Stoneworts (Charophytes)

Nick Stewart

What are stoneworts and how to recognise them

Books and keys

Important characters

Habitats and threats

Stoneworts are highly specialised, complex, macroscopic, green, freshwater algae.

Nitella tenuissima

Weed is major snag for Broad sailors

A super-weed has outgrown its welcome among stranded sailors on a Norfolk Broad.

The rare stonewort, or Chara baltica, has not been seen on Hickling Broad for 100 years, but what is good news for ecologists is no laughing matter for yachtsmen.

For while the protected stonewort, along with its sister species, Chara intermedia, is living proof of a clear and thriving waterway, its tangling tentacles have brought yachts and cruisers grinding to a halt.

And it has landed the Broads Authority in a dilemma: cut too much of the plant, found on only four British sites since 1970, and risk contravening European legislation; cut too little and incur the wrath of boat hire yards and yachtsmen.

A report by conservation officers to Thursday's navigation committee proposes a cut to give

Picture: DANIEL KENNEDY

CAUGHT UP: Simon Wolfe, of Hickling Broad Sailing Club, with some of the troublesome weed. Left: A close-up of stonewort.

▼ TROUBLE WITH WEED

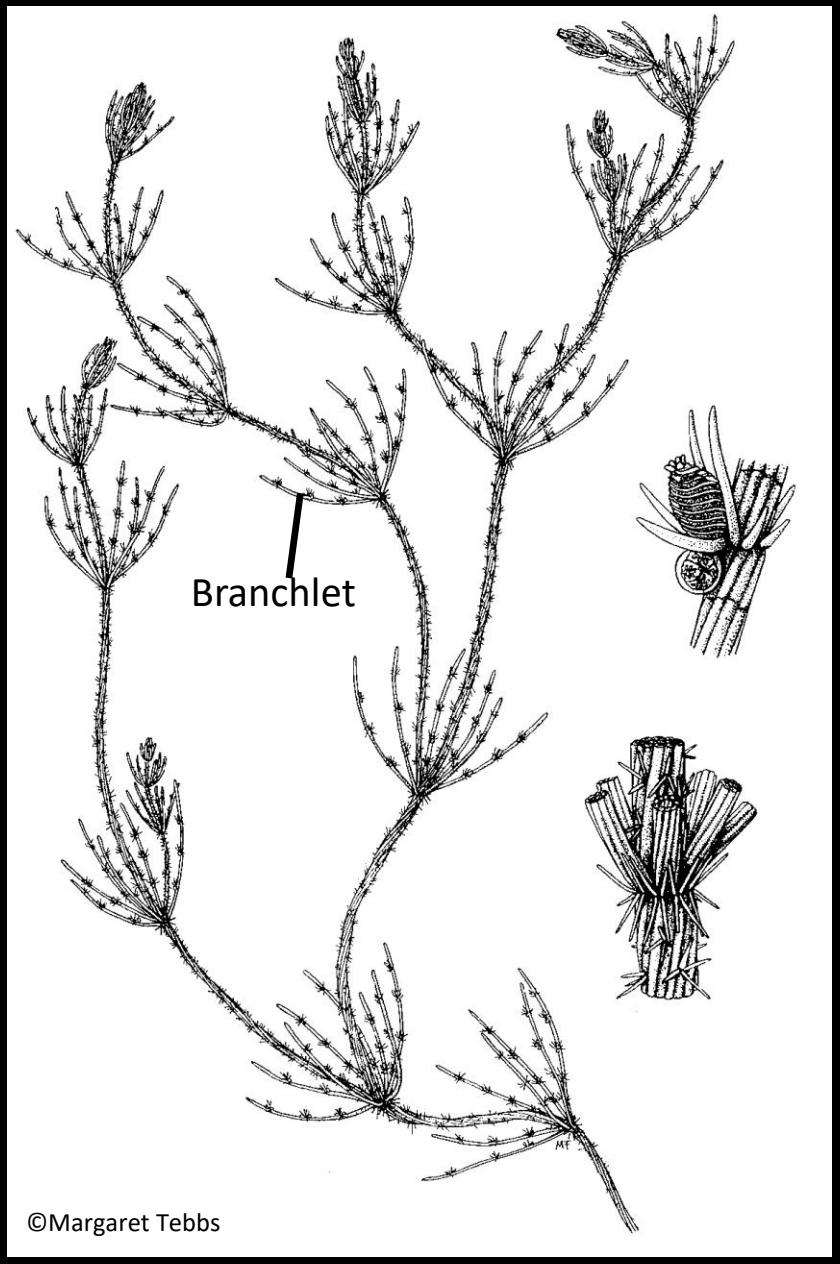
A weed problem on Hickling Broad is not an entirely new phenomenon. In 1922 some 3470 tons of weed was removed at a cost of several hundred pounds "enabling yachts and wherries to reach Pleasure Boat Staithe for the first time since 1913". The following year, nine men in five boats were engaged in weed removal and by 1925 the removal cost was reported at £1400. Weed growth was next reported as a problem in 1947 and sponge weed masses between 2000 and 1760 tons a year were removed by the Yare, Bure and Waveney Commissioners between 1960 and 1968.

Yields declined and removal ceased after 1974 until a selective weed-cutting programme was introduced three years ago to combat milfoil and fennel pondweed.

Honorary status among the higher plants

The only non-vascular plants included in the remit of the Botanical Society of Britain and Ireland

They are included in the term “aquatic macrophytes” used for monitoring of the vegetation of lakes and rivers

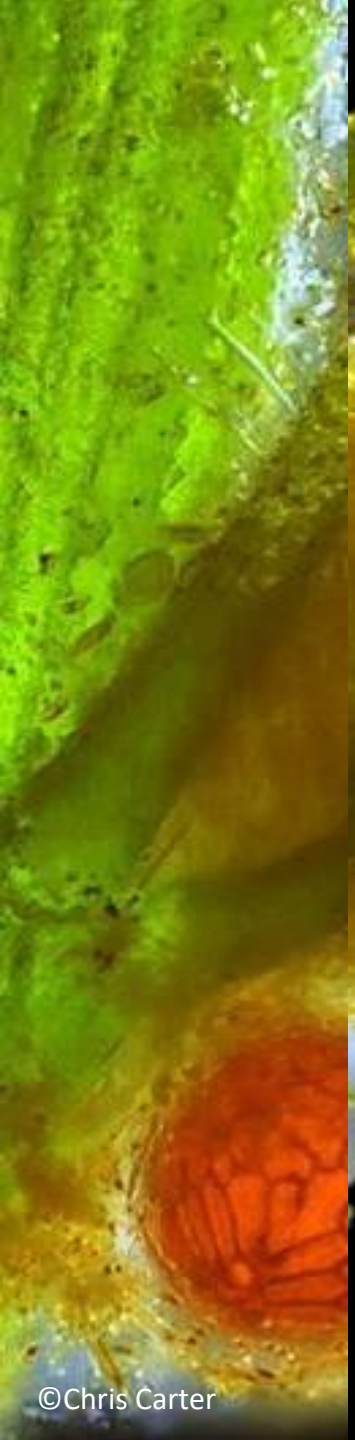


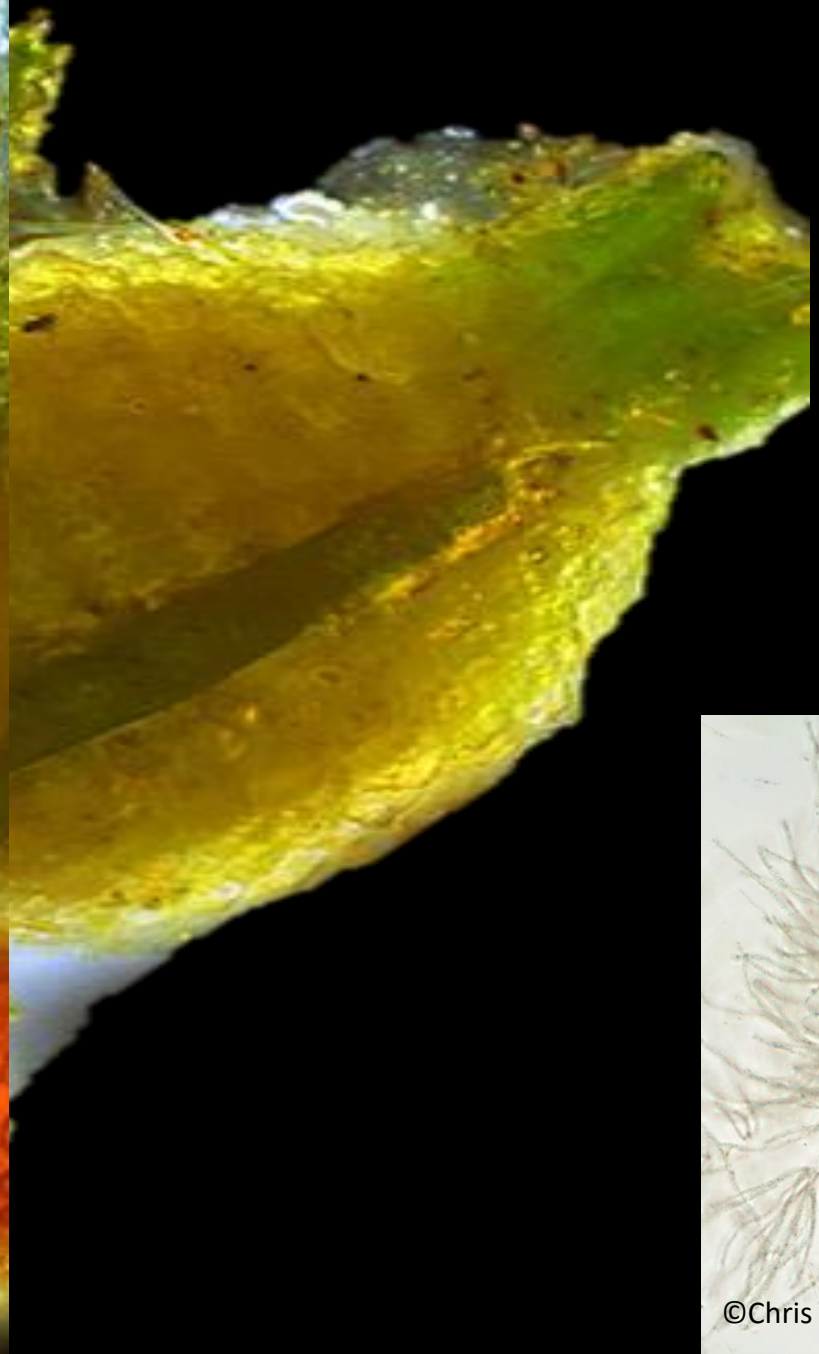
Recognising a stonewort

- Aquatic plants 5cm to 100cm in length
- Regular whorls of c. 8 cylindrical branchlets
- Branchlets often +/- undivided giving horsetail-like appearance
- Some species have divided branchlets but these have very simple cell structure
- Some have a distinctive smell
- Some encrust lime on the surface of the plant
- Distinctive fruiting structures

