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Michelcostea, a new diatom genus (Bacillariophyta) from the sub-Antarctic Region

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With 19 figures and 2 tables

Abstract: The genus *Michelcostea* gen. nov. is described as a new genus based on light and scanning electron microscopy observations made on valves formerly identified under the name of *Navicula bryophiloides* var. *linearis*, a taxon invalidly described by Maillard from Iles Kerguelen. The new genus is characterized in having a deep mantle, uniseriate to biseriate striae, located in deep grooves, interrupted at the valve face/mantle junction by a hyaline zone, composed of small, rounded areolae, occluded externally by clearly perforated hymenes, a curved raphe with unilaterally deflected external distal raphe endings and straight indistinct internal proximal raphe endings. *Michelcostea lecohuiana* sp. nov. is described as its *typus generis*. The new genus is compared to similar genera. Notes on its ecology are added.

Key words: Bacillariophyta, morphology, new genus, sub-Antarctica

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Introduction

For a long time, the diatom flora of the Antarctic Region (comprising the Antarctic Continent, the Maritime Antarctic Region and the sub-Antarctic islands (Chown & Convey 2007) was considered as being largely composed of cosmopolitan species (Jones 1996, Van de Vijver & Beyens 1999a). Despite some older publications (Germain 1937, Bourrelly & Manguin 1954, Le Cohu & Maillard 1983, 1986) describing several new taxa from the sub-Antarctic Iles Kerguelen, the number of reported cosmopolitan taxa was nevertheless quite high (see Kellogg & Kellogg 2002 who listed all reported taxa from Antarctica).

A large taxonomic effort, revising the entire Antarctic non-marine diatom flora during the past 15 years contradicted however these previous results. A large number of new taxa was described (Van de Vijver et al. 2002, 2004a, Zidarova et al. 2016) indicating that a highly specific and even endemic flora is present, showing a distinct bioregionalism (e.g., Van de Vijver et al. 2005, 2014). The three different parts of the Antarctic Region all have their own (usually endemic) diatom flora with only a handful of Antarctic species present in all three parts.

The diatom flora of the sub-Antarctic islands in the southern Indian Ocean has been the subject of several taxonomic studies during the past 75 years. Germain (1937) and Bourrelly & Manguin (1954) described several new taxa from the Iles Kerguelen, a large archipelago in the southern Indian Ocean. Both studies were based on a handful of samples.

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The first large overview of the sub-Antarctic diatom flora was made by Le Cohu & Maillard (1983, 1986) analyzing more than 75 samples from different parts of the Iles Kerguelen. Van de Vijver et al. (2002) revised almost 30 years later the diatom flora of the nearby Iles Crozet and together with the transfer of twenty taxa (mainly described by Germain (1937) and Manguin in Bourrelly & Manguin (1954)), described another 37 new taxa, many of which still recognized as being typical sub-Antarctic endemics, never found outside the sub-Antarctic Region (Van de Vijver et al. 2002, 2005, Kopalová et al. 2015). Later studies on Heard Island (Van de Vijver et al. 2004b) and the Prince Edward Islands (Van de Vijver et al. 2008) confirmed the presence of a typical sub-Antarctic diatom flora. Since 2002, several new taxa have been added to this flora, mainly based on revisions of so-called cosmopolitan taxa present on the islands (e.g., Romero & Van de Vijver 2011, Van de Vijver 2012, Van de Vijver et al. 2004a, 2014).

In 1986, Maillard (in Le Cohu & Maillard 1986) described *Navicula bryophiloides* var. *linearis* as a new variety of the sub-Antarctic *Navicula bryophiloides* Manguin (in Bourrelly & Manguin 1954). Van de Vijver (in Van de Vijver et al. 2002) transferred both the species and the variety to the genus *Adlafia* Gerd Moser, Lange-Bertalot & Metzeltin (1998). However, the initial description of the variety *linearis* proved to be invalid as a designation of a holotype was missing (which according to article 40 of the International Code of Nomenclature for algae, fungi, and plants (McNeill et al. 2012) is necessary after 01/01/1958). As it was not corrected when transferring the variety to the genus *Adlafia*, also this new combination is invalid.

In the present study, we investigated the ultrastructure of *Navicula bryophiloides* var. *linearis* to unravel its correct identity. The results, based on detailed scanning electron microscopy observations, revealed that this taxon presented a unique combination of morphological features that have not been found in any other genus, known so far. The taxon is therefore described as a new genus and as it was originally invalidly published, also as a new species: *Michelcostea lecohuiana* gen. & spec. nov. The new genus is compared with related genera such as *Adlafia* and *Envekadea* Van de Vijver, Gligora, F.Hinz, Kralj & Cocquyt. Notes on its biogeographical distribution and ecology are added.

