

SHORT COMMUNICATION

## *Cosmarium coeselii*: a characteristic new desmid species from Dutch broads areas

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### Key words

*Cosmarium*  
*Cosmarium coeselii*  
*Cosmarium pachydermum*  
Desmidiaceae  
new species  
rich fen  
quaking bog  
desmids

**Abstract** – Detailed research into desmids in Dutch rich fen areas in the past decades has shown that peat excavation ditches and fen hollows accommodate a high diversity of species. This has also stimulated taxonomic research on individual species from these environments. This article discusses the taxonomy of *Cosmarium pachydermum*; a form frequently associated with this species as var. *aethiopicum* is described as a new species *C. coeselii*, named after Peter Coesel in honor of his great significance for desmid research in the Netherlands.

*Cosmarium coeselii* can be distinguished from the nominate variety of *C. pachydermum* by its more regularly curved semicell outline, somewhat smaller size and narrower isthmus. *Cosmarium coeselii* is a widespread but never common species of quaking bogs and mesotrophic lakes with some supply of minerals and is known to date from the Netherlands and France. *Cosmarium pachydermum* has a similar ecological preference, but is only rarely found in fen areas in the Netherlands. In the rest of Europe, this species seems to prefer upland and mountainous areas.

**Samenvatting** – Gedetailleerd onderzoek in de afgelopen decennia aan sialgalen in Nederlandse laagveengebieden heeft aan het licht gebracht dat petgaten en trilveenpoeltjes een grote soortenrijkdom kunnen herbergen. Hierdoor is ook taxonomisch onderzoek aan afzonderlijke soorten uit deze milieus gestimuleerd. In dit artikel wordt de taxonomie van *Cosmarium pachydermum* besproken; een veelal als var. *aethiopicum* gedetermineerde vorm wordt als de nieuwe soort *C. coeselii* beschreven. Deze soort is genoemd naar Peter Coesel als eerbetoon voor zijn grote betekenis voor het sialgalenonderzoek in Nederland.

*Cosmarium coeselii* kan van de nominaat variëteit van *C. pachydermum* worden onderscheiden door de meer regelmatig gebogen semicel omtrek, de wat kleinere afmetingen en de slankere isthmus. *Cosmarium coeselii* is een wijdverbreide maar nooit algemene soort van trilveen poeltjes en van mesotrofe meertjes met enige aanvoer van mineralen en is tot op heden bekend uit Nederland en Frankrijk. *Cosmarium pachydermum* heeft een vergelijkbare ecologische voorkeur, maar komt binnen Nederland slechts zeldzaam voor in laagveengebieden. In de rest van Europa lijkt deze soort een voorkeur te hebben voor heuvel- en berggebieden.

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### INTRODUCTION

As part of an extensive study into the distribution and ecology of Desmidiaceae (Conjugatophyceae, Streptophyta) in the Holocene rich fen area of Northwest-Overijssel, the Netherlands, Coesel (1979a, 1979b) presented an annotated list of the spe-

cies found in this area (see also Coesel 1981). The diversity of desmid species compete with that of comparable areas in the Vechtplassen in the west of the Netherlands (see Heimans & Meijer 1955, Zwart 1969; compare also Coesel & van Tooren 2002) and has a different character from that of moorland pools and bogs on Pleistocene sandy soils (Beijerinck 1926, Heimans 1925). Partly because of the detailed figures, later included in a

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desmid Flora for the whole of the Netherlands (Coesel 1982, 1983, 1991, 1994, 1997), research into taxonomy, ecology and distribution of desmids received a lot of attention. This resulted in the establishment of a working group on Dutch desmids in 1999, chaired by Peter Coesel. Meanwhile, also the new Flora 'Desmids of the Lowlands' has been published (Coesel & Meesters 2007), in which the above-mentioned Dutch data have been combined with those from Flanders and Northern Germany.

Since then, research projects of the working group members have yielded a lot of valuable taxonomical and ecological information, including the description of new species from various habitats and locations (e.g. Coesel & van Westen 2013, Kouwets 2001, 2008, Šťastný & Kouwets 2012, van Geest & Coesel 2019, van Tooren & van Westen 2011, van Westen 2015, van Westen & Coesel 2014, 2018, 2020).