Nitella mucronata

Hornwort – Ceratophyllum


©Chris Carter



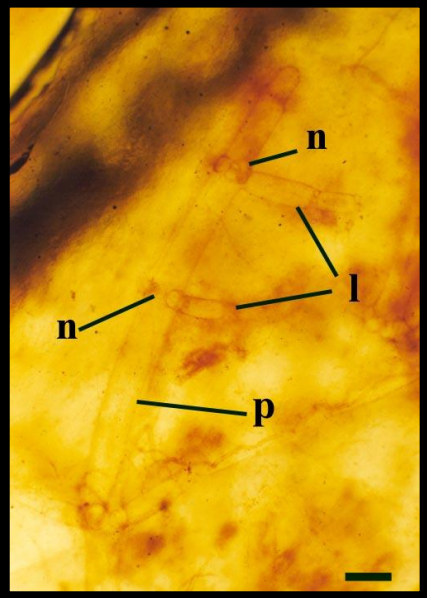

©Chris Carter
100 µm

Early Devonian stoneworts

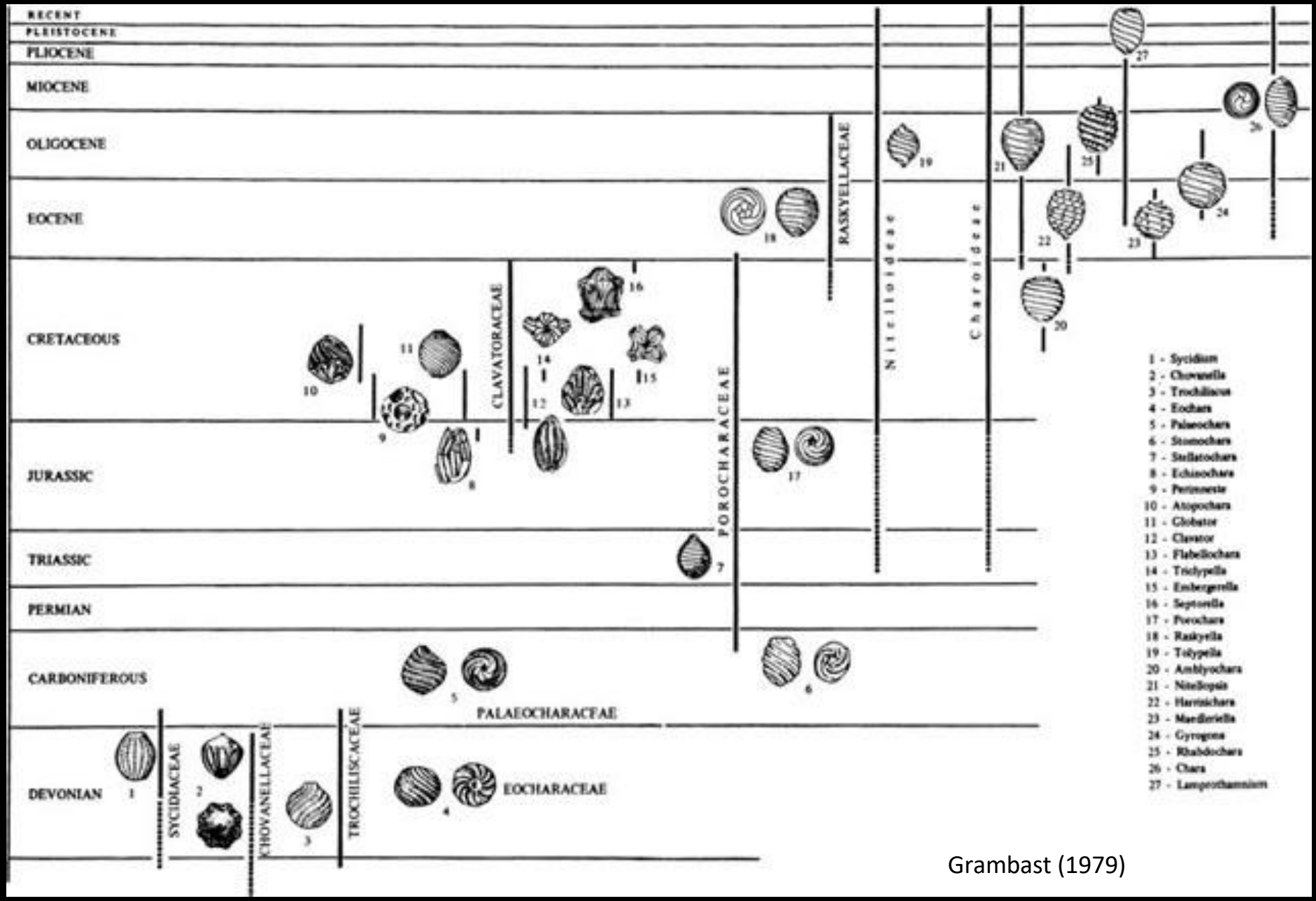
Rhynie chert environment

Artist: Richard Bizley

Palaeonitella cranii

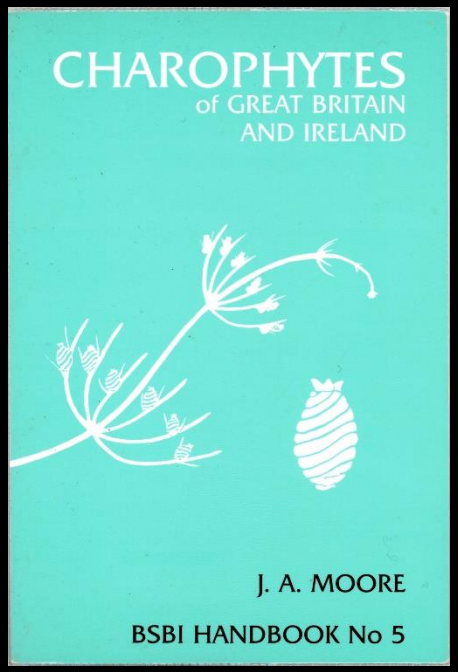


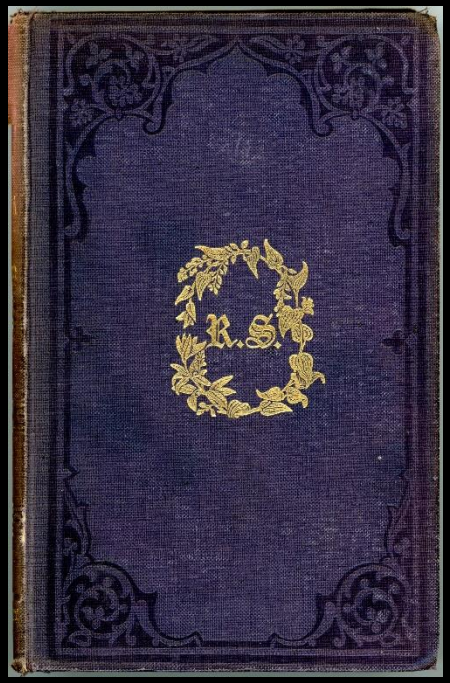
R.Kelman et al. (2004)

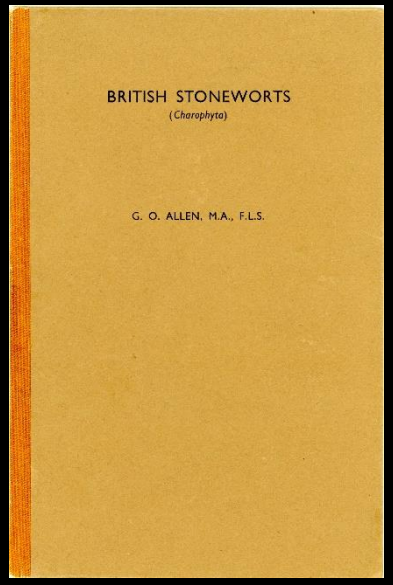


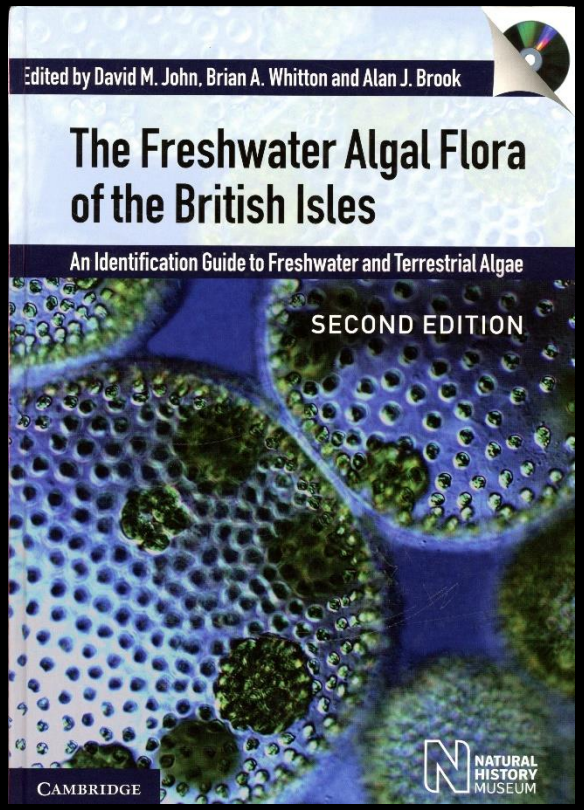
Grambast (1979)

Books


CHAROPHYTES
of GREAT BRITAIN
AND IRELAND
J. A. MOORE
BSBI HANDBOOK No 5


R.S.


BRITISH STONEWORTS
(Charophyta)
G. O. ALLEN, M.A., F.L.S.


Edited by David M. John, Brian A. Whitton and Alan J. Brook
The Freshwater Algal Flora of the British Isles
An Identification Guide to Freshwater and Terrestrial Algae
SECOND EDITION
CAMBRIDGE
NATURAL HISTORY MUSEUM

Polish Charophytes

An Illustrated Guide to Identification

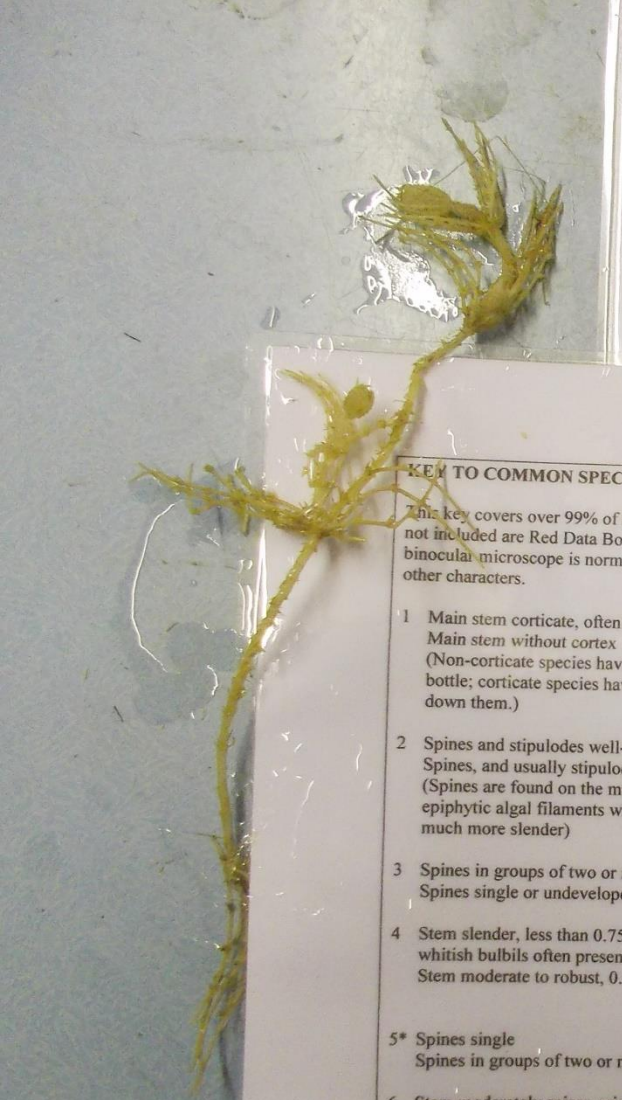


TABLE 1: Overview of Chara species without spines or with single blunt spines
[The following separations can be difficult in the field but with familiarity and a combination of characters it is possible to make field determinations with reasonable accuracy. However, confirmation under low-power microscope is recommended. Spines and stipulodes are the most useful diagnostic field characters when weather and lack of encrustation permit (best to look at the youngest expanded internode for the best-developed spines (which are deciduous) and least encrustation)]

	Chara virgata	*Chara globularis*	*Chara vulgaris*	*Chara contraria*
Spines	Minute raised bumps	Rudimentary; difficult to see even under low-power microscope	Raised bumps to elongate and obtuse; when elongate, usually more or less appressed to stem	Raised bumps to elongate and obtuse; when elongate, usually spreading to inclined
Stipulodes	Only upper row developed, shortly conical (rarely more elongate with obtuse	Not developed or minutely globular (rarely with upper row slightly developed on	Both sets equally developed, more than twice as long as broad, blunt	Both sets equally developed, more than twice as long as broad, blunt (rarely rather

KEY TO COMMON SPECIES OF STONEWORT

This key covers over 99% of stoneworts encountered in Britain and Ireland. Species not included are Red Data Book or "near threatened". An asterisk indicates that a binocular microscope is normally required. A x20 hand lens is recommended for other characters.

1 Main stem corticate, often spiny — **2**
Main stem without cortex — **8**
(Non-corticate species have semi-translucent stems, like looking through a green bottle; corticate species have more opaque stems with stripes of cells running down them.)