Material and methods

Several samples collected during multiple expeditions in the sub-Antarctic Region were used in this morphological and taxonomical study. Table 1 lists all samples used in this study.

Diatom samples were prepared for LM observation following the method described in van der Werff (1955). Small parts of the sample were cleaned by adding 37% H_2O_2 and heating to 80 °C for about 1h. The reaction was completed by addition of $KMnO_4$. Following digestion and centrifugation (three times 10 minutes at 3700 × g), cleaned material was diluted with

Table 1. List of samples used in this study.

Sample ID	Geographic locality	Source
BM060	Crozet	Van de Vijver & Beyens 1999b
BM225	Crozet	Van de Vijver & Beyens 1999b
BA060	Crozet	Van de Vijver et al. 2002
KERN16	Kerguelen	unpublished material
D1050	Heard Island	Van de Vijver et al. 2004b
H1064	Heard Island	Van de Vijver et al. 2004b
H1571	Heard Island	Van de Vijver et al. 2004b
Q185	Heard Island	Van de Vijver et al. 2004b

distilled water to avoid excessive concentrations of diatom valves on the slides. Cleaned diatom material was mounted in Naphrax®. The slides were analyzed using an Olympus BX53 bright field microscope and the Olympus UC30 Imaging System. Samples and slides are stored at the BR-collection, property of the Belgian federal government and given in permanent loan to the Botanic Garden Meise (Belgium). For scanning electron microscopy (SEM) parts of the oxidized suspensions were filtered through a 1-µm Isopore™ polycarbonate membrane filter (Merck Millipore). The stubs were sputter-coated with a Gold-Palladium layer of 20 nm and studied in a ZEISS Ultra SEM microscope at 3 kV (Natural History Museum London, UK). Diatom terminology follows Ross et al. (1979) (stria/areola structure) and Round et al. (1990) (raphe structure). The morphology of the new genus has been compared with the ultrastructure of known genera described worldwide: *Adlafia* (Moser et al. 1998, Lange-Bertalot 2001), *Kobayasiella* Lange-Bertalot (Lange-Bertalot 1996, 1999) *Envekadea* (Gligora et al. 2009), *Boreozonacola* Lange-Bertalot et al. (Kulikovskiy et al. 2010), *Cosmioneis* D.G.Mann & Stickle (Round et al. 1990), *Neidiopsis* Lange-Bertalot & Metzeltin (Lange-Bertalot & Genkal 1999), *Sellaphora* Mereschkowsky (Round et al. 1990) and *Veigaludwigia* Lange-Bertalot & Rumrich (Metzeltin & Lange-Bertalot 2007).

Results

***Michelcostea* Van de Vijver, Lange-Bertalot, C.E.Wetzel & Ector gen. nov.**

Typus generis: *Michelcostea lecohuiana* Van de Vijver, Lange-Bertalot, C.E.Wetzel & Ector sp. nov.

Etymology: The new genus is named after our dear friend and colleague Dr. Michel Coste (Irstea Bordeaux, France), in honor of his outstanding career in diatom science.

Frustules in girdle view rectangular. Valves usually linear with (sometimes) weakly undulating margins. Striae uniseriate, located in elongated grooves. Near the axial area, striae becoming biseriate. Areolae rounded, separated externally by thin silica bridges, occluded by perforated hymenes. Valve face striae separated from mantle areolae by a clear hyaline zone, internally visible as a thin longitudinal ridge running from apex to apex. Raphe filiform, curved. Proximal raphe endings externally unilaterally deflected, simple, internally straight, simple. Distal raphe endings externally deflected, continuing shortly onto the valve mantle, internally terminating on small, but well-developed helictoglossae. Girdle composed of two open, perforated copulae, one row of areolae on the pars exterior, one on the pars interior.