Desmids are known for their specific environmental requirements and are therefore a suitable group for assessing the environment on quality and value (Coesel 1998). Obviously, a correct identification of the observed species is a prerequisite for a right assessment. A striking characteristic of the present taxonomy of desmids is the existence of large numbers of infraspecific taxa (at the level of variety and form). It is often unclear why such taxa are associated with a particular species. According to current systematic views, a species is characterised by the total of all infraspecific taxa (the monothetic species concept, see Kouwets 2008). However, sometimes the infraspecific taxa of a species differ greatly, also in their ecology. Since for various reasons determinations are not always carried out to an infraspecific level, this can also influence an assessment when the number of taxa encountered or their ecology is a factor. Hence, infraspecific taxa that differ greatly could therefore better be classified as separate species.

In the current article the taxonomy of *Cosmarium pachydermum* P.M. Lundell is examined. The discussion focuses on the relationship between the nominate variety of this species, *Cosmarium pachydermum* var. *pachydermum*, and *C. p.* var. *aethiopicum* (West & G.S. West) West & G.S. West, both of which are reported from quaking bogs in Northwest-Overijssel (Coesel 1979b).

## RESULTS AND DISCUSSION

### *Cosmarium pachydermum* P.M. Lundell 1871

#### Taxonomy

On the basis of collections from various locations in southern Sweden, Lundell (1871: 39, pl. 2: 15) gives a clear description and detailed figure of *Cosmarium pachydermum* with as the most important characteristics: very large *Cosmarium* species, about one third longer than broad, deeply constricted, semicells high semicircular with a highly arched apex, the lower part of the sides quite straight, basal corners rounded quite suddenly. The top view is elliptical, the side view elliptical-circular. The cell wall is indicated to be thick and densely punctate. No information is given about the chloroplast except that each semicell has two pyrenoids. As dimensions, Lundell (1871) gives 105–117 × 80–87 µm with a thickness of 55–59 µm and an isthmus width of 37–40 µm. The thickness of the cell wall is specified as 2.5–3 µm. In their Flora of British desmids, West & West (1905) adopt Lundell's description and figure, but most curiously translate the Latin word 'altus', meaning 'high', with 'broad' giving the diagnosis a somewhat different character. In addition, they include much smaller forms with a length from 78 µm and a width from 60 µm.

From West Africa (Angola), West & West (1897: 114) described *Cosmarium lundellii* var. *aethiopicum*<sup>1</sup> with semicells that widen towards the apex and a cell wall that is finely punctate between small scrobiculations. As dimensions they gave 71–107 × 61–80 µm with a thickness of 54 µm and an isthmus width of 30–33 µm. Unfortunately, a figure is absent and the availability of type material is unknown. A few years later they mention this variety from the oligo-mesotrophic Loch Shin in Scotland, with dimensions 69 × 61 µm, a thickness of 40 µm and an isthmus width of 28 µm. They fortunately do present a figure of this material (West & West 1903: 541, pl. 15: 7), but here too the availability of type material is unknown.

In their above-mentioned Flora, West & West (1905) classify var. *aethiopicum* as a variety in *Cosmarium pachydermum* (stating that it was erroneously referred to *C. lundellii* G.B. Delponte 1877 in their original paper). They give a slightly modified description in which – in accordance with their Scottish figure – they omit the characteristic of the semicells widening towards the apex and slightly increase the range of dimensions to include the Scottish form (West & West 1905: 141). However, in our opinion it is highly speculative to consider the poorly known form from Africa and that from Europe as one and the same taxon; this rather is an example of force fitting and taxonomic drift (Kouwets 2008). The concepts of *C. pachydermum* var. *pachydermum* and var. *aethiopicum* expressed in West & West (1905) suggest overlapping characters and have created much taxonomic confusion.

