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Silica-scaled chrysophytes from Mt. Sinbul wetland in South Korea

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A study on silica-scaled chrysophytes (Chrysophyceae and Synurophyceae) from Mt. Sinbul alpine wetland, South Korea was performed from January 2018 to March 2020 using scanning electron microscopy (SEM). We found a total of 19 taxa of silica-scaled chrysophytes; *Mallomonas* (13); *Synura* (3); *Chromophysomonas* (1); *Chrysosphaerella* (1); and *Paraphysomonas* (1), of which six taxa, including two new species (*Mallomonas dimorphus* sp. nov. and *Mallomonas alpestris* sp. nov.), were reported for the first time in Korea. All the species are illustrated with SEM micrographs and briefly described with regard to their taxonomy. Two new species were described based on the cell shape, size and ultrastructure of the scales and bristles. *