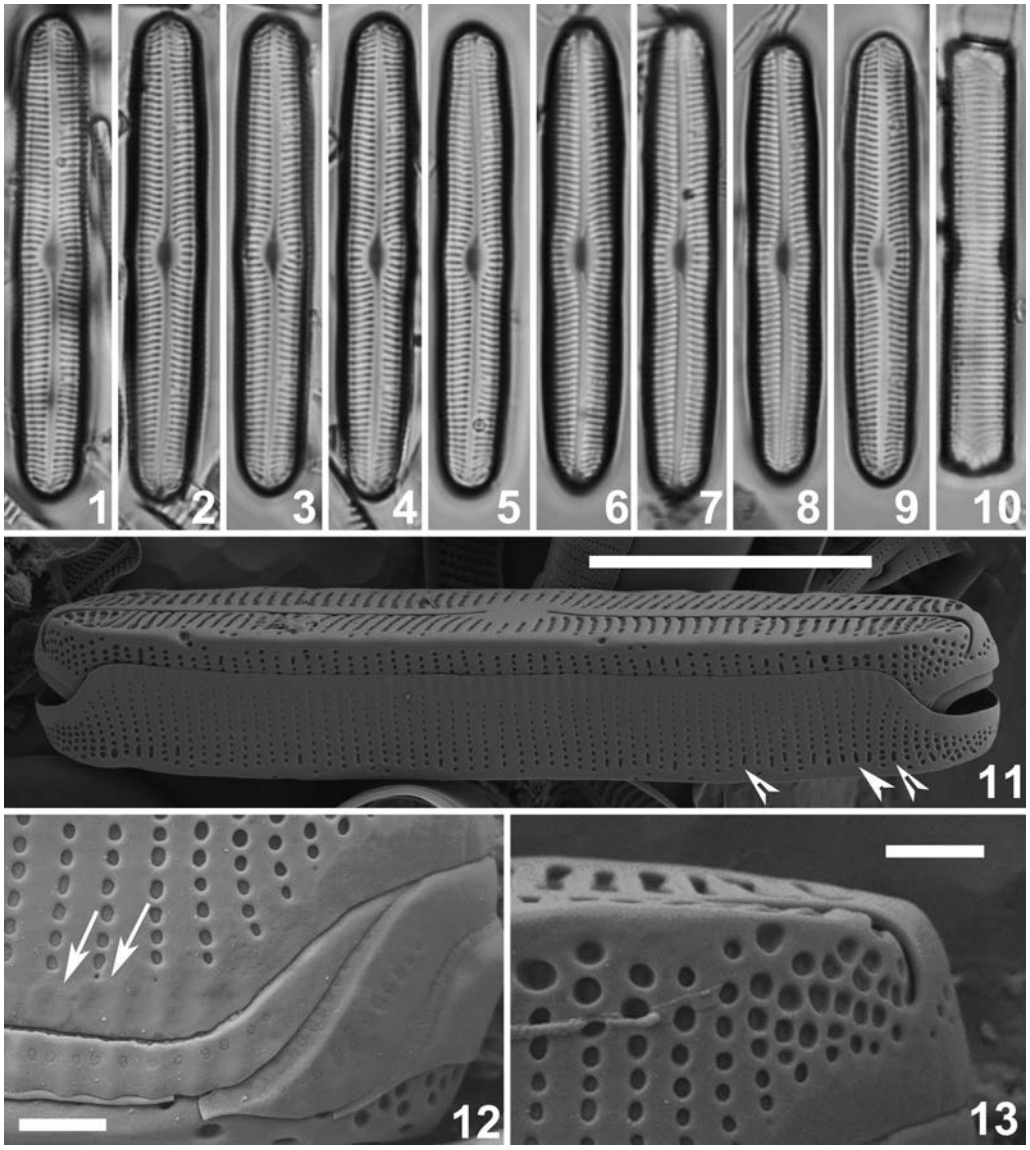
***Michelcostea lecohuiana* Van de Vijver, Lange-Bertalot, C.E.Wetzel & Ector sp. nov.**

Type: HEARD ISLAND, Skua Beach, sample H1064 (53°04’57.1”S/73°40’27.9”W), leg. N.J.M. Gremmen, coll. date 28/01/2001 (holotype, slide no. BR–4474; isotype, slide PLP-319, University of Antwerp, Belgium).