2 Spines and stipulodes well-developed and acute-tipped — **4**
Spines, and usually stipulodes blunt-tipped or undeveloped — **3**
(Spines are found on the main stem (cf. bracts on the branchlets). Beware of epiphytic algal filaments which are sometimes confused as spines but are usually much more slender)

3 Spines in groups of two or more — **4**
Spines single or undeveloped — **Go to table 1**

4 Stem slender, less than 0.75 mm wide and usually less than 0.5 mm wide; small whitish bulbils often present among rhizoids; dioecious — **5**
Stem moderate to robust, 0.75-3 mm wide; whitish bulbils absent; monoecious — **6**

5* Spines single — ***Chara aspera***
Spines in groups of two or more — ***Chara curta***

6 Stem moderately spiny; spine clusters spaced so that the stem is easily visible among the spines, except on the youngest parts of the stem; spines deciduous and often absent from older parts of the stem; (outer bracts less than half the length of the inner ones; branchlets usually long, up to 8 cm, often flexuous giving a spidery appearance;) — **7**
Stem densely spiny; spine clusters close together and usually obscuring the stem; spines persistent; (outer bracts more than half the length of the inner ones; branchlets usually shorter and stiffer, usually less than 3 cm, giving a neater appearance) — ***Chara aculeolata***
(* *Chara aculeolata* can be confirmed microscopically by the cortical rows bearing the spine clusters being much more prominent than the ones between)

7 Spines sticking out from the stem (inclined more or less towards the centre of the internode), acute-tipped; (cortex even in width or with spine-bearing rows narrower than those between) — ***Chara hispida***
Spines appressed to stem with two of the two/three spines (not usually more than three) more or less pointing in opposite direction up and down the stem (in youngest, not fully expanded internodes the density of spines may push them in various directions), obtuse to acute-tipped; (spine-bearing rows much narrower than those between so that spines appear to be in furrows of stem) — ***Chara rudis***

8 Branchlets apparently unbranched, but many with a minute tuft of 1-2 celled branches at the ends, visible under a hand lens; plant robust (stem 1-3 mm diameter and internodes up to 10 cm long), usually more or less yellowish-green — ***Nitella translucens***
Many branchlets conspicuously branched; plant slender to robust, usually grey-green, mid to dark green or black — **9**

9 Branchlets with more or less rounded tips; fertile branchlets dividing pinnately (i.e. central axis with smaller side branches), strongly incurved to form tight untidy balls; sterile branchlets much longer and unbranched; plant often encrusted and brittle, brownish or greyish green — ***Tolypella glomerata***
Branchlets with a distinctly pointed tip (usually acute, apiculate or mucronate); sterile and fertile branchlets dividing furcately (i.e. like tuning-forks), the fertile ones loose or sometimes forming tight heads but not usually as ball-like as in *Tolypella*; plant normally little-encrusted, mid to dark green or black — **10**

10 Ultimate segment of branchlets 2-3 celled, at least one cell well developed but the 1-2 at the tip often minute and visible only under hand lens or low-power microscope — ***Nitella mucronata***
Ultimate segment of branchlets single celled (note: apiculate tips can be composed largely of cell-wall tissue and this can sometimes be confused for an extra cell) — **11**

11* Dioecious; antheridia 650-775 microns; mature oospore 375-425 microns — ***Nitella opaca***
Monoecious; antheridia 500-625 microns; mature oospore 500-575 microns — ***Nitella flexilis***

(Sterile material should be recorded as *Nitella flexilis* agg. Fertile material is rare after the end of July)

Nick Stewart Updated May 2018

33 species in Britain and Ireland

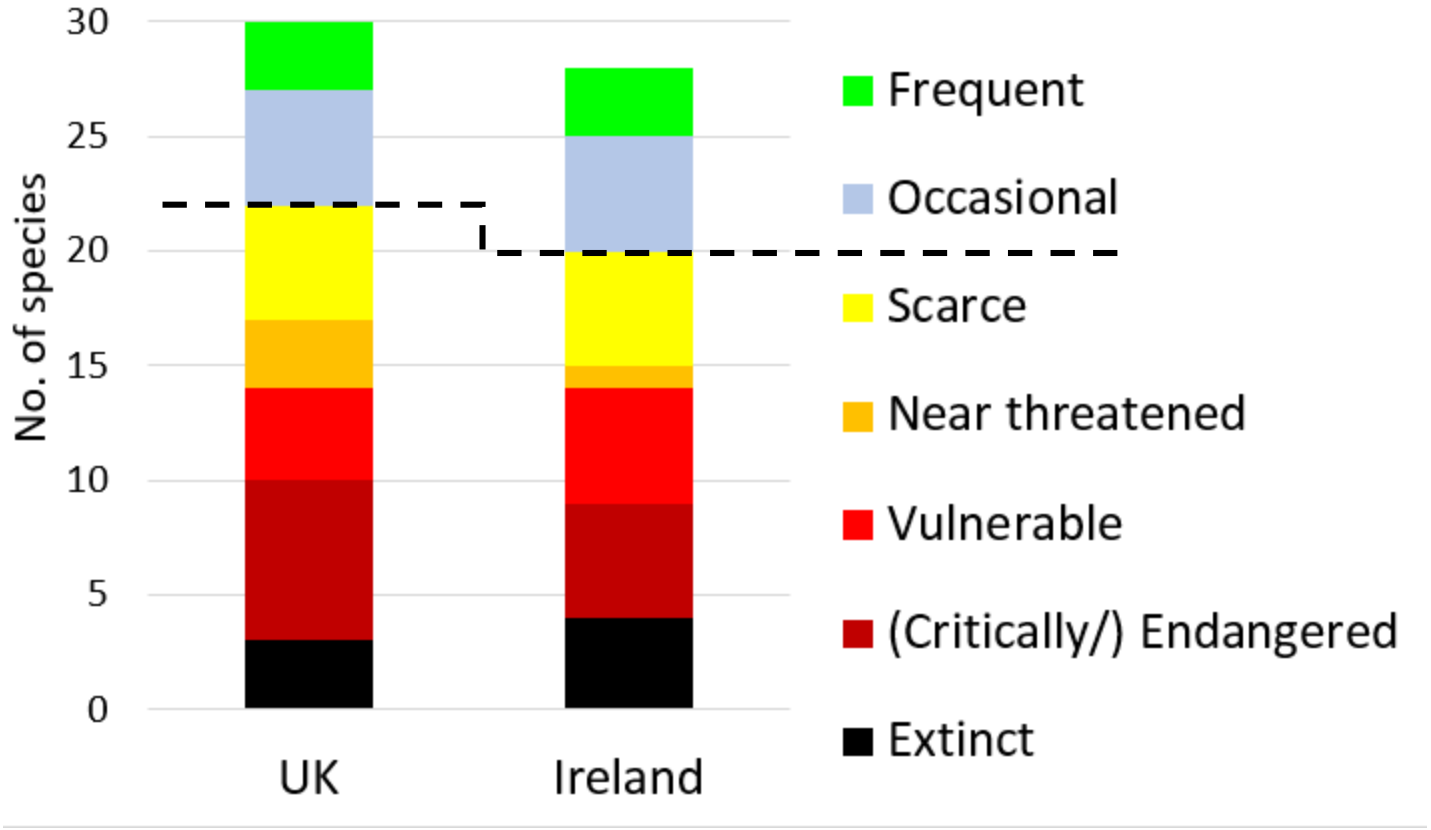
Widespread and frequent:
Chara virgata, Chara vulgaris, Nitella opaca

Locally frequent:
Chara aspera, Chara aculeolata, Chara contraria, Chara curta, Chara globularis, Chara hispida, Chara subspinosa (*rudis*), *Nitella translucens*

Occasional:
Nitella flexilis s.s., *Nitella confervacea, Nitella mucronata, Tolypella glomerata*

Rare:
The rest

Status of stoneworts in UK & Ireland

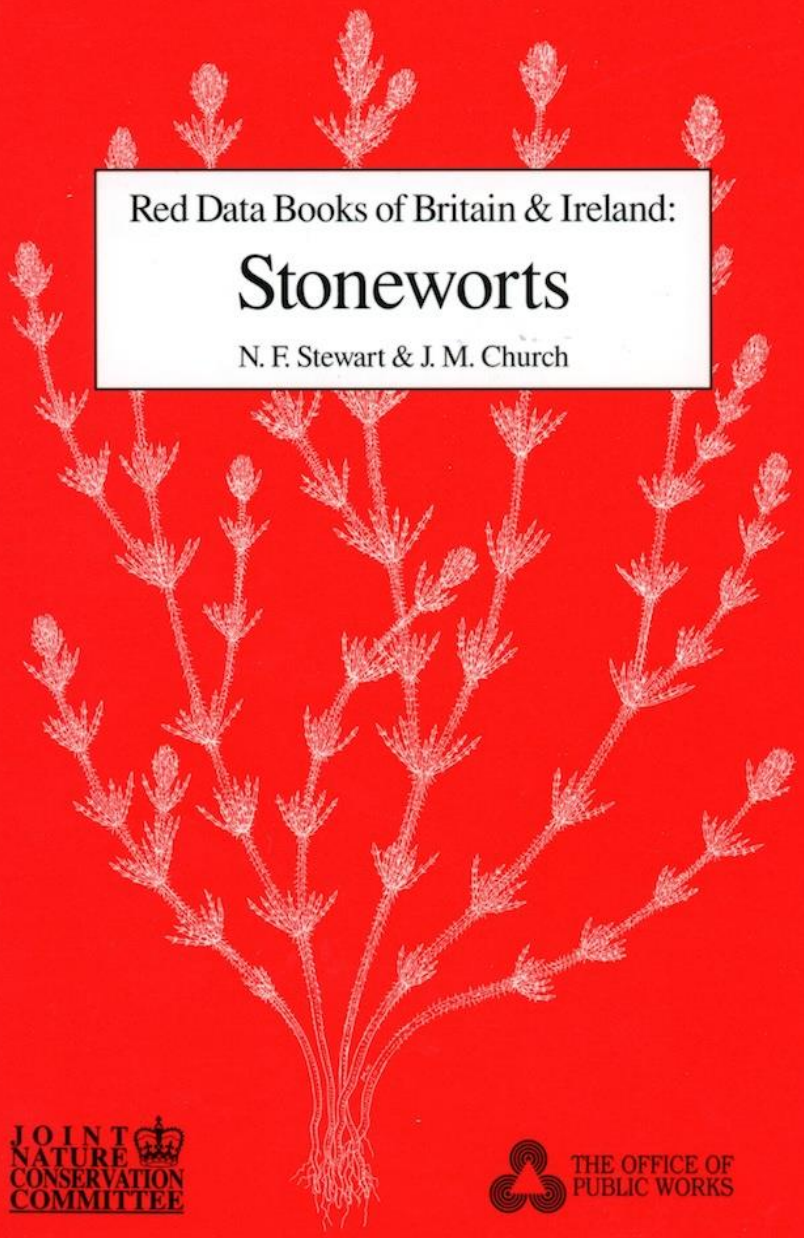


Source: Stewart & Church 1992. *Nitellopsis obtusa* and *Tolypella nidifica* added to Ireland since then

Red Data Books of Britain & Ireland:

