

## 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, appearing rough; 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; (branchlets usually long, up to 8 cm, often flexuous giving a spidery appearance; outer bracts less than half the length of the inner ones) **7**  
Stem densely spiny, appearing prickly or furry; spine clusters close together and usually obscuring the stem; spines persistent; (branchlets usually shorter and stiffer, usually less than 3 cm, giving a neater appearance; outer bracts more than half the length of the inner ones) **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 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 1-3 celled branches at the ends, visible under a hand lens; plant robust (stem 1-3 mm diameter and internodes up to 10 cm long), translucent, 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 normally 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)

**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)]

	<i>Chara virgata</i>	<i>Chara globularis</i>	<i>Chara vulgaris</i>	<i>Chara contraria</i>
<b>Spines</b>	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
<b>Stipulodes</b>	Only upper row developed, shortly conical (rarely more elongate with obtuse tips and lower row developed but less than half length of upper ones)	Not developed or minutely globular (rarely with upper row slightly developed on youngest shoots)	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 poorly-developed especially in young plants)
<b>Cortex *</b>	Two rows between each spine-bearing row, the latter being markedly wider	Two rows between spine-bearing rows but equal width and lack of spine development makes difficult to assess; c.10-12 rows visible when looking at one side of stem (cf. c.7-8 in <i>C.vulgaris</i> and <i>C.contraria</i> )	One row between each spine-bearing row, the latter being narrower to equal the former so that spines often appear to be coming out of stem furrows	One row between each spine-bearing row, the latter being significantly wider than the former so that the spines appear to be on the stem ridges
<b>Other non-diagnostic characters</b>				
<b>Stem stature</b>	Slender, usually less than 0.5 mm wide	Usually, moderate stature, 0.5 -1 mm wide	Moderate stature, 0.5-1 mm wide	Usually fairly slender, 0.4-0.7 mm diam, sometimes moderate stature to 1 mm wide
<b>Colour</b>	Mid to dark green; often little-encrusted	Mid green or olive green, sometimes slightly greyish; encrustation variable	Greyish green, usually encrusted; rarely mid to dark green when unencrusted	Greyish green; usually encrusted
<b>Branchlet form</b>	Stiff, ascending forming neat whorls	Fairly stiff and ascending forming neat whorls	Flexuous, spreading to ascending or sometimes strongly incurved, often rather untidy	Flexuous, spreading to strongly incurved, although often neater than <i>C.vulgaris</i> with longer internodes relative to branchlets

Nick Stewart  
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NAMES OF BRITISH AND IRISH STONEWORTS – Annotate your *BSBI Handbook No 5 Charophytes of Great Britain and Ireland*