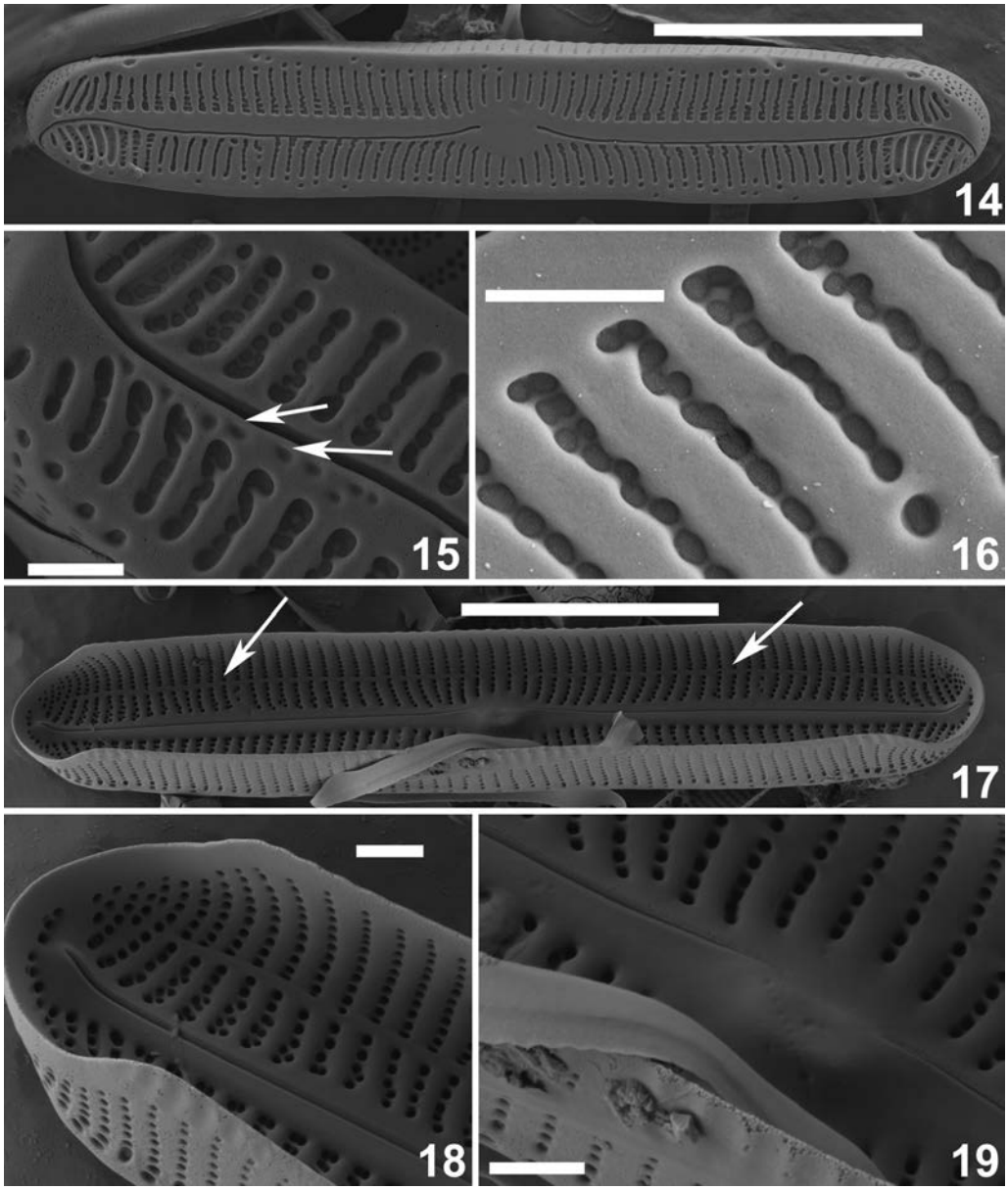
Synonym: *Navicula bryophiloides* var. *linearis* Maillard in Le Cohu & Maillard (1986) (invalid name), *Adlafia linearis* (Maillard) Van de Vijver (in Van de Vijver et al. 2002) (invalid name)

Etymology: The specific epithet *lecohuiana* refers to our dear friend and colleague Prof. Dr. René Le Cohu on the occasion of his 80th birthday.

Light microscopy (Figs 1–10): Frustules in girdle view rectangular (Fig. 10). Valves almost strictly linear with weakly undulating valve margins and broadly rounded, never protracted valve apices. Valve dimensions (n = 25): length 28.0–47.0 µm, width 5.0–6.0 µm. Axial area very narrow, 1/7–1/8 of the total valve width, linear, weakly widening near the central area. Central area small, elliptical to apically elongated, never forming a fascia. Raphe branches clearly curved, almost asymmetrically positioned next to one margin of the axial area, filiform. Proximal raphe endings simple, clearly unilaterally deflected. Distal raphe endings not discernible in LM. Striae



Figs 1–13. *Michelcostea lecohuiana* gen. & sp. nov. LM pictures taken from the holotype population (sample H1064) from Skua Beach, Heard Island. SEM pictures taken from sample Q185, Heard Island. Figs 1–9. Light microscopy observations of individual valves. Fig. 10. Light microscopy observation of an entire frustule in girdle view. Fig. 11. Entire frustule in girdle view. The arrows indicate large depressions with several areolae. Fig. 12. Detail of the mantle and the girdle copulae. The arrows indicate mantle plaques. Fig. 13. Detail of the valve apex in girdle view. Note the irregular position of the areolae and the striae near the apex and the short distal raphe ending, continuing onto the mantle. Scale bar represents 10 µm except for Figs 12 & 13 where scale bar = 1 µm.