In their *Cosmarium* Flora, Krieger & Gerloff (1962) also give a broad interpretation of the two varieties of *C. pachydermum*. They, however, presented a figure of the nominate variety after Messikommer (1943), which slightly differs from the apparently slightly stylized figure of Lundell (1871). The semicells usually have a less regularly curved outline, often more or less parallel sides in the lower half and occasionally a slightly less extremely thick cell wall, and correspond to finds elsewhere in Europe, especially from mountainous regions (compare, e.g., Ducellier 1917, Insam & Krieger 1936, Lenzenweger 1982). Most confusingly, Krieger & Gerloff (1962) illustrate var. *aethiopicum* with a figure of a semicell composed of adapted information of two different authors, reproduced at the wrong scale and only superficially similar to the Scottish form. They further confused the issue by giving a similar range of dimensions for both varieties: 80–125 × 60–92 and 80–129 × 64–105 µm, for the nominate variety and var. *aethiopicum*, respectively. Finally, Růžicka (1987) pointed out similarities between *C. pachydermum*, especially the Scottish form of its var. *aethiopicum*, and *C. candianum* G.B. Delponte 1877, which is described from a subalpine lake in Italy. In our opinion, however, *C. candianum* is a poorly known, large (104.4 × 72 µm, which is not in accordance with the figures) and deeply constricted form of unknown affinity.

#### Occurrence in the Netherlands

The forms of the nominate variety of *Cosmarium pachydermum* reported from the Netherlands agree with the European forms as presented by Krieger & Gerloff (1962) and other authors mentioned above (Coesel 1979b, Zwart 1969; Fig. 1.a & 2.a). Data from the present authors based on material from the Netherlands and France indicate that cell length rarely falls below 100 µm and only occasionally exceeds 120 µm with a maximum of 125 µm. The dimensions measured are length 96–125 µm, width 71–92 µm, thickness 50–59 µm and an isthmus width of 35–40 µm. Length-width ratio of the cells 1.28–1.46.

<sup>1</sup> The epithet 'aethiopicum' has the obsolete meaning of 'from Africa'.