Stoneworts

N. F. Stewart & J. M. Church



JOINT NATURE CONSERVATION COMMITTEE

THE OFFICE OF PUBLIC WORKS

IMPORTANT CHARACTERS

With a cortex - Chara

Chara vulgaris

Without a cortex –

Tolypella

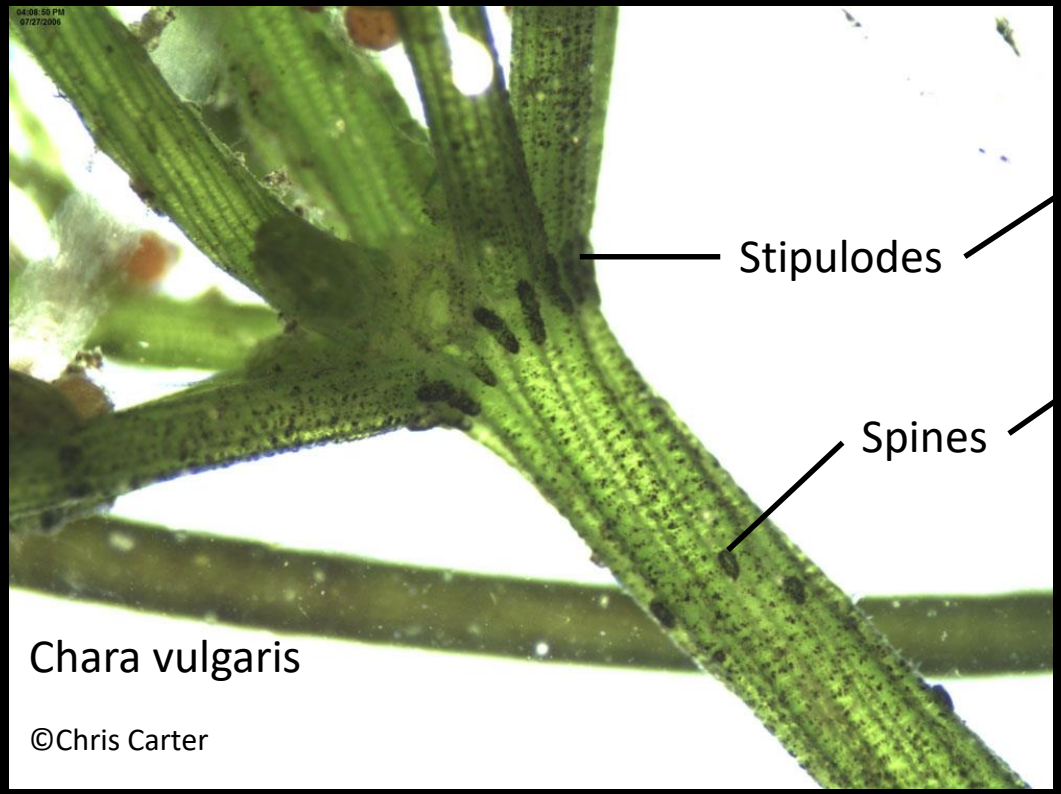
Nitella

Lamprothamnium

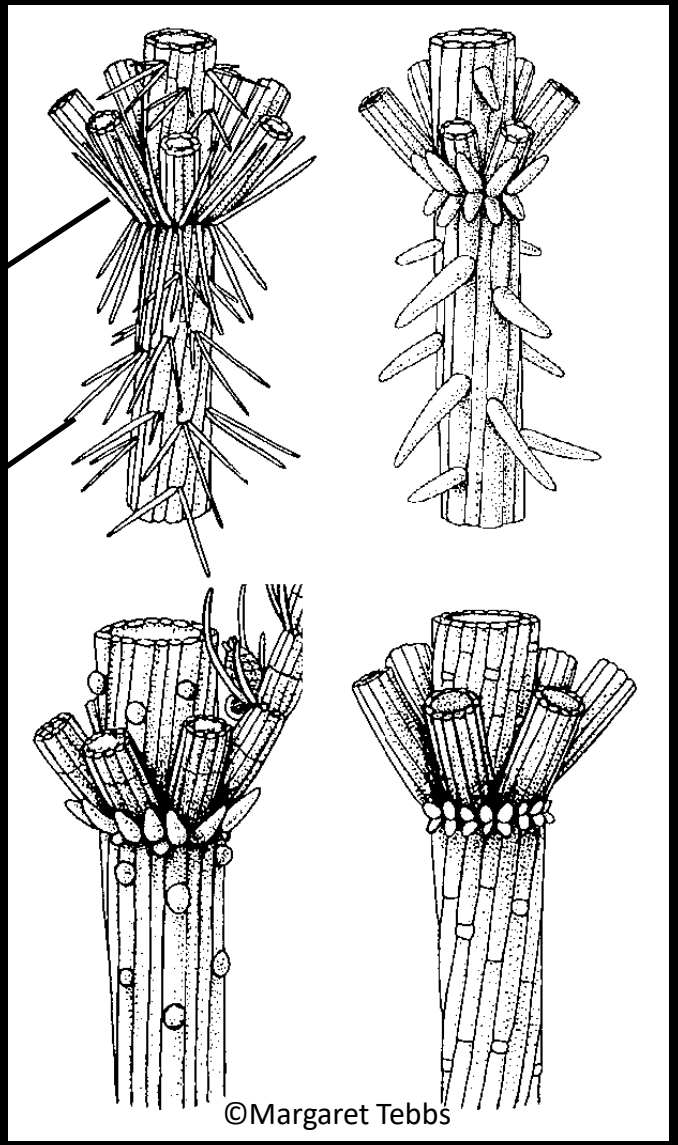
Nitellopsis

Nitella opaca

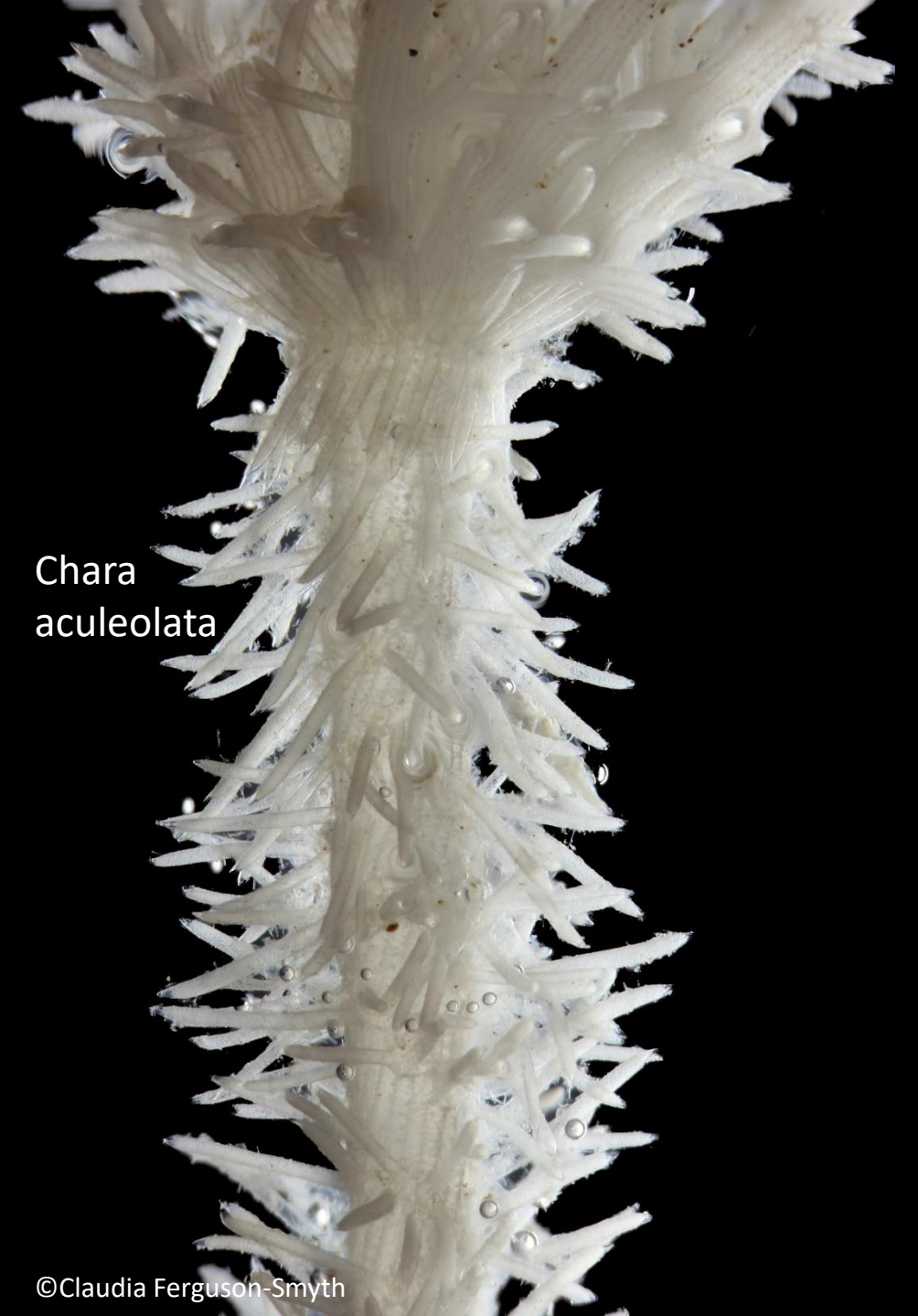
SPINES AND STIPULODES



Chara vulgaris



NB. Spines occur on the main stems, not the branchlets

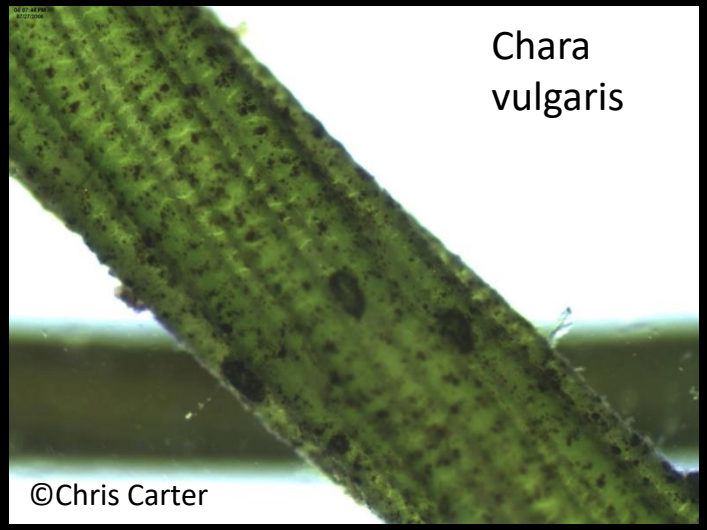

Chara
aculeolata
©Claudia Ferguson-Smyth

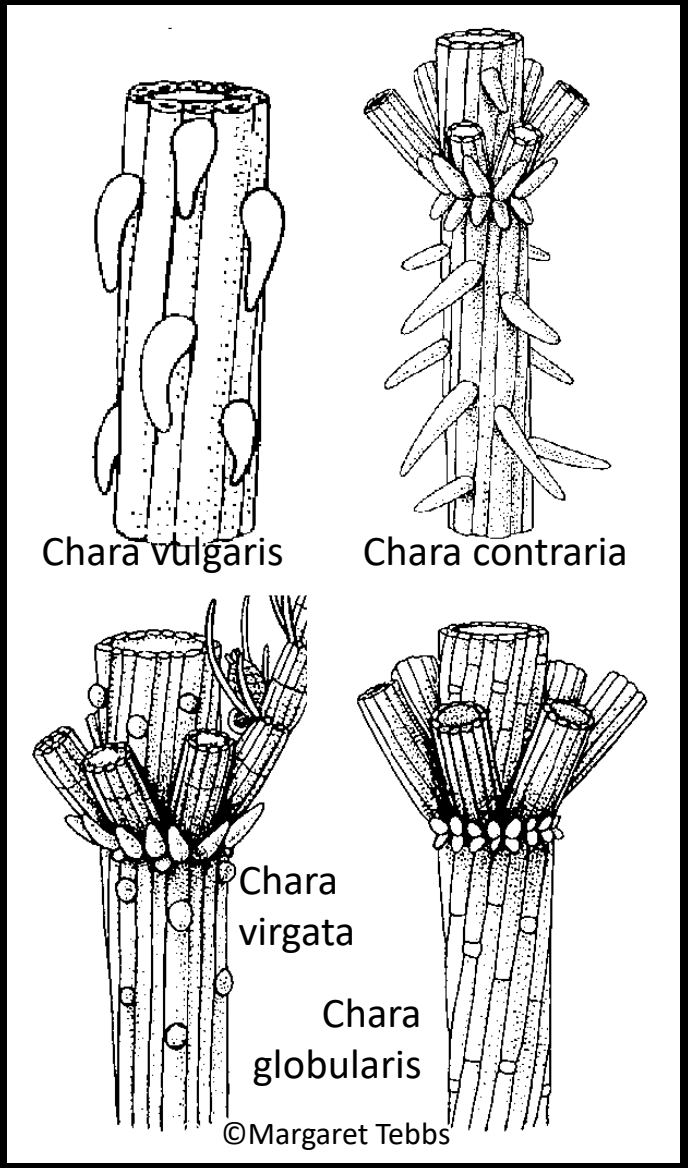

Chara
aspera
©Claudia Ferguson-Smyth

Chara globularis