Figs 14–19. *Michelcostea lecohuiana* gen. & sp. nov. SEM pictures taken from sample Q185, Heard Island except fig. 16 taken from the holotype population (sample H1064) from Skua Beach, Heard Island. Fig. 14. External view of an entire valve. Note the curved raphe branches, the striae composed of elongated deep grooves and the deflected distal raphe endings. Fig. 15. External detail of the striae at the valve apex. Note the deep grooves in which the striae are located, the biseriate endings of the striae near the axial area and the shallow depressions bordering the axial area (arrows). Fig. 16. External detail of the areolae with the typical external perforated hymenes. Fig. 17. Internal view of an entire valve. The arrows indicate the narrow hyaline line separating the valve face striae from the mantle areolae. Fig. 18. Internal detail of the valve apex with the helictoglossae. Fig. 19. Internal detail of the central area with the straight proximal raphe endings and the raised central nodule. Scale bar represents 10 µm for Figs 14 & 17 and 1 µm for Figs 15, 16, 18 & 19.

weakly radiate throughout the entire valve, at the apices becoming more convergent, 17–19 in 10 µm. Striation pattern becoming more or less irregular near the apices. Areolae not visible in LM.

Scanning electron microscopy (Figs 11–19): Girdle composed of 2 open bands, perforated by two rows of areolae, one on the pars exterior, one on the pars interior (Figs 11, 12). Mantle quite deep with uniseriate mantle striae (Fig. 11). Mantle areolae becoming smaller towards the mantle edge, leaving a narrow longitudinal zone at the mantle edge. Mantle plaques present at the edge (Fig. 12, arrows). Occasionally, larger depressions present near the valve face/mantle junction in which two or more areolae present (Fig. 11, arrows). At the apices, striation pattern less regular with larger areolae (Fig. 13). Valve face with transapically elongated grooves in which striae are positioned. Striae generally uniseriate except near the axial area where striae mostly biseriate (Figs 14–16), composed of small rounded areolae, separated by small silica bridges (Fig. 16). Areolae occluded by perforated external hymenes. Near the apices, small depressions present bordering the axial area (Fig. 15, arrows). Valve face striae clearly separated from the mantle striae by a large hyaline zone (Fig. 14). External raphe branches clearly curved (Fig. 14). External proximal raphe endings simple, unilaterally deflected (Fig. 14). Distal raphe endings distinctly deflected opposite the proximal endings, continuing shortly onto the mantle (Figs 13, 14). Internally, interruption between mantle striae and valve face striae clearly present as a thin narrow hyaline zone running from apex to apex (Fig. 17, arrow). Biseriate part of the striae near the axial area discernible. Internal proximal raphe endings straight, simple (Fig. 19). Central nodule clearly developed, raised (Figs 17, 19). Distal raphe endings terminating on well-developed helictoglossae (Fig. 18).

Ecology and distribution

Michelcostea lecohuiana has been found on the Crozet Archipelago (Van de Vijver et al. 2002), Iles Kerguelen (Le Cohu & Maillard 1986) and Heard Island (Van de Vijver et al. 2004b). The species seems absent on the Prince Edward Islands (Van de Vijver et al. 2008) and Amsterdam & St. Paul Island (Chattová et al. 2014), the two most northern sub-Antarctic island groups of the southern Indian Ocean, despite the fact that on each of the investigated islands, a comparable (ecological) array of samples has been collected. *Michelcostea lecohuiana* was mostly found, though usually in low abundances, living on wet terrestrial to semi-dry moss vegetation. The accompanying flora is mainly composed of *Humidophila* and *Pinnularia* species. In almost all samples *Adlafia bryophiloides* was likewise present.