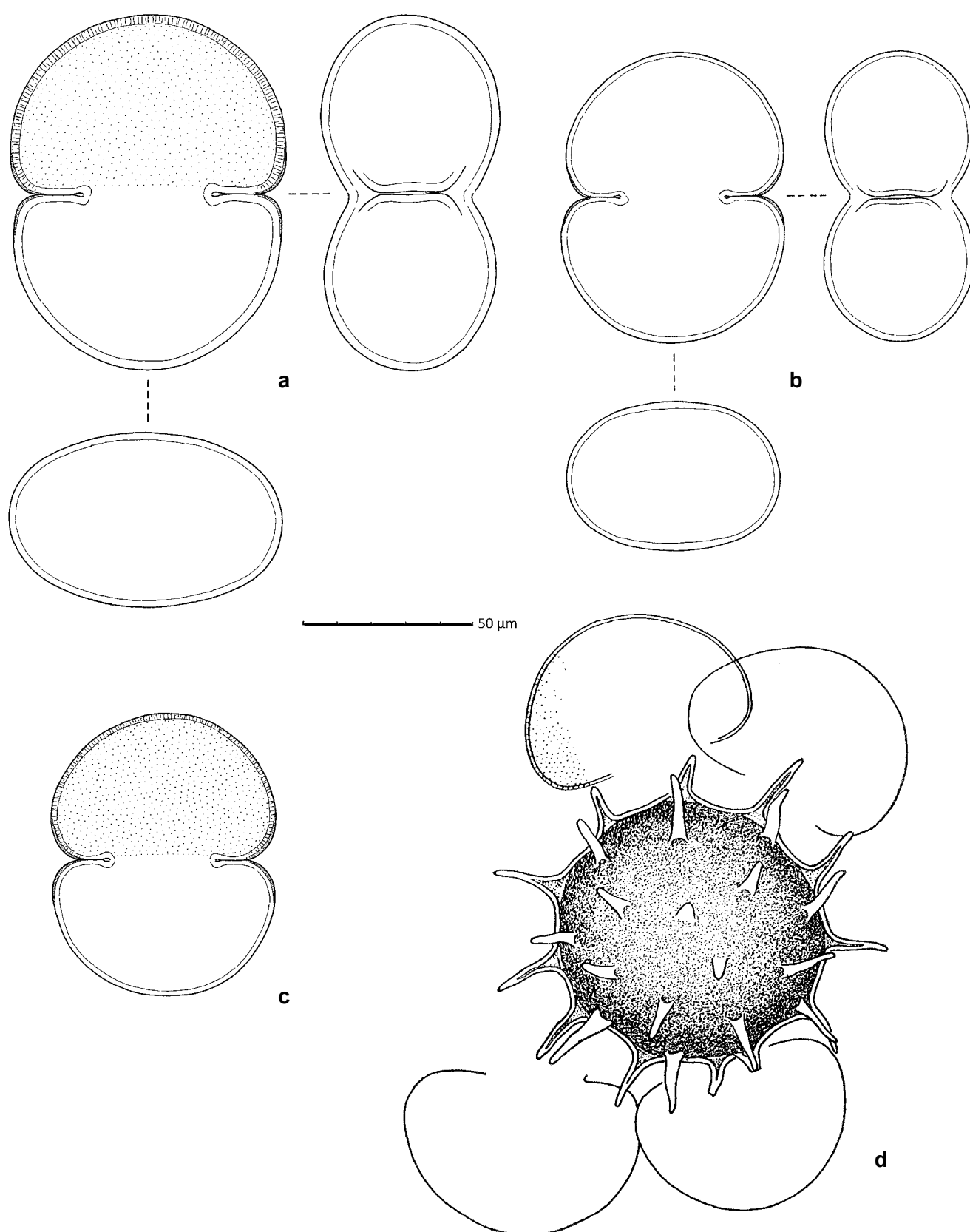


Fig. 1. a. *Cosmarium pachydermum* P.M. Lundell var. *pachydermum*, after van Westen 2011-63, Wapserveen, Province of Drenthe, the Netherlands (herb. M.C. van Westen); b & c. *Cosmarium coeselii* Kouwets, Van Westen & Van Tooren, after F.A.C. Kouwets, nr. 1289, Weerribben, Province of Overijssel, the Netherlands (L [L 0608440], holotype); d. *Cosmarium coeselii*, after Coesel (1974, as *C. pachydermum* var. *aethiopicum* West & G.S. West), Weerribben, Province of Overijssel, the Netherlands; a & b. Frontal, lateral and apical views of the same cell; c. Frontal view; d. Zygospore formed from the merged contents of two conjugating cells. Note the four adhering gametangial semicells.