Current name (See Watsonia (2002) 24: 203-208 for checklist)	English name	Moore (1986)	Allen (1950), Groves & Bullock-Webster (1920, 1924)
<i>Chara aculeolata</i>	Hedgehog Stonewort	<i>C.pedunculata</i>	<i>C.aculeolata</i>
<i>Chara aspera</i>	Rough Stonewort	<i>C.aspera</i> var. <i>aspera</i>	<i>C.aspera</i>
<i>Chara baltica</i>	Baltic Stonewort	<i>C.baltica</i>	<i>C.baltica</i>
<i>Chara braunii</i>	Braun's Stonewort	<i>C.braunii</i>	<i>C.braunii</i>
<i>Chara canescens</i>	Bearded Stonewort	<i>C.canescens</i>	<i>C.canescens</i>
<i>Chara connivens</i>	Convergent Stonewort	<i>C.connivens</i>	<i>C.connivens</i>
<i>Chara contraria</i>	Opposite Stonewort	<i>C.vulgaris</i> vars. <i>contraria</i> & <i>hispidula</i>	<i>C.contraria</i>
<i>Chara curta</i>	Lesser Bearded Stonewort	<i>C.aspera</i> var. <i>curta</i>	<i>C.desmacantha</i>
<i>Chara denudata</i>	Naked Stonewort	<i>C.vulgaris</i> var. <i>denudata</i>	<i>C.denudata</i>
<i>Chara fragifera</i>	Strawberry Stonewort	<i>C.fragifera</i>	<i>C.fragifera</i>
<i>Chara globularis</i>	Fragile Stonewort	<i>C.globularis</i> var. <i>globularis</i>	<i>C.globularis</i> , <i>C.fragilis</i>
<i>Chara hispida</i>	Bristly Stonewort	<i>C.hispida</i> vars. <i>hispida</i> & <i>major</i>	<i>C.hispida</i>
<i>Chara intermedia</i>	Intermediate Stonewort	( <i>C.intermedia</i> )	<i>C.contraria</i> X <i>hispida</i>
<i>Chara muscosa</i>	Mossy Stonewort	<i>C.muscosa</i>	<i>C.muscosa</i>
<i>Chara rudis</i>	Rugged Stonewort	<i>C.hispida</i> var. <i>rudis</i>	<i>C.rudis</i>
<i>Chara tomentosa</i>	Coral Stonewort	<i>C.tomentosa</i>	<i>C.tomentosa</i>
<i>Chara virgata</i>	Delicate Stonewort	<i>C.globularis</i> var. <i>virgata</i>	<i>C.delicatula</i>
<i>Chara vulgaris</i>	Common Stonewort	<i>C.vulgaris</i> vars. <i>vulgaris</i> , <i>crassicaulis</i> , <i>gymnophylla</i> , <i>longibracteata</i> & <i>papillata</i>	<i>C.vulgaris</i>
<i>Lamprothamnium papulosum</i>	Foxtail Stonewort	<i>L.papulosum</i>	<i>L.papulosum</i>
<i>Nitella capillaris</i>	Slimy-fruited Stonewort	<i>N.capillaris</i>	<i>N.capillaris</i>
<i>Nitella confervacea</i>	Least Stonewort	<i>N.confervacea</i>	<i>N.confervacea</i> , <i>N.batrachosperma</i>
<i>Nitella flexilis</i>	Smooth Stonewort	<i>N.flexilis</i> var. <i>flexilis</i> p.p.	<i>N.flexilis</i>
<i>Nitella gracilis</i>	Slender Stonewort	<i>N.gracilis</i>	<i>N.gracilis</i>
<i>Nitella hyalina</i>	Many-branched Stonewort	<i>N.hyalina</i>	<i>N.hyalina</i>
<i>Nitella mucronata</i>	Pointed Stonewort	<i>N.mucronata</i>	<i>N.mucronata</i>
<i>Nitella opaca</i>	Dark Stonewort	<i>N.flexilis</i> var. <i>flexilis</i> p.p.	<i>N.opaca</i>
<i>Nitella spanioclema</i>	Few-branched Stonewort	<i>N.flexilis</i> var. <i>spanioclema</i>	<i>N.spanioclema</i>
<i>Nitella tenuissima</i>	Dwarf Stonewort	<i>N.tenuissima</i>	<i>N.tenuissima</i>
<i>Nitella translucens</i>	Translucent Stonewort	<i>N.translucens</i>	<i>N.translucens</i>
<i>Nitellopsis obtusa</i>	Starry Stonewort	<i>Ns.obtusa</i>	<i>Ns.obtusa</i>
<i>Tolypella glomerata</i>	Clustered Stonewort	<i>T.nidifica</i> var. <i>glomerata</i>	<i>T.glomerata</i>
<i>Tolypella intricata</i>	Tassel Stonewort	<i>T.intricata</i>	<i>T.intricata</i>
<i>Tolypella nidifica</i>	Bird's Nest Stonewort	<i>T.nidifica</i> var. <i>nidifica</i>	<i>T.nidifica</i>
<i>Tolypella prolifera</i>	Great Tassel Stonewort	<i>T.prolifera</i>	<i>T.prolifera</i>

## ***NITELLA FLEXILIS & NITELLA OPACA***

Wood & Imahori (1965) united *Nitella flexilis* and *N.opaca*, which had been regarded as separate species for over a century. This view was followed by Moore (1986) (under *N.flexilis* var. *flexilis*) and Stewart & Church (1992) (under *N.flexilis*). However, in line with the prevailing view elsewhere in Europe, it is necessary to reinstate them as two species.

The essential difference is that *N.flexilis* is monoecious and *N.opaca* dioecious. However, the male structures (antheridia) mature up to a month before the female structures (oogonia) and then disintegrate. This means that the absence of one type of sexual structure cannot reliably be used as evidence of dioecy unless male and female plants are present in the site at the same time. Fortunately, there is also a size difference of the sexual structures of the two species (the oospore is the dark coloured spore within the oogonium):

***N.flexilis***: Monoecious; mature oospore 500-575 microns; antheridia usually 500-625 microns but a rare form in the Fens has larger antheridia c.800 microns in diameter (see below).

