the BESL hydrological model.</p>	<p>BA, Plantlife, UEA</p> <p>BA, EA, NE, BESL</p>	EA, NE
5.6	<b>Communications and Publicity</b>			
5.6.1	None proposed.	Pass survey results to Norfolk Biological Records Centre and Joint Nature Conservation Committee, so that they can be incorporated in national and local databases.	BA, NE, WMA, NBRC	

## Abbreviations

BA	Broads Authority
BLG	Barton Liaison Group
BMF	British Marine Federation
DEFRA	Department of Environment, Food and Rural Affairs
EA	Environment Agency
NBRC	Norfolk Biological Records Centre
NE	Natural England
NSBA	Norfolk and Suffolk Boating Association
NWT	Norfolk Wildlife Trust
RYA	Royal Yachting Association
UEA	University of East Anglia
UTWG	Upper Thurne Working Group
WMA	Water Management Alliance

## MANAGEMENT GUIDANCE

***(This guidance is a general summary; for more detailed information or advice, please consult the references or contacts below.)***

Most stonewort species are unable to tolerate significant levels of nutrient pollution, particularly nitrogen; as a result, they are exceptional indicators of water quality. Nutrients have the effect of encouraging competition, particularly the growth of epiphytic algae, which inhibits nutrient exchange through cell walls. The largest threats to their survival are eutrophication and salinity increases from sea level rise.

Impact of plant cutting has yet to be established for all species. There is some evidence of the effect of one season of cutting on the Intermediate Stonewort (*Chara intermedia*), using a variety of cut heights. However, there is no evidence of the impact of repeat, year-on-year cutting. This will be the focus of future research; however, in 2005-07, the stonewort condition was too poor or absent to allow cutting. It is likely that results will be transferable to the Baltic Stonewort, but may not be relevant to the Starry Stonewort where the individual plants are more fragile.

Dredging of the Catfield channel was shown to have a potentially negative impact on adjacent chara beds by causing high turbidity, increased cover of re-suspended silt and direct mechanical damage by manoeuvring of barges. Dredging has the potential to remove the viable seed bank for this species in current stonewort sites, although it is thought that stonewort oospores may be viable for decades as they quickly reappear in new land-locked peat diggings, however further research is required viability time. Dredging may also promote stonewort growth as was seen in Barton and Hasingham Broads. Exposure of firmer sediments by removal of soft, overlying sediment is not possible in the Broads as the sediments quickly remobilise in the shallow waters. Thus, exposure of firmer sediment is not a reason for sediment removal in the Broads. In addition, the deeper water can decrease light climate, further reducing the success of stoneworts; however, in the shallow broads, light is often not limiting and stonewort are tolerant of low light conditions (1mmol/m/sec) and stoneworts have been found at 60m depth in New Zealand. It is also worth considering the role of sediment removal in decreasing nutrient loading, a major factor affecting the success of stonewort colonisation. All these factors need detailed consideration before management actions are taken.

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## REFERENCES

Appropriate Assessment Report. (1999). Assessment of the proposed cutting of aquatic plants in Hickling Broad.

Harris, J. (2001). Survey of the aquatic plants of the Upper Thurne Rivers and Broads.

Kelly, A. (2003). Broads annual macrophyte monitoring report 2003.

Stewart, N. (2004). Important Stonewort Areas of the United Kingdom. Plantlife International, Salisbury, UK.

Stewart, N. & Church J.M. (1992). Red Data Books of Britain and Ireland: Stoneworts. JNCC, Peterborough.