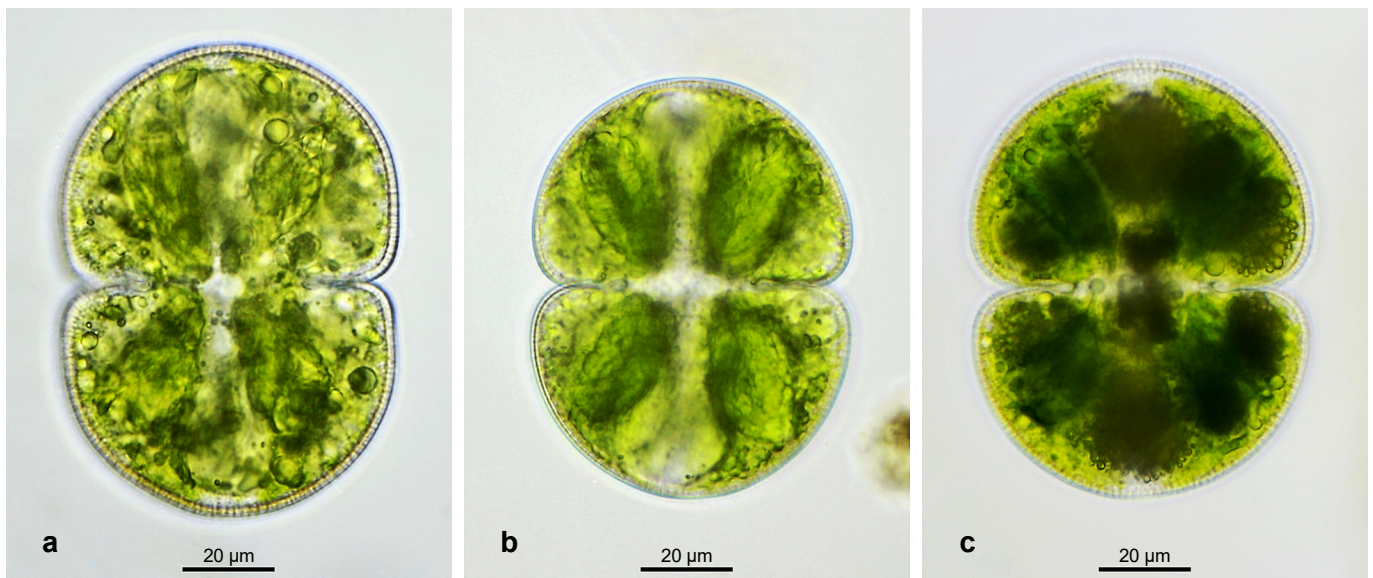


Fig. 2. a. *Cosmarium pachydermum* P.M. Lundell var. *pachydermum*, Kiersche Wieden, Province of Overijssel, the Netherlands; b. *Cosmarium coeselii* Kouwets, Van Westen & Van Tooren, De Holmers near Elp, Province of Drenthe, the Netherlands; c. *Cosmarium coeselii*, Kiersche Wieden, Province of Overijssel, the Netherlands. Note the differences in semicell outline and depth of the sinus between *C. pachydermum* var. *pachydermum* and *C. coeselii*.

From a small depression in a mesotrophic quaking bog in 'De Weerribben' in Northwest-Overijssel, Coesel (1974: fig. 6; see our Fig. 1.d) described a zygospore that he associated with *Cosmarium pachydermum* var. *aethiopicum*, based on the above-discussed concept in Krieger & Gerloff (1962). A vegetative cell belonging to that form and measuring  $84 \times 68 \mu\text{m}$  is later given in his annotated species list (Coesel 1979b). Homfeld (1929) had previously given a very similar zygospore from a lake in North-Germany, near Plön, Schleswig-Holstein, as was also remarked by Coesel (1974). However, Homfeld (1929) associated his zygospore with *C. pachydermum* var. *pachydermum*, but from the adhering gametangial semicells it can be concluded that Homfeld's form is most probably the same form as presented by Coesel (1974) under var. *aethiopicum*. Moreover, for vegetative cells from the same population Homfeld (1929) gave  $90 \times 63 \mu\text{m}$ , with an isthmus width of  $30 \mu\text{m}$ . Recent findings of this form by the present authors on various localities in the Netherlands (see Fig. 1.b, 1.c, 2.b & 2.c) suggest that it should not be identified with the doubtful *Cosmarium pachydermum* var. *aethiopicum* in its original concept; the relation with the form sensu West & West (1903, 1905) is unclear. It seems therefore justified to describe the form as a separate new species here. We propose to name this characteristic new species from rich fens and broads areas in the Netherlands after Peter F.M. Coesel in honour of his continuous efforts to stimulate research into the Desmidiaceae, one of the most interesting groups of green algae in the Netherlands.

## TAXONOMIC TREATMENT

***Cosmarium coeselii* Kouwets, Van Westen & Van Tooren, spec. nov.** — Fig. 1.b, 1.c, 1.d, 2.b & 2.c.

Holotype: Fixed natural sample (squeezed aquatics), collection F.A.C. Kouwets, nr. 1289, 27 June 2015, L [L 0608440]!

Type locality: the Netherlands, Province of Overijssel, Stobberibben in Weerribben, area with peat excavation ditches and quacking bogs, small hollow with *Utricularia intermedia* Hayne.

Dutch grid coordinates (Amersfoortcoördinaten): X: 195,251 / Y: 533,168; latitude / longitude coordinates according to WGS84: 52.78430 / 5.98381.

Large *Cosmarium*; cells in outline regular elliptical, fairly deeply constricted; sinus linear and closed. Semicells semicircular with broadly rounded basal angles; side view subcircular-elliptic, top view elliptic with broadly rounded poles. Cell wall densely covered with fine pores. Chloroplast axial with two pyrenoids. Zygospore spherical, set with rather long and slender, sometimes slightly curved spines, about 11–12 visible along its circumference.