***N.opaca***: Dioecious; mature oospore 375-450 microns; antheridia 650-775 microns.

Although there are reputed to be vegetative differences between the two species, there is considerable overlap and none of these are reliable. However, *N.flexilis* tends to be laxer with more acute (rather than abruptly mucronate) branchlet tips, the fertile ones not usually being contracted to form tightish heads.

Sterile material should continue to be recorded as *N.flexilis* aggregate.

Some of the forms of the two species may deserve recognition but the simple structure and general plasticity of form makes it difficult to define these. Among those described are:

*N.flexilis* var. *crassa*: A stouter form with the second segment of the branchlets much shorter than the first (sometimes less than an eighth of length).

*N.flexilis* var. *nidifica*: With fertile whorls contracted to form more or less dense heads.

*N.flexilis* var. *fryeri*: With larger antheridia c.800 microns in diameter and markedly protandrous.

*N.opaca* var. *attenuata*: With very long slender branchlets often equalling the stem internodes and with second segments about equalling the first segment (cf. a third to two fifths in the type).

*N.opaca* unnamed variety: A dwarf and slender form similar in appearance to *N.gracilis* occurring in upland lakes in Scotland and Wales.

*Revised from Rich & Jermy (1998) Plant Crib 1998.*

*N.F.Stewart July 2003*

**NATIONAL STATUS OF STONEWORTS IN BRITAIN AND IRELAND**

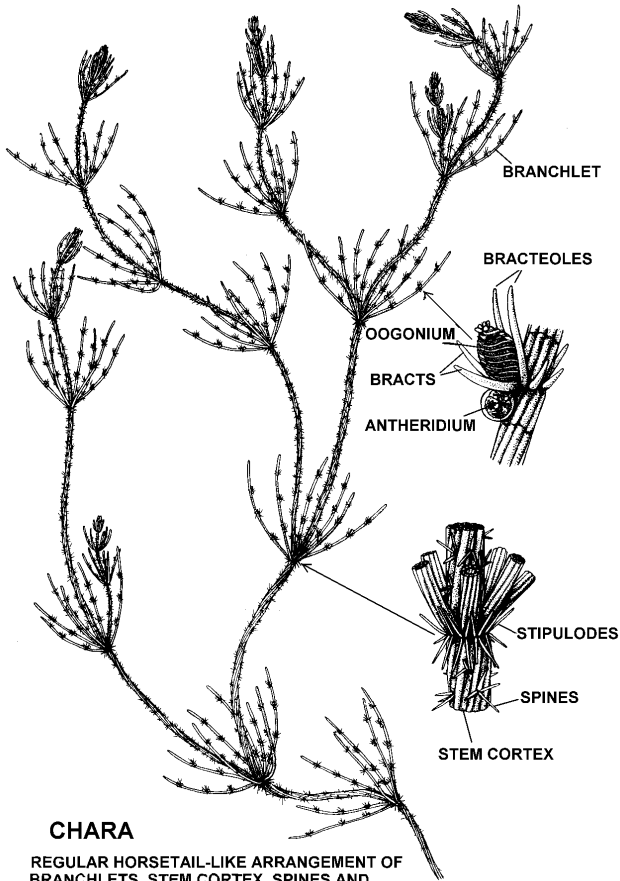
	<b>British status</b>	<b>Irish status (provisional)</b>
<i>Chara aculeolata</i>	Nationally Scarce	Scarce
<i>Chara aspera</i>	Occasional	Scarce
<i>Chara baltica</i>	Vulnerable	Critically Endangered
<i>Chara canescens</i>	Endangered, Schedule 8	Vulnerable
<i>Chara connivens</i>	Endangered	Extinct
<i>Chara contraria</i>	Occasional	Occasional
<i>Chara curta</i>	Nationally Scarce and Near Endemic	Occasional and Near Endemic
<i>Chara denudata</i>		Vulnerable
<i>Chara fragifera</i>	Vulnerable	
<i>Chara globularis</i>	Occasional	Occasional
<i>Chara hispida</i>	Occasional	Occasional
<i>Chara intermedia</i>	Endangered	
<i>Chara muscosa</i>	Data deficient and Near Endemic	Extinct and Near Endemic
<i>Chara rudis</i>	Near threatened	Scarce
<i>Chara tomentosa</i>		Vulnerable
<i>Chara virgata</i>	Frequent	Frequent
<i>Chara vulgaris</i>	Frequent	Frequent
<i>Lamprothamnium papulosum</i>	Near threatened, Schedule 8	Vulnerable
<i>Nitella capillaris</i>	Extinct	
<i>Nitella confervacea</i>	Near threatened	Near threatened
<i>Nitella flexilis</i>	Nationally Scarce	Scarce
<i>Nitella gracilis</i>	Vulnerable	Critically Endangered
<i>Nitella hyalina</i>	Extinct	
<i>Nitella mucronata</i>	Nationally Scarce	Endangered
<i>Nitella opaca</i>	Frequent	Frequent
<i>Nitella spaniclema</i>		Extinct
<i>Nitella tenuissima</i>	Endangered	Vulnerable
<i>Nitella translucens</i>	Occasional	Occasional
<i>Nitellopsis obtusa</i>	Vulnerable	
<i>Tolypella glomerata</i>	Nationally Scarce	Scarce
<i>Tolypella intricata</i>	Endangered	Endangered
<i>Tolypella nidifica</i>	Endangered	Critically Endangered
<i>Tolypella prolifera</i>	Endangered	Extinct