Discussion

Originally, the new taxon was considered to be only a variety of *Adlafia bryophiloides*, with whom it often occurs in the same habitats. According to Maillard, both taxa could be separated by differences in valve outline with *M. lecohuiana* (as *N. bryophiloides* var. *linearis*) lacking the typical capitate apices, and the striation pattern with *M. lecohuiana* having a lower stria density. Analysis of the ultrastructure revealed several other important morphological differences making it clear that there is no relation between both taxa and that they should be treated as two independent taxa. This was previously recognized by Van de Vijver et al. (2002) who raised the former Maillard variety to species level. However, erroneously, Van de Vijver et al. (2002) placed both taxa in the genus *Adlafia*. Whereas this seems correct for *N. bryophiloides*, it is now evident that the var. *linearis* differs sufficiently from the genus *Adlafia* to exclude its position in this genus.

It is however clear that the observed valves on Heard Island and Iles Crozet are conspecific with the taxon (invalidly) described by Maillard in Le Cohu & Maillard (1986). Only one (hand drawn) illustration was provided (Le Cohu & Maillard 1986, Fig. 26) but the description and given stria density fits entirely. Therefore, the name *N. bryophiloides* var. *linearis* is added as a synonym to this new species as the name cannot be accepted (as stated earlier) based on article

40 of the International Code (McNeill et al. 2012). Van de Vijver et al. (2002) mentioned a stria density that is higher (20–25 in 10 µm) but this is most likely based on erroneous stria counts making their combination *Adlafia linearis* also a synonym of *Michelcostea lecohuiana*.

Table 2 compares the new genus with several other naviculoid genera that show some (although never entirely) similar combination of morphological features that are found in *M. lecohuiana*. These are *Adlafia*, *Kobayasiella*, *Veigaludwigia*, *Boreozonacola*, *Neidiopsis*, *Sellaphora*, *Cosmioneis* and *Envekadea*.

The genus with the highest similarity to *Michelcostea* is *Adlafia* (Table 2), in which genus the taxon was originally placed by Van de Vijver et al. (2002). Both genera differ however in several important morphological features. The striation pattern in *Adlafia* is very dense, composed of very fine, distinctly radiate striae becoming abruptly convergent towards the apices in nearly all species. *Michelcostea* has large, only weakly radiate striae throughout the entire valve, weakly but gradually becoming convergent at the apices that are quite well discernible in LM. The striae are uniseriate and externally occluded by porous hymenes in *Adlafia*, continuing without interruption onto the mantle (Moser et al. 1998, plate 36). In *Michelcostea* on the other hand, the striae are located in deep transapically oriented grooves, becoming larger towards the apices. Moreover, near the axial area, the usually uniseriate striae become biseriate (visible both internally and externally). There is a clear interruption by a large hyaline zone at the valve face/mantle junction separating distinctly the valve face striae from the mantle striae. Additionally, the mantle in *Michelcostea* is quite deep, which is less the case in *Adlafia*. The mantle striae of *Michelcostea* are parallel and evenly spaced in the middle but become irregular and quite dense near the apices. This was never observed in *Adlafia* (Moser et al. 1998, plate 26, fig. 5) The raphe structure in both genera is rather similar with curved external raphe branches, distally unilaterally deflected to the secondary side and continuing shortly onto the mantle, although in *Michelcostea*, the internal proximal raphe endings are short and straight, whereas in *Adlafia* they are usually shortly deflected to even bent (Moser et al. 1998, plate 26, fig. 4). The girdle bands bear two rows of poroids in *Adlafia* on the pars exterior whereas in *Michelcostea*, there is one row in the pars exterior and one row in the pars interior. Based on these important differences, it is clear that *Adlafia* cannot be the host genus for this taxon.

The genus *Envekadea*, mainly composed of marine or brackish taxa (Gligora et al. 2009, Lee et al. 2013, Atazadeh et al. 2014), can also be excluded based on important differences in the structure of the raphe and the striae. *Envekadea* has a typical sigmoid raphe with the distal raphe endings deflected into opposite directions, a feature never observed in *Michelcostea* (Gligora et al. 2009, Fig. 24). The striae in *Envekadea* are composed of rather large, square or rectangular to even polygonal areolae, never located in elongated grooves (Gligora et al. 2009, fig. 29). The striae continue without interruption from the valve face onto the mantle. The girdle bands in *Envekadea* lack any perforation, typically present in *Michelcostea* (Gligora et al. 2009, fig. 49).