Chara vulgaris

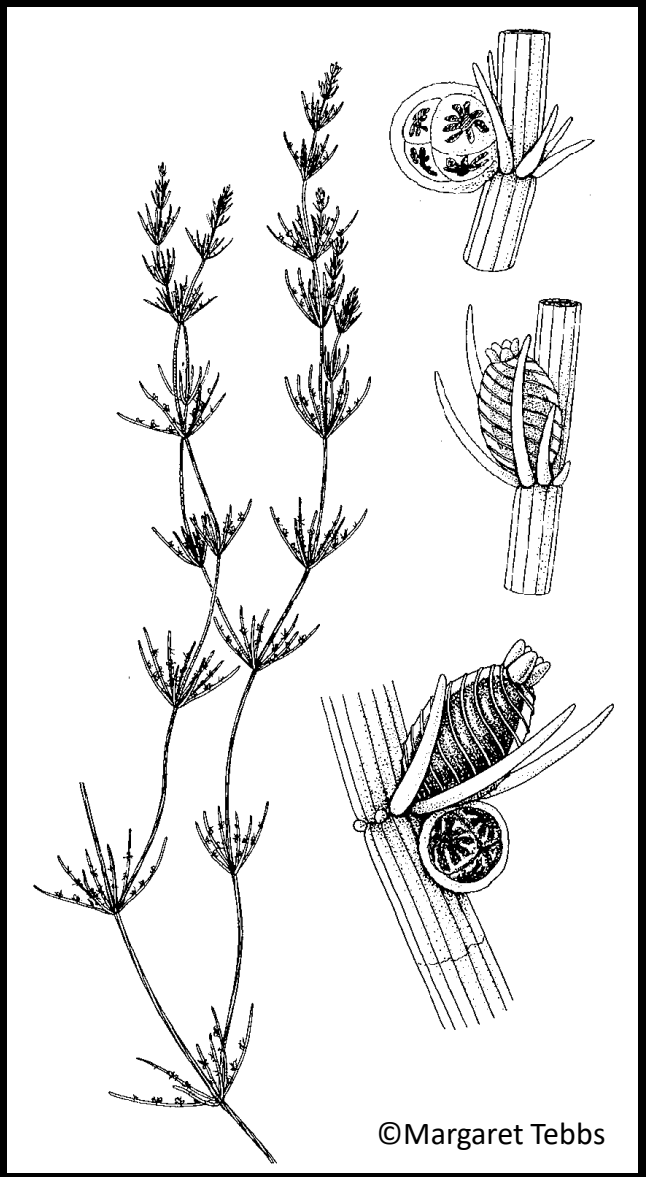
CORTEX VARIATIONS



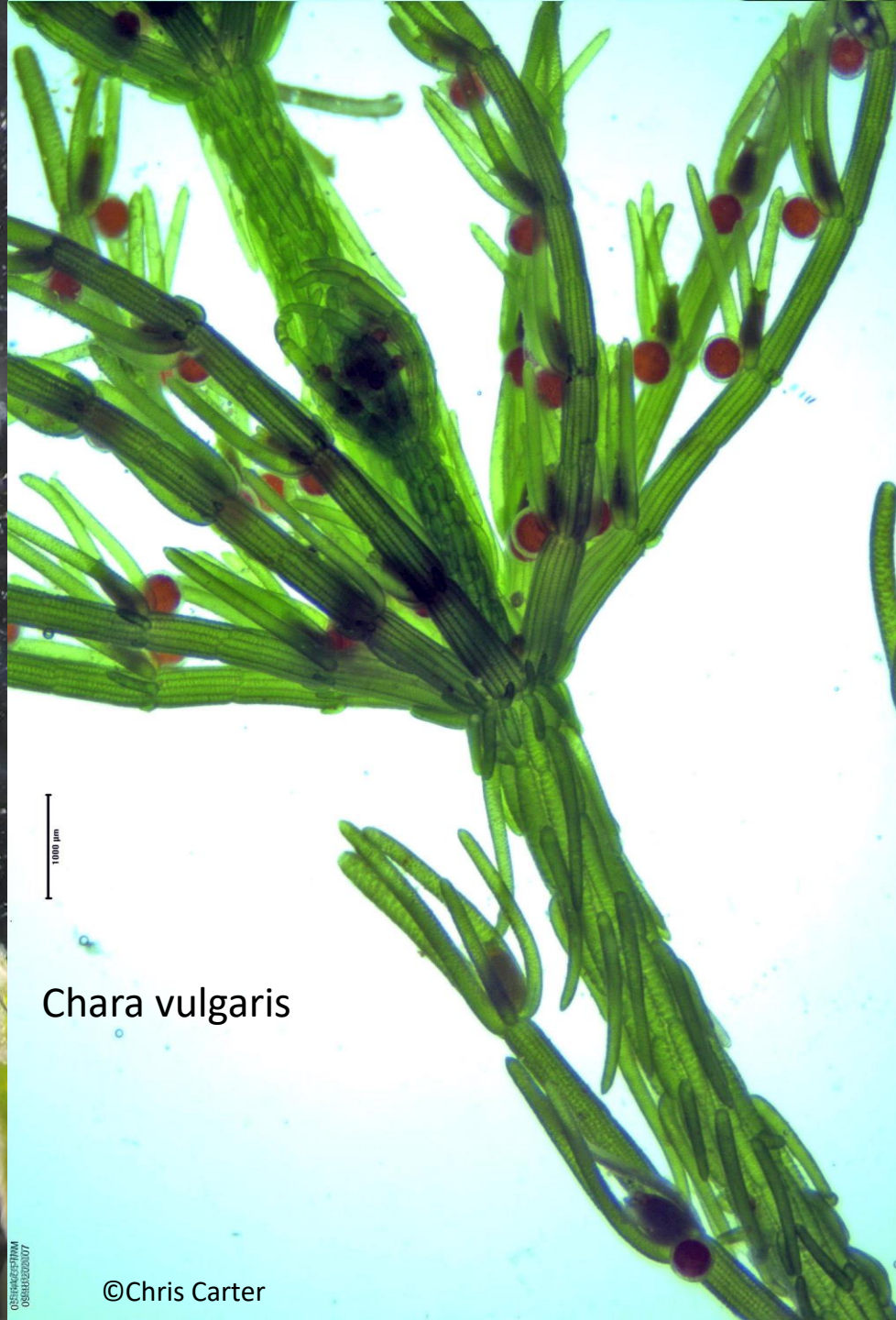


Chara canescens

Fruiting Structures



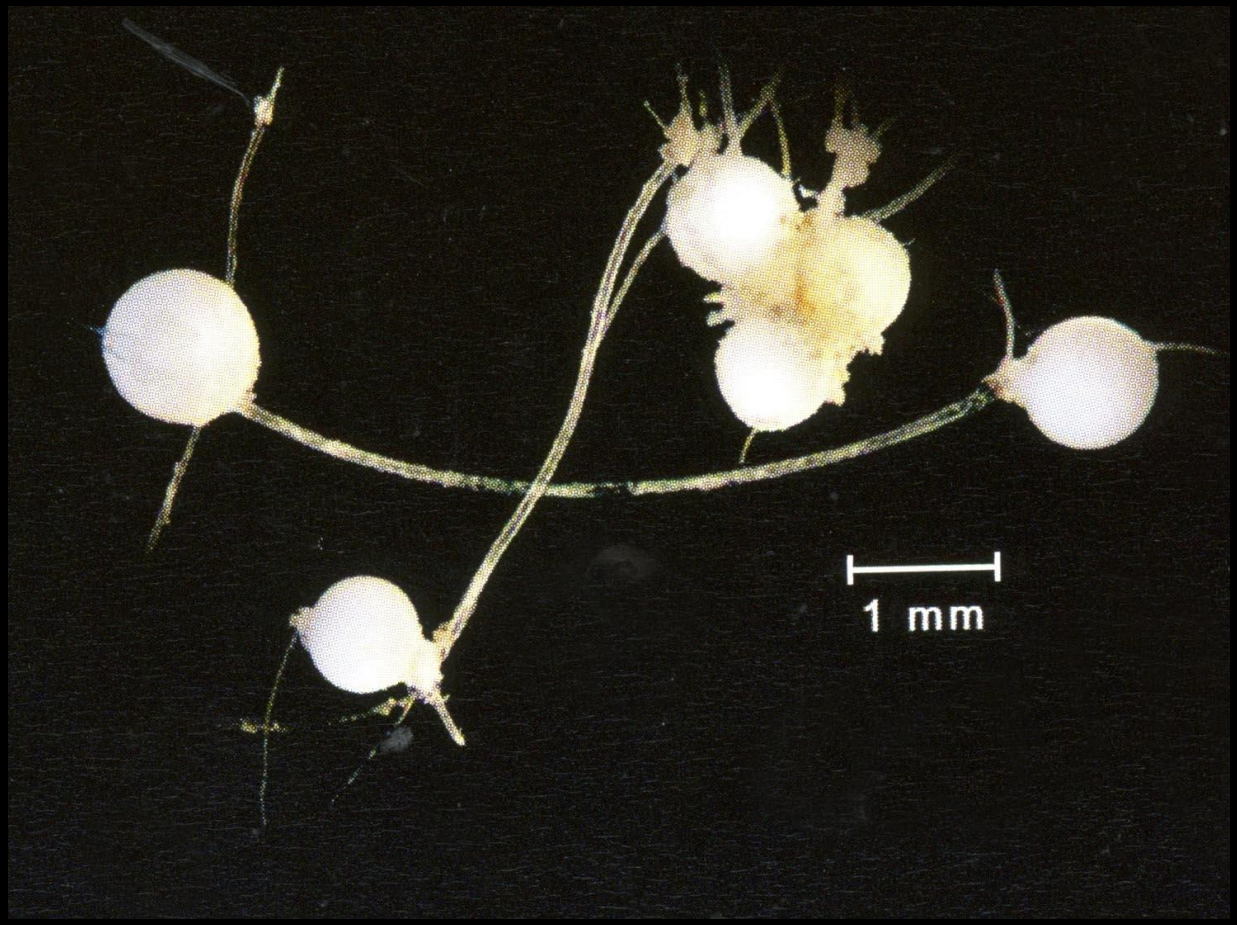

Chara connivens
©Claudia Ferguson-Smyth


1000 µm
Chara vulgaris
©Chris Carter

Chara connivens

Nitella opaca

Bulbils



Review of *Chara*

9 species that are not Red Listed

3 Large spiny species: *Chara hispida, Chara rudis, Chara aculeolata*

2 Small spiny species (sharp spines): *Chara aspera, Chara curta*

4 Small to medium species, without spines or with single blunt spines: *Chara vulgaris, Chara contraria, Chara globularis, Chara virgata*