Dimensions of vegetative cells: length  $71\text{--}96 \mu\text{m}$ , width  $57\text{--}75 \mu\text{m}$ , thickness circa  $44\text{--}46 \mu\text{m}$ , isthmus  $26\text{--}34 \mu\text{m}$ . Length–width ratio 1.20–1.38.

Dimensions of the zygospore: diameter without spines  $70\text{--}80 \mu\text{m}$ , with spines  $100\text{--}115 \mu\text{m}$ .

Identification — *Cosmarium coeselii* can be easily distinguished from the nominate variety of *C. pachydermum*: *Cosmarium coeselii* has evenly curved semicells, is smaller with a slightly lower length–width ratio, and has a narrower isthmus (Fig. 3 & 4). In contrast with what was suggested by West & West (1905) and Krieger & Gerloff (1962), no overlap was found between the range of cell-length in both species and true intermediate forms connecting both species do not seem to exist (compare Coesel 1979b). The relation with the Scottish form associated with var. *aethiopicum* by West & West (1905) is unclear, albeit that it is unlikely that *C. coeselii* and the Scottish form are conspecific. The single cell figured by West & West in their original publication (West & West 1903: pl. 15: 7) is rather small and has a length–width ratio of only 1.13. In their British Flora, they presented two very similar cells (West & West 1905: pl. 77: 8–9). These forms suggest that still more undescribed species occur in Europe. *Cosmarium candianum* is much larger and has a relatively deeper constriction.

The fine punctation between the cell wall pores that can be frequently seen under the light microscope in *Cosmarium pachydermum* and *C. coeselii* apparently is of no taxonomic value.

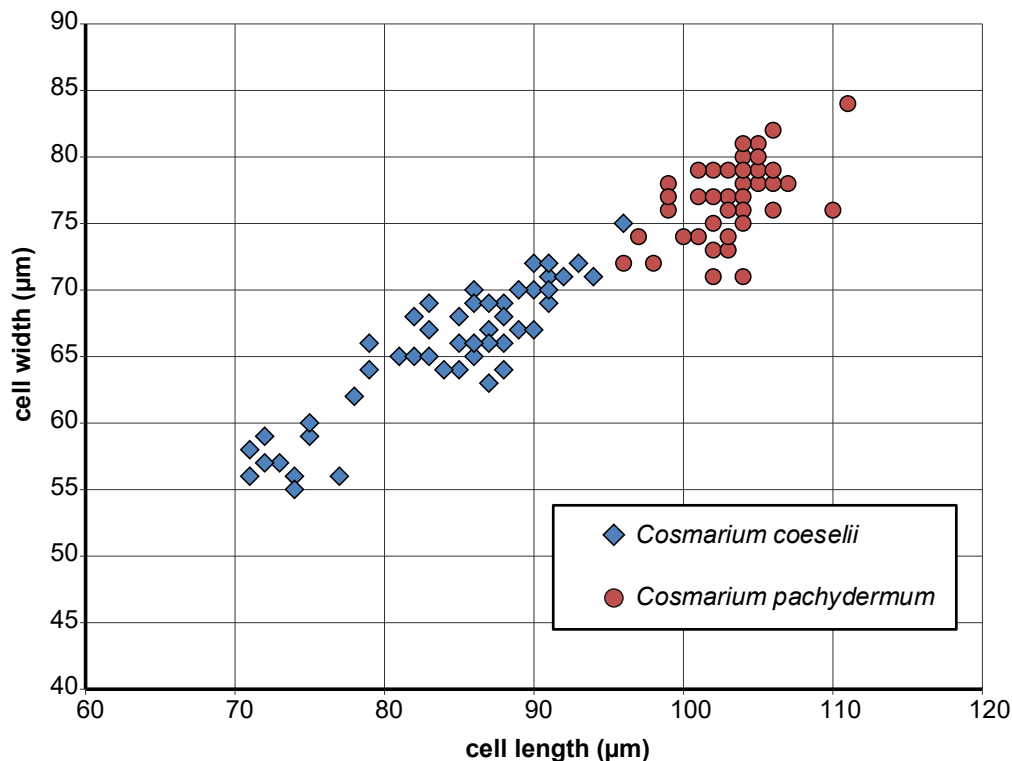


Fig. 3. Length to width ratio for cells from various populations of *Cosmarium pachydermum* P.M. Lundell var. *pachydermum* and *C. coeselii* Kouvets, Van Westen & Van Tooren in the Netherlands.