Veigaludwigia, only known from South America (Rumrich et al. 2000, Vanormelingen et al. 2008), shows a characteristic set of features (Table 2) that are absent in *Michelcostea*. The most striking difference is the presence of internal spines along the valve margins in *Veigaludwigia* (Rumrich et al., 2000, plate 74, figs 4–5). These spines, even discernible in LM, have never been seen in *Michelcostea*. Internally, the proximal raphe endings in *Veigaludwigia* are distinctly hooked (Rumrich et al., 2000, plate 74, fig. 8), unlike *Michelcostea* that has straight, simple endings. Therefore, we exclude *Veigaludwigia* as host genus for the new taxon.

Cosmioneis (Table 2) has similar features to *Michelcostea* but differs in its raphe structure, with large external proximal raphe pores and anchor-shaped internal endings. The areolae are usually large and occluded internally by hymenes (Round et al. 1990), contrary to *Michelcostea* that has external hymenes. The girdle structure is generally composed of 7 open bands, each bearing one row of perforations, whereas *Michelcostea* has only 2 perforated open copulae.

Neidiopsis shares several features with *Michelcostea* such as the hyaline interruption between mantle striae and valve face striae, but can be separated based on the internal areola occlusions

Table 2. Comparison table between the new genus *Envekadea* and some freshwater genera presenting a similar set of features.

	Michelcostea	***Envekadea***	***Adlafia***	***Kobayasiella***	***Boreozonacola***	***Veigaludwigia***	***Sellaphora***	***Cosmioneis***	***Neidiopsis***
Valve size (µm)	< 50	variable	< 40	relative small	< 50	variable	variable	variable	variable
Valve outline	linear with broadly rounded apices	linear-lanceolate with broadly rounded to (sub)- capitate apices	linear to linear-lanceolate, protracted, subcapitate or rostrate apices	linear to elliptic-lanceolate, protracted, subcapitate or rostrate apices	linear with undulated margins and broadly rounded apices	linear, sometimes with undulated margins	linear, lanceolate or elliptical, bluntly rounded to capitate apices	lanceolate to elliptical, rostrate or strongly capitate ends	linear to linear-elliptical or linear-lanceolate with rostrate apices
Raphe	straight, curved	usually straight, filiform	filiform, weakly curved	filiform, umbilicus present	filiform, weakly curved	filiform, weakly curved	straight, filiform	straight, filiform	straight, filiform
Proximal raphe endings	deflected, simple	expanded, forming conical depressions, straight	simple	simple	deflected, simple	straight, simple	simple to expanded, (slightly) deflected	greatly expanded, forming conical depressions, straight	straight, simple, very closely together
Proximal internal endings	straight, indistinct	very slightly deflected to one side	clearly deflected, indistinct	T-shaped, straight	weakly deflected, simple	strongly hooked	deflected to the primary side	anchor-shaped	straight, indistinct
Distal raphe endings	unilaterally deflected to the secondary side, shortly continuing onto the mantle	very short terminating in expanded, golfclub-like pores bent to opposite directions, giving the raphe a sigmoid look	unilaterally deflected to the secondary side	unilaterally, strongly deflected or hooked to the secondary side	unilaterally deflected, continuing on the mantle	unilaterally deflected	deflected or hooked to the primary side	curved towards the secondary side	unilaterally deflected, continuing on the mantle
Conopeum	absent	absent	absent	absent	absent	absent	usually present	absent	absent
Striation pattern	rather broad striae, weakly radiate throughout, situated in deep grooves, becoming larger towards the apices	very dense, radiate in the centre, then abruptly convergent close to the apices	very dense, clearly radiate, ad the apices convergent	radiate in the centre, then abruptly convergent close to the apices	parallel to weakly radiate throughout	clearly radiate in the middle, convergent near the apices	parallel to radiate, sometimes convergent near the poles	radiate	radiate at the valve center, becoming parallel and finally convergent near the apices