Large spiny Charas

Chara aculeolata

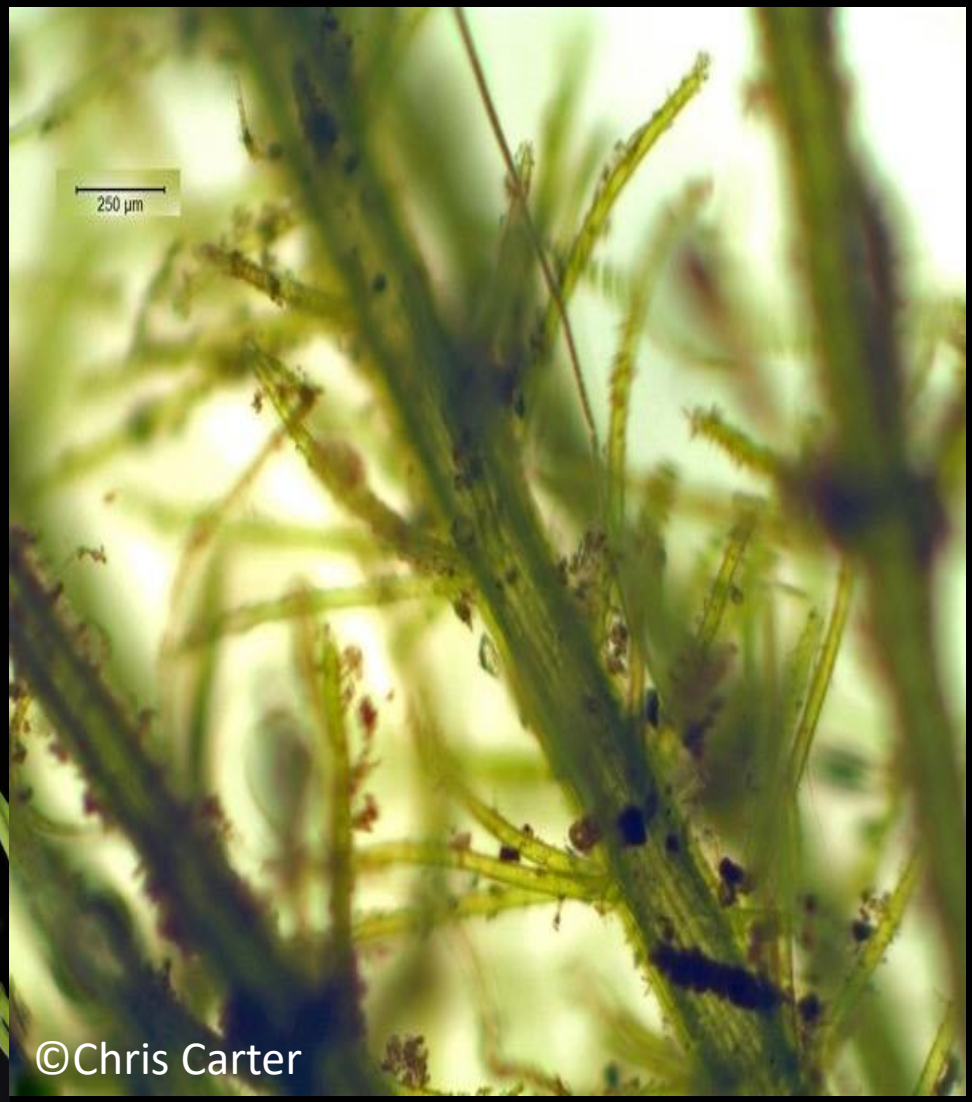
Chara hispida

Chara rudis

Small spiny species

Chara aspera

©Claudia Ferguson-Smyth



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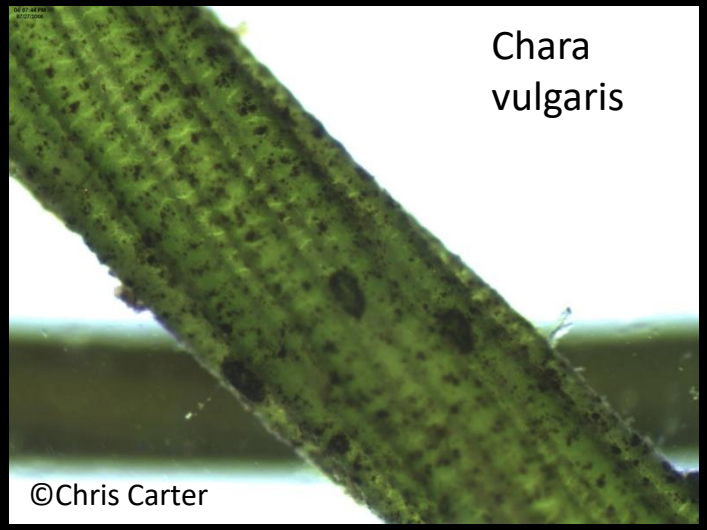
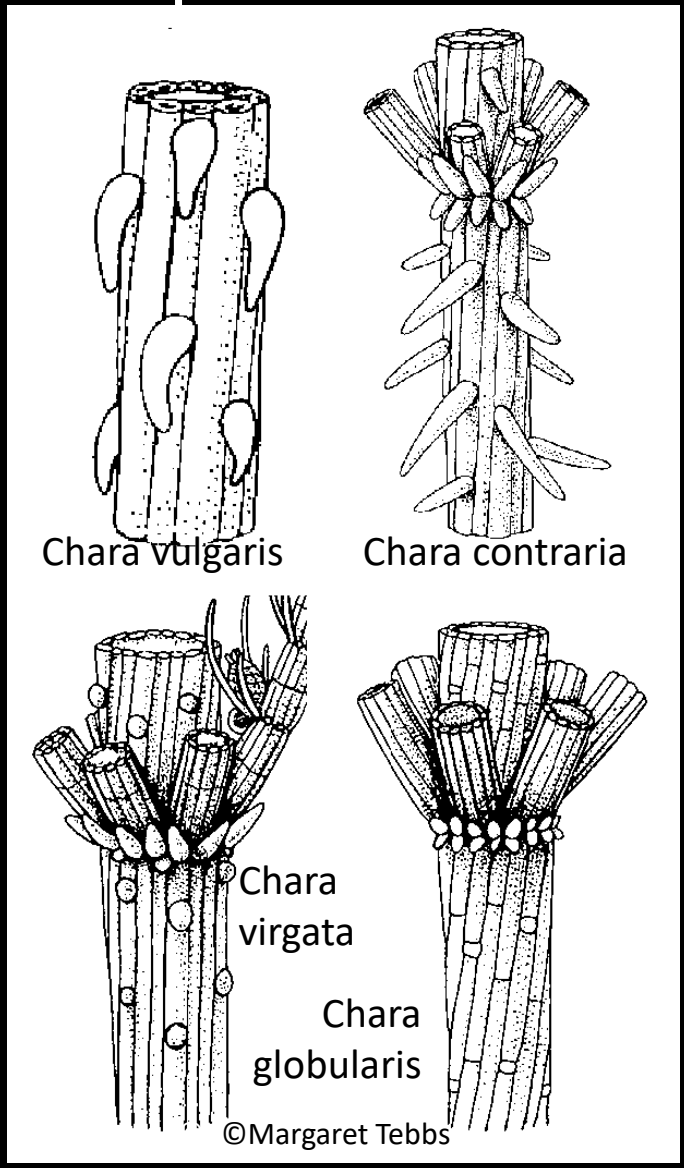
Chara curta

Small to medium species without spines or with single blunt spines





Nitella and Tolypella

Nitella – furcate branching

Nitella mucronata ©Mary Groves

Tolypella – pinnate branching

Tolypella glomerata ©Mary Groves

Nitella

Nitella opaca

Nitella opaca

Tolypella

©Chris Carter

Tolypella glomerata

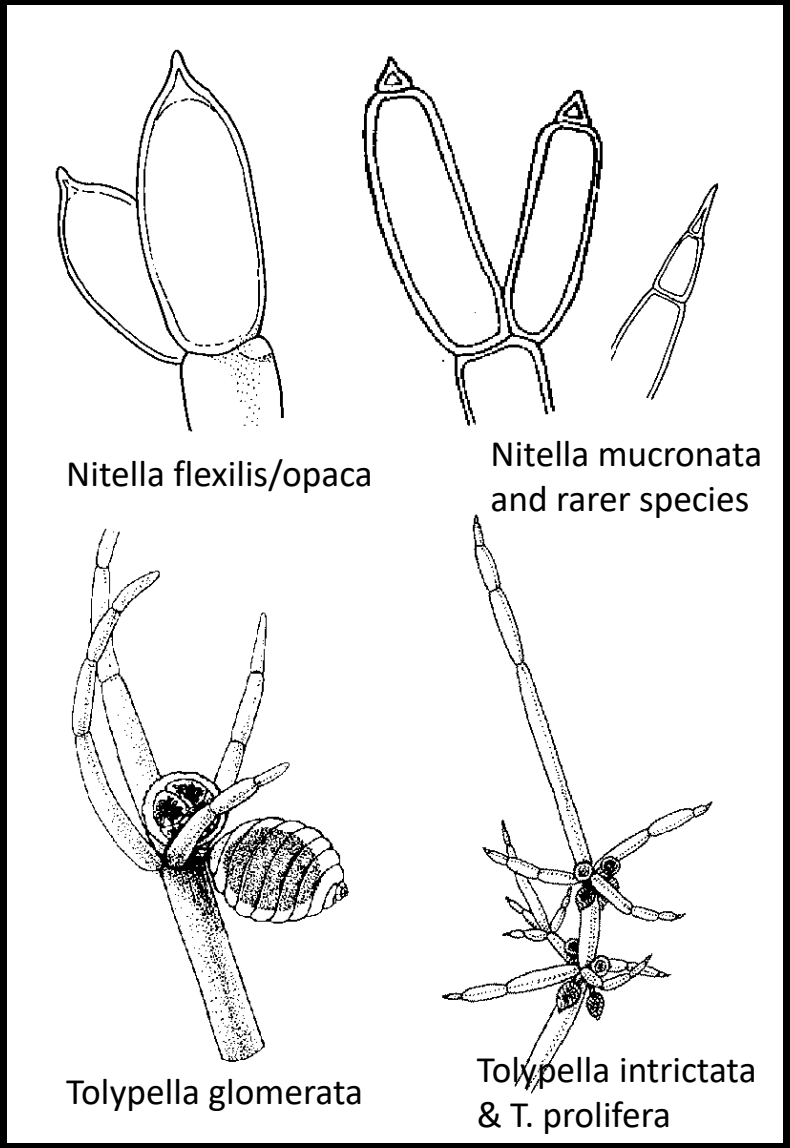
Nitella translucens

- Branchlets appear unbranched but tiny crown of divisions at tips

©Claudia Ferguson-Smyth

©J-B Mouronval et al

BRANCHLET TIPS



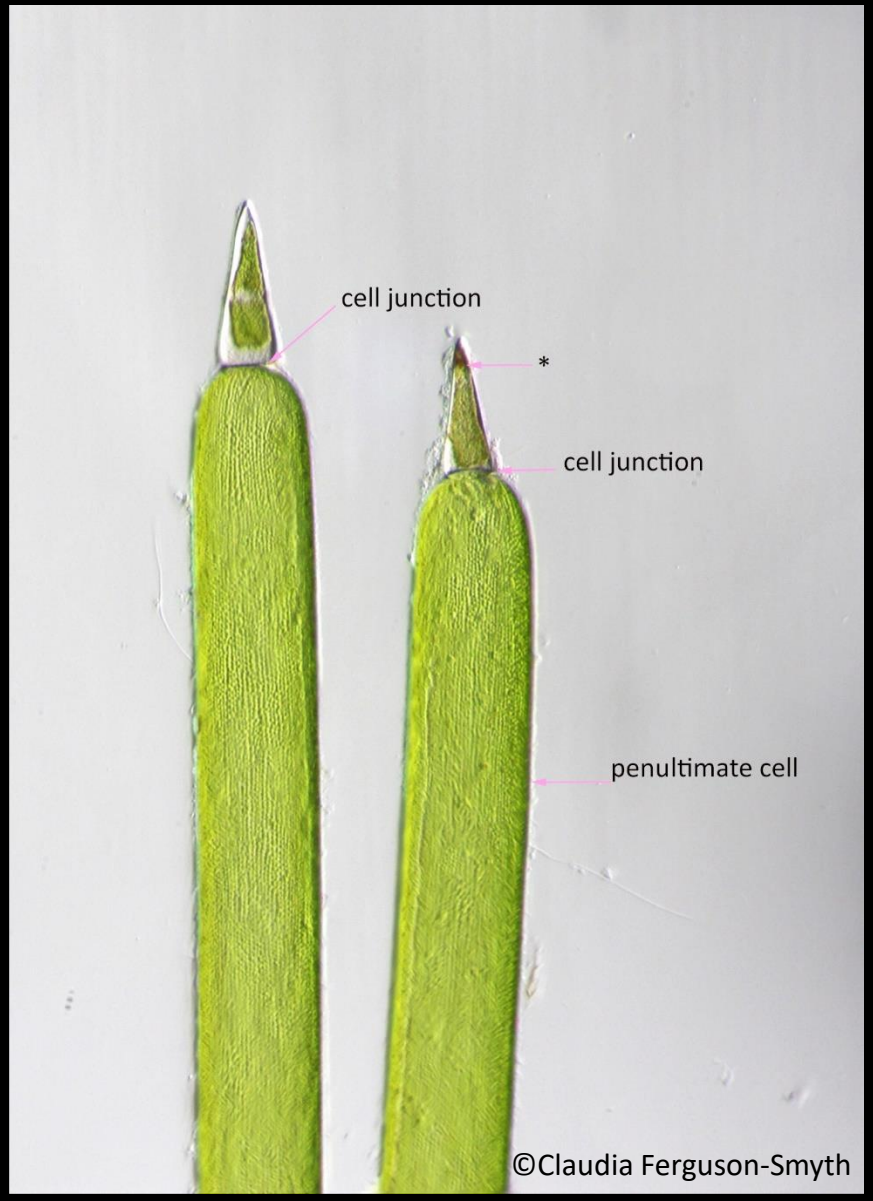
Nitella

Are branchlet tips made up of extra cells?

Tolypella

Are tips blunt or sharp?

Nitella mucronata



Nitella opaca

Nitella opaca (dioecious)

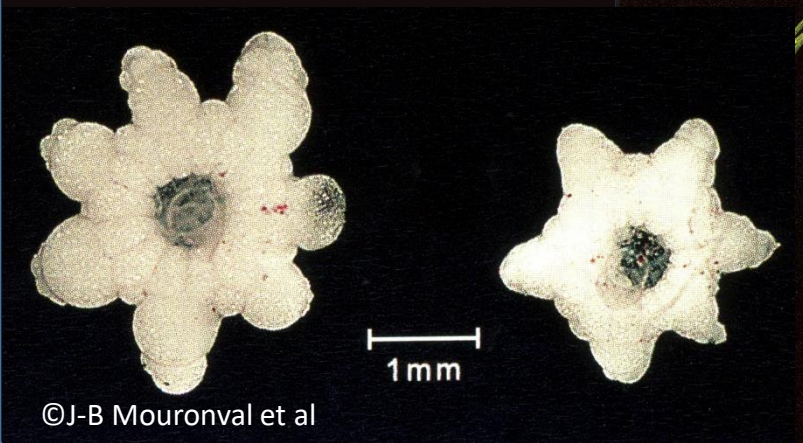
Lamprothamnium papulosum

- No cortex but regular whorls of branchlets as in *Chara*
- Note presence of stipulodes (absent in other genera without cortex)
- Characteristic compact bushy stem tips (like fox tails).

Nitellopis obtusa

- Form as in Nitella but branching pinnate.