Note: Irish statuses are based on the Republic of Ireland and Northern Ireland together. The above statuses are therefore provisional pending an all-Irish review.

**REGIONAL RARITY OF MORE COMMON STONEWORTS BY EA/SEPA/EHS REGION (excluding RDB, Near Threatened, Nationally Scarce species)**

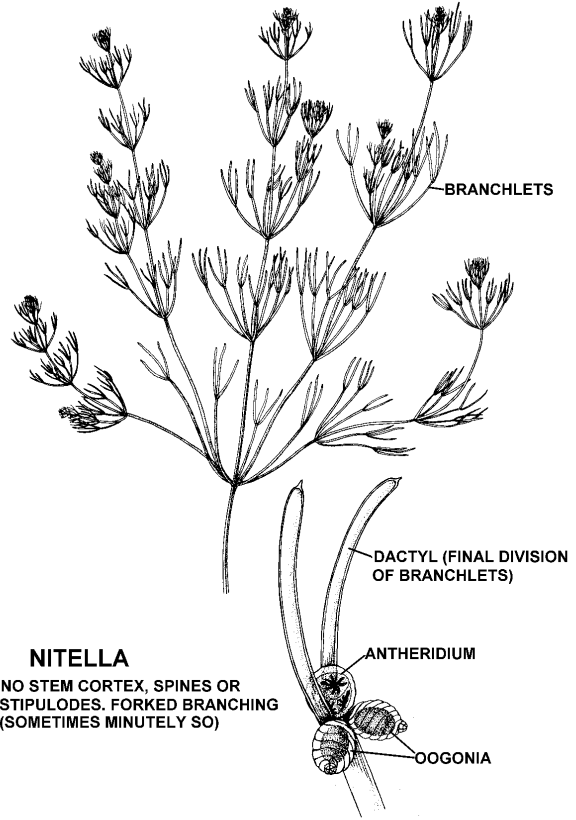
	Environment Agency								SEPA			EHS
	South West	Southern	Thames	Anglian	Midlands	North East	North West	Wales (scientific)	West	East	North	Northern Ireland
RR = Regionally rare + = not rare Ex = Extinct - = never recorded												
Qualifying 10 km squares	<16	<8	<8	<18	<13	<15	<10	<16	<18	<12	<37	<10
<i>Chara aspera</i>	RR	Ex	RR	RR	RR	RR	RR	RR	RR	RR	+	Scarce
<i>Chara contraria</i>	RR	RR	+	+	RR	RR	RR	RR	RR	RR	RR	+
<i>Chara curta</i>	Nationally Scarce											
<i>Chara globularis</i>	RR	+	+	+	RR	RR	RR	RR	RR	RR	RR	+
<i>Chara hispida</i>	RR	RR	RR	+	RR	RR	RR	RR	RR	RR	RR	+
<i>Chara virgata</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Chara vulgaris</i>	+	+	+	+	+	+	+	+	+	RR	+	+
<i>Nitella opaca</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Nitella translucens</i>	RR	RR	RR	RR	Ex	RR	RR	RR	+	RR	+	+