Occurrence, ecology, and distribution — In the Netherlands, *Cosmarium coeselii* is a rather common but never abundant species in quaking bogs. In addition, it can be found in small mesotrophic lakes with a rather high supply of seepage water or with other sources of minerals. Outside the Netherlands, it is known from several mesotrophic lakes throughout France, but most probably it is widely distributed throughout Europe.

*Cosmarium pachydermum* has more or less the same ecological preferences, but is very rare nowadays in the Netherlands and almost completely restricted to fen areas. It is widely distributed throughout Europe, with an apparent preference for upland and mountain areas.

*Cosmarium pachydermum* can be found on the Dutch Red List of endangered desmids (Coesel 1998), but in fact both species should now be included in this list.

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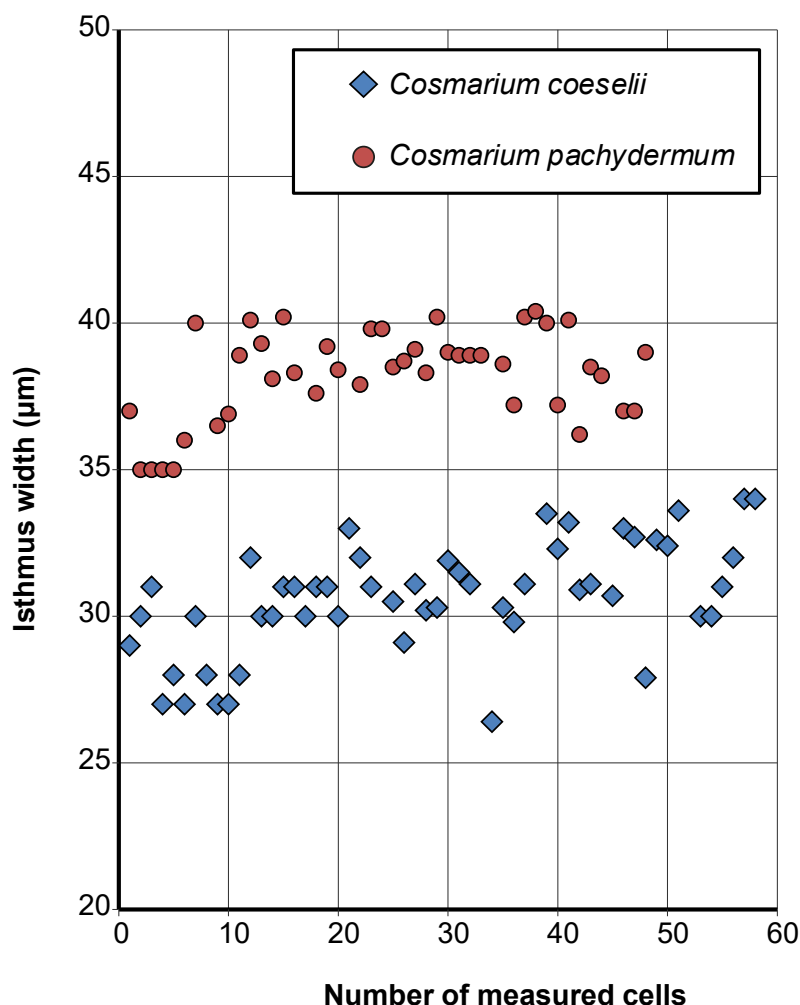


Fig. 4. Isthmus width of cells from various populations of *Cosmarium pachydermum* P.M. Lundell var. *pachydermum* and *C. coeselii* Kouvets, Van Westen & Van Tooren in the Netherlands.

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