- Characteristic whitish, star-shaped bulbils produced at lower stem nodes



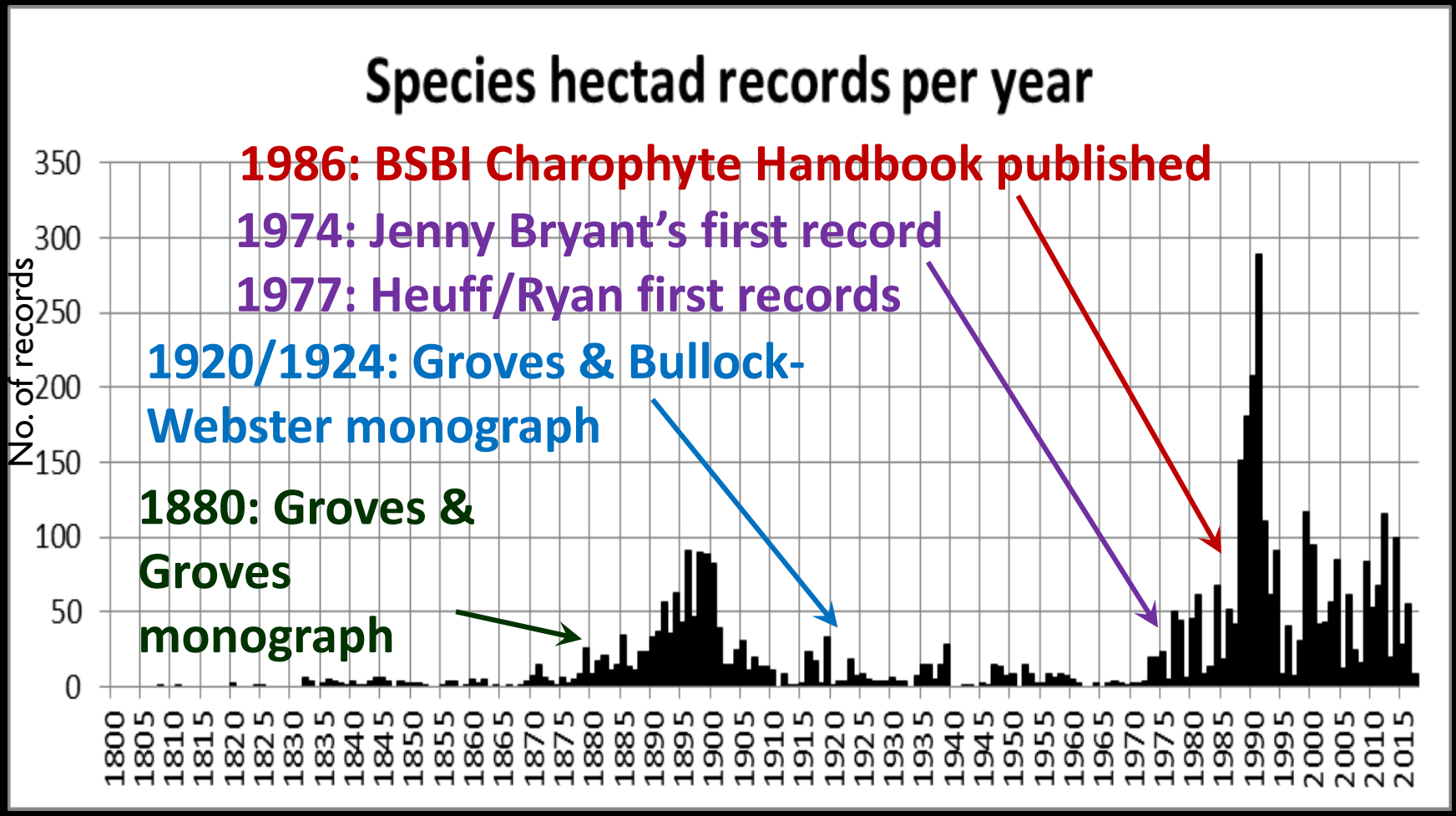
Some identification tips

Best place to look for characters is the first expanded internode back from stem tip

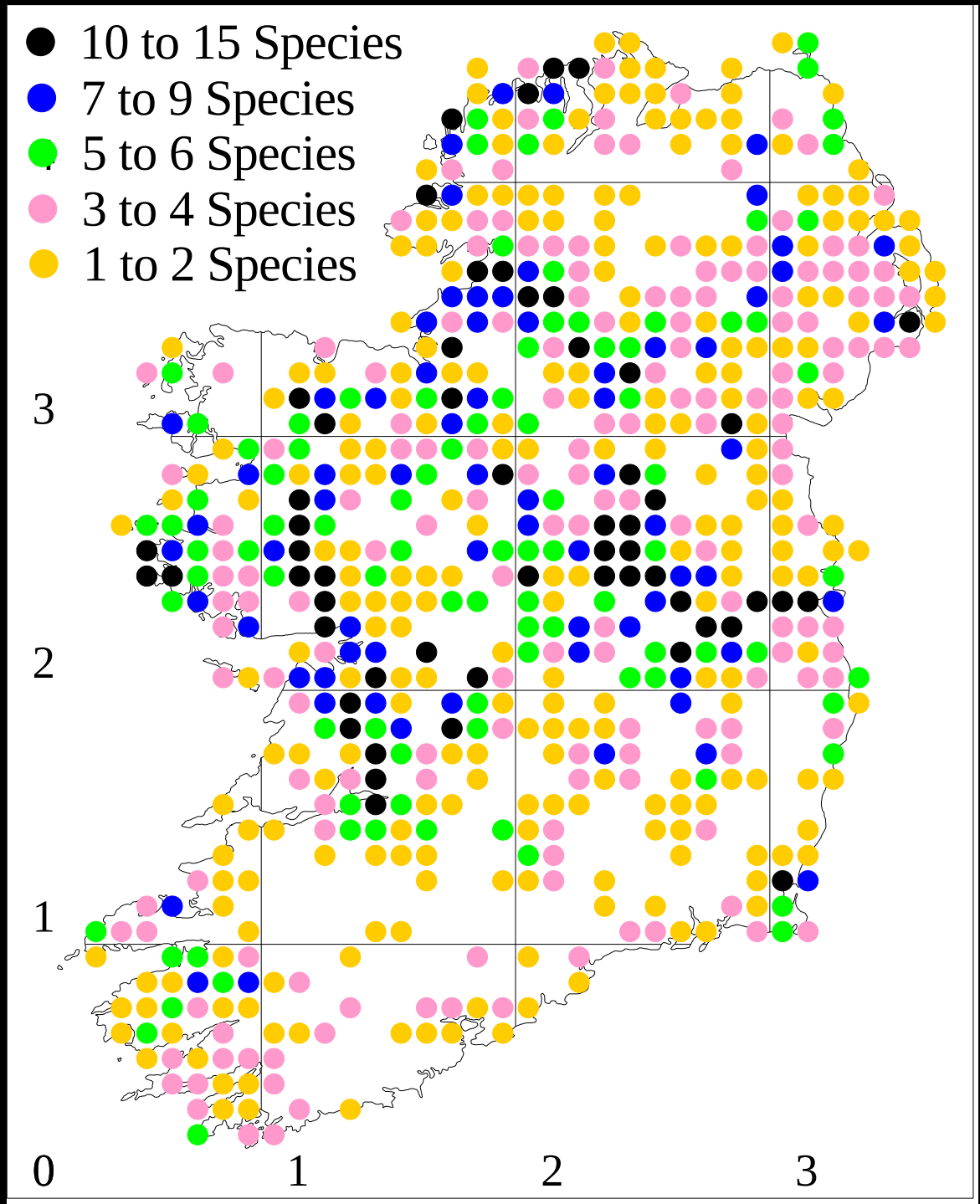
Underneath light tends to work best to show up cortex etc when looking through microscope

If very encrusted, treat with vinegar to dissolve the carbonate

Charophytes: Recording activity in Ireland



Number of 10x10 km square stonewort records per year in Ireland


10 to 15 Species
7 to 9 Species
5 to 6 Species
3 to 4 Species
1 to 2 Species
3
2
1
0
1
2
3

Richest hectads

Ireland

Hectad	Species total	County	Location
M17	16	Mayo	Lough Carra area
N45	16	Westmeath	Mullingar lakes
R39	16	Clare/Galway	Gort lakes
C14	15	Donegal	Fanad Peninsula
M80	15	Galway/N Tipperary	Lough Derg/River Shannon
O13	15	Dublin	Dublin City (Royal & Grand Canals)
O03	14	Dublin/Kildare	West Dublin City (Royal & Grand Canals)

Britain

Hectad	Species total	County	Location
TG42	16	Norfolk	Norfolk Broads (Thurne system)
TL57	16	Cambridgeshire	The Fens (Wicken Fen area)
TG41	15	Norfolk	Norfolk Broads (Thurne system)
TL48	15	Cambridgeshire	The Fens (Ouse Washes area)
TL47	14	Cambridgeshire	The Fens (Ouse Washes area)

GOOD STONEWORT HABITATS

Calcareous low-nutrient lakes and pools

Lough Bunny

Temporary and permanent pools in dune slacks

Turloughs: Hydrology, Ecology and Conservation

Edited by S. Waldren

Gravel pits and limestone quarries

Pools in calcareous fens

Machair loughs

Some species in oligotrophic loughs – mainly Nitellas

Lochan near Loch Stack – several in this area contain *Nitella gracilis*

Brackish loughs

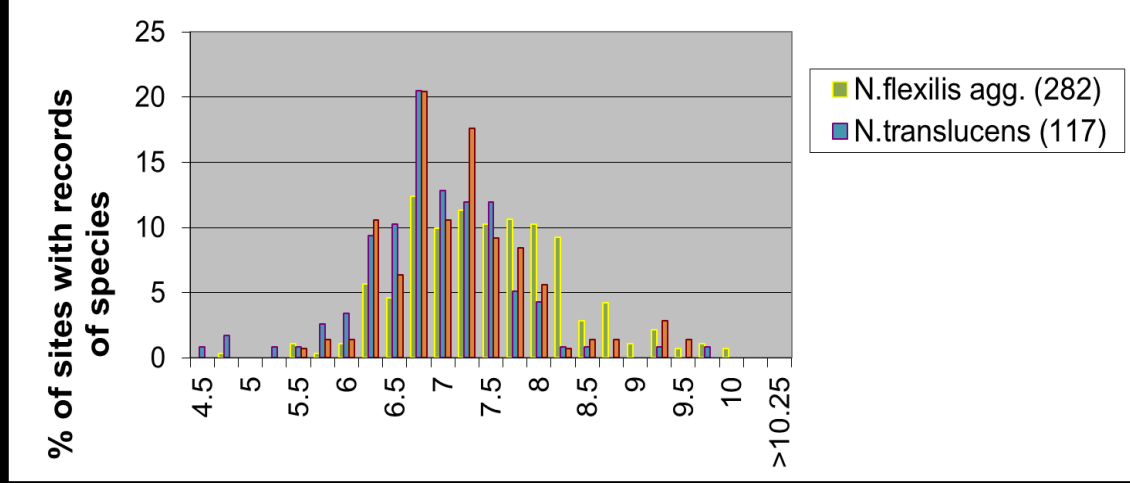
Lady's Island Lake

Tolypella nidifica

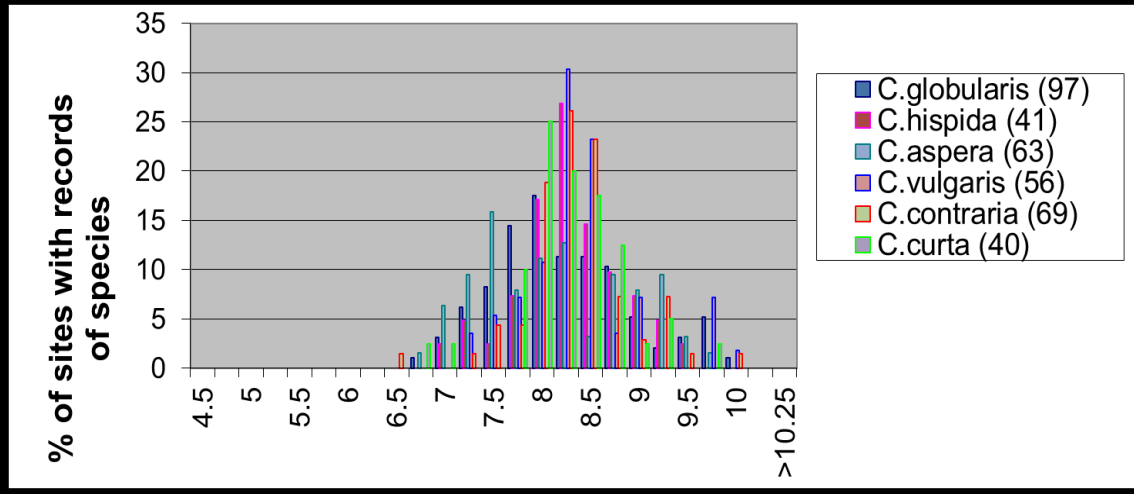
Lamprothamnium papulosum

pH preferences of stoneworts

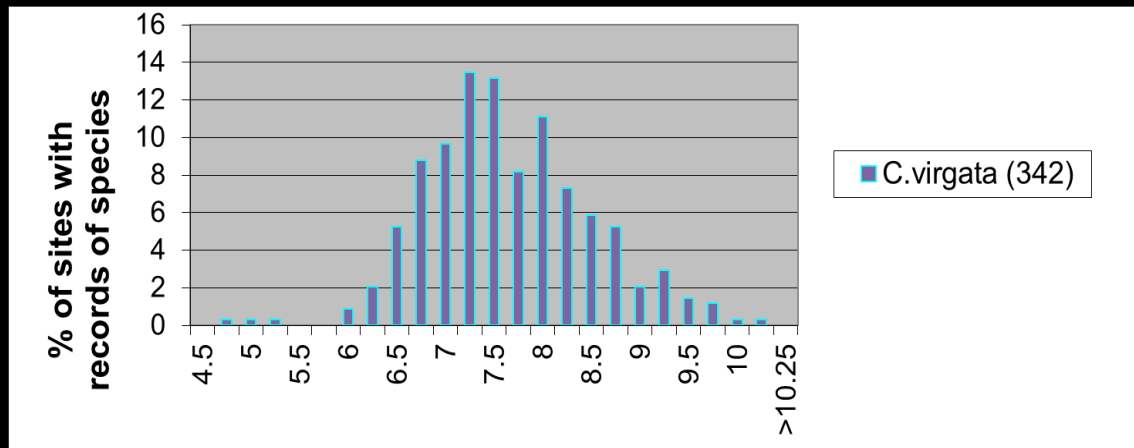
Nitella spp.