# FEATURES OF STONEWORTS



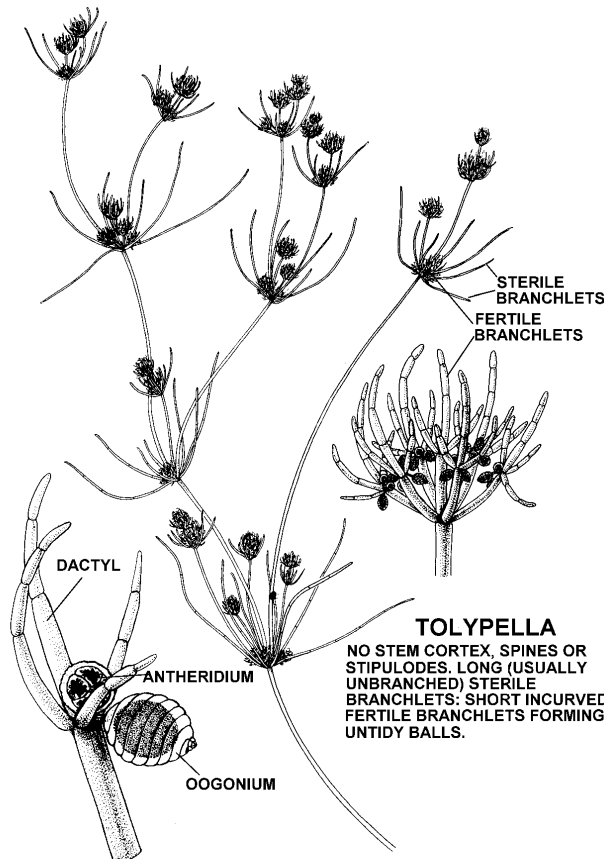
## CHARA

REGULAR HORSETAIL-LIKE ARRANGEMENT OF BRANCHLETS. STEM CORTEX, SPINES AND STIPULODES PRESENT (BUT SOMETIMES RUDIMENTARY)



## NITELLA

NO STEM CORTEX, SPINES OR STIPULODES. FORKED BRANCHING (SOMETIMES MINUTELY SO)



## TOLYPELLA

NO STEM CORTEX, SPINES OR STIPULODES. LONG (USUALLY UNBRANCHED) STERILE BRANCHLETS; SHORT INCURVED FERTILE BRANCHLETS FORMING UNTIDY BALLS.

## LAMPROTHAMNIUM

FORM AS IN CHARA BUT WITHOUT STEM CORTEX STIPULODES PRESENT. NO SPINES. INTERNODES AT STEM-TIPS CONTRACTED TO FORM FOX-TAIL-LIKE HEADS.

## NITELLOPSIS

FORM AS IN NITELLA BUT BRANCHLETS PINNATELY-DIVIDED. NO STEM CORTEX, SPINES OR STIPULODES. CHARACTERISTIC, WHITE, STAR-SHAPED BULBILS PRODUCED AT LOWER STEM NODES.

## OTHER TERMS

HAPLOSTICHOUS - ROWS OF CORTEX EQUAL TO NUMBER OF BRANCHLETS. ALL CORTICAL ROWS WITH SPINES.

DIPLOSTICHOUS - ROWS OF CORTEX DOUBLE THE NUMBER OF BRANCHLETS. ALTERNATE ROWS WITH SPINE CELLS (IF SPINES PRESENT)

TRIPLOSTICHOUS - ROWS OF CORTEX TRIPLE THE NUMBER OF BRANCHLETS. EVERY THIRD ROW WITH SPINES (IF SPINES PRESENT).

TYLACANTHOUS - PRIMARY (SPINE-BEARING) CORTEX WIDER THAN SECONDARY CORTEX. SPINES APPEAR TO BE ON RIDGES OF STEM.

AULACANTHOUS - PRIMARY (SPINE-BEARING) CORTEX NARROWER THAN SECONDARY CORTEX. SPINES APPEAR TO BE IN THE FURROWS OF STEM.

ISOSTICHOUS - PRIMARY AND SECONDARY CORTICAL ROWS MORE OR LESS EQUAL IN WIDTH.