	Michelcostea	***Envekadea***	***Adlafia***	***Kobayasiella***	***Boreozonacola***	***Veigaludwigia***	***Sellaphora***	***Cosmioneis***	***Neidiopsis***
Striae	uniseriate to occasionally biseriate, interrupted by a hyaline zone at the valve face/mantle junction, interruption clearly visible internally	uniseriate, continuing without interruption over the valve face/ mantle junction	uniseriate, continuing without interruption from valve face to mantle	presence of a hyaline ridge at the valve face/mantle junction	uniseriate, continuing without interruption from valve face to mantle	uniseriate, continuing without interruption over the valve face/mantle junction	uniseriate or biseriate	uniseriate, continuing over the face/mantle junction	uniseriate to occasionally biseriate, interrupted by a hyaline zone at the valve face/ mantle junction, interruption clearly visible internally
Areolae	rounded, occluded externally by perforated hymenes, internally	large, rectangular to polygonal pores, usually occluded externally by perforared hymenes	simple, small rounded poroids, occluded externally by hymenes	transapically elongated, finely hymenated	simple, small, unoccluded	rounded, depressed in outer surface, occluded externally by hymenes	small, simple rounded poroids, internally occluded by hymenes	small, round poroids internally occluded by hymenes	simple, small, internally occluded by hymenes
Girdle structure	2 bands each with double row of poroids	2–3 non-porous bands	2 bands each with double row of poroids	2 bands with one or two rows of poroids	4–5 narrow, non perforated bands	unknown	a few open, non-porous bands	7 open bands with one row of poroids	a few perforated bands
Spines	absent	absent	absent	absent	absent	present in valve interior	absent	absent	absent
Plastids	unknown	one, H-shaped in valve view	unknown	one, H-shaped, asymmetrical	unknown	unknown	one single, H-shaped	two H-shaped in girdle view	unknown

(*Michelcostea* has externally occluded areolae), a different stria structure with typical uniseriate striae becoming biseriate in part of their course and straight external raphe branches (Lange-Bertalot & Genkal 1999, Bahls 2014).

Another closely related genus might be *Sellaphora* (Table 2) although the presence of a conopeum in most of its taxa precludes the inclusion of this new taxon in *Sellaphora*. Additionally, the areolae in *Sellaphora* are internally occluded by hymenes whereas in *Michelcostea* the occlusions are clearly present on the valve exterior. There seems to be no separation between the valve face striae and the mantle striae in *Sellaphora* (Round et al. 1990) contrary to *Michelcostea* where a clear separation between both stria parts is visible. However, part of the taxa in *Sellaphora* might still be confused with *Michelcostea*. Lange-Bertalot et al. (2003) illustrated several *Sellaphora* taxa with some slight resemblance in LM with *Michelcostea* (see for instance *S. fusticulus* (Oestrup) Lange-Bertalot) but in girdle view, it is clear that there are distinct differences, for instance in the length of the mantle striae. When the SEM structure is considered, both genera markedly differ in the points highlighted above.

The recently established genus *Boreozonacola* (Kulikovskiy et al. 2010) has uniseriate striae, composed of very fine areolae, never located in deep grooves. Areolae apparently unoccluded (based on the description given in Kulikovskiy et al. 2010, p. 17). Girdle composed of 4–5 non-perforated, narrow copulae contrary to *Michelcostea* that has only two rather large perforated copulae. Mantle plaques always absent. Internal proximal raphe endings shortly deflected, contrary to *Michelcostea* that has straight proximal endings. These morphological differences justify the separation of *Michelcostea* from *Boreozonacola*.

Finally, the genus *Kobayasiella* must also be excluded as a possible host genus for this taxon. The principal features of *Kobayasiella* (Lange-Bertalot 1996) include the presence of an *umbilicus* (sensu Kobayasi & Nagumo 1988), visible as a slight 'notch' at about one third to halfway along the straight raphe. This *umbilicus* is absent in *Michelcostea*, that shows a continuous, though curved, raphe from apex to central area without the characteristic "notch".

The striae in *Kobayasiella* are composed of transapically elongated, finely hymenate areolae, never located in grooves. Near the valve face/mantle junction, the valve face striae are separated from the mantle striae by a slightly thickened, raised hyaline ridge (Vanhoutte et al. 2004, fig. 3A) (Table 2), contrary to *Michelcostea* that possesses only a narrow, never raised hyaline zone. Both features exclude *Kobayasiella* as the genus in which the new taxon should be placed. Le Cohu et al. (2012) and Le Cohu & Azémar (2010) showed the ultrastructure of some *Kobayasiella* taxa and observed that the girdle consists of at least three copulae and they even suggested that these copulae were closed, which is certainly not the case in *Michelcostea*.

In conclusion, it is clear that this new taxon cannot be assigned to any published genus based on morphological features. Therefore a new genus, *Michelcostea* gen. nov., was proposed to accommodate this limno-terrestrial species with a deep mantle, uniseriate to biseriate striae located in deep grooves, interrupted at the valve face/mantle junction by a hyaline zone, composed of small, rounded areolae, occluded externally by perforated hymenes, a curved raphe with unilaterally deflected external distal raphe endings and straight indistinct internal proximal raphe endings.

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