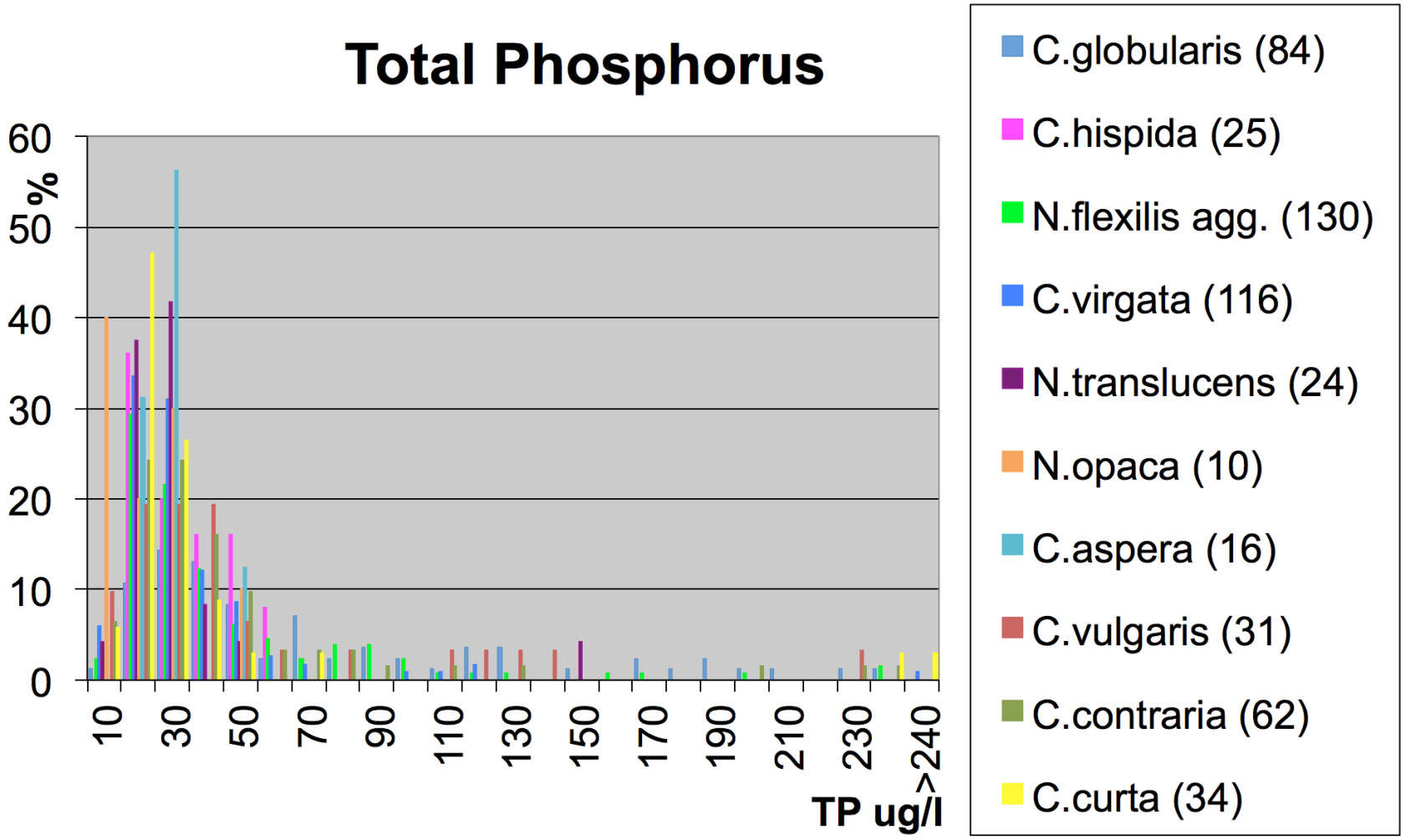


Most Chara spp.

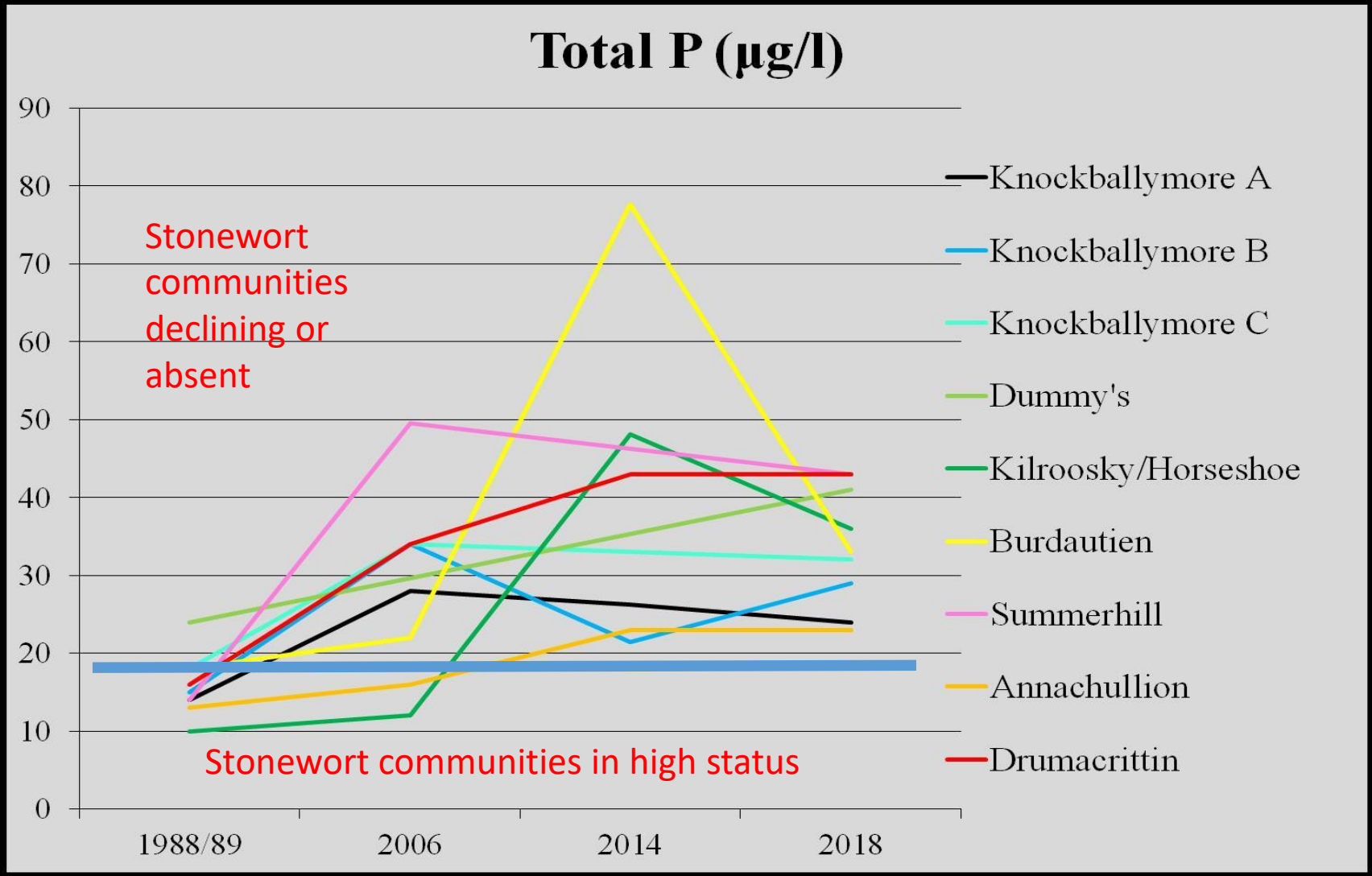


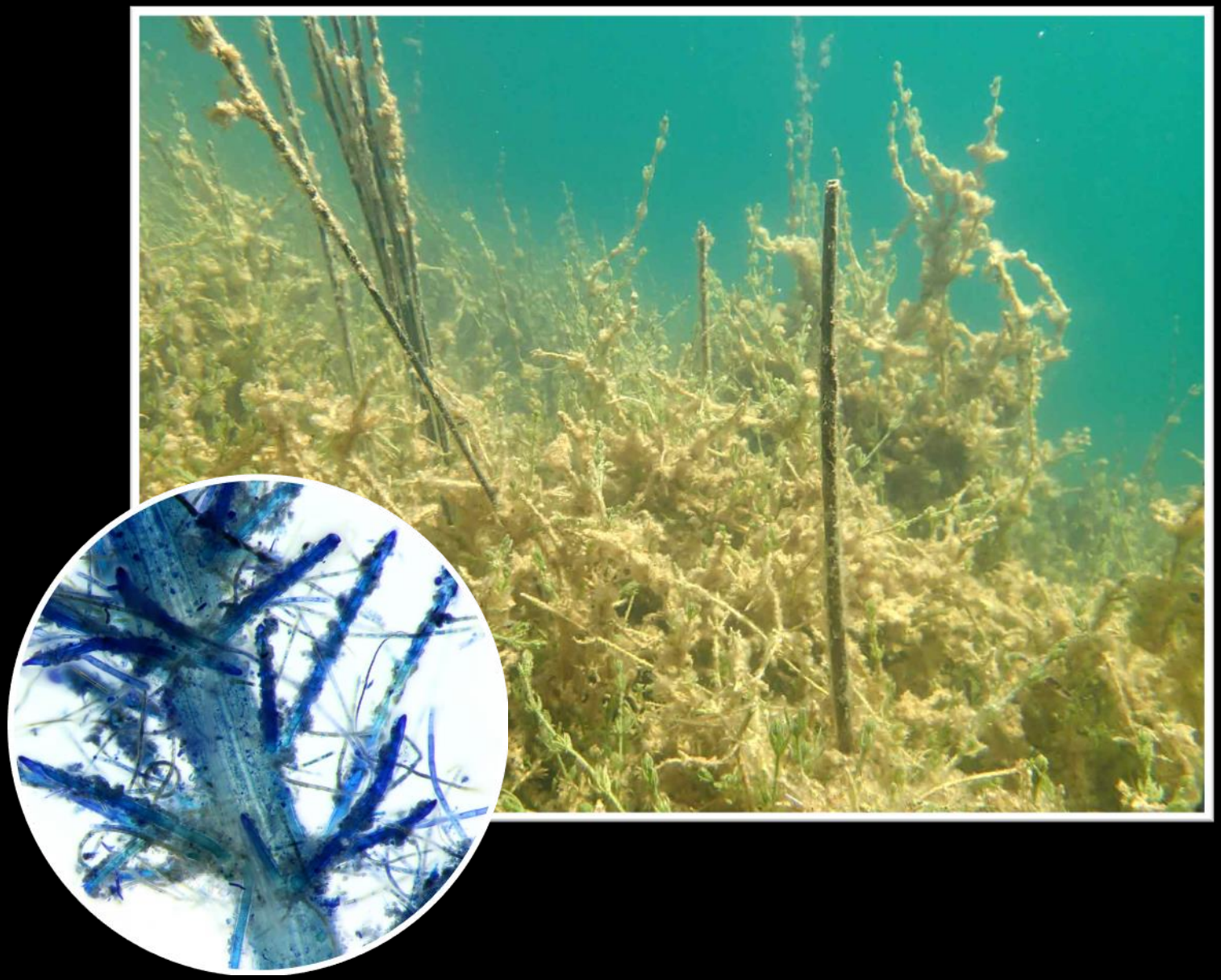
Chara virgata




Total Phosphorus
60
50
40
30
20
10
0
%
10
30
50
70
90
110
130
150
170
190
210
230
>240
TP ug/l
C.globularis (84)
C.hispida (25)
N.flexilis agg. (130)
C.virgata (116)
N.translucens (24)
N.opaca (10)
C.aspera (16)
C.vulgaris (31)
C.contraria (62)
C.curta (34)

Clones / Magheraveely Lakes – CANN Project





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THANKS!

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An Roinn Cultúir, Oidhreachta agus Gaeltachta
Department of Culture, Heritage and the Gaeltacht

National Parks & Wildlife Service

Chris Carter, Claudia Ferguson-Smyth and J.-P.Mouronaval et al. who provided many of the pictures.
Sarah Pierce for organising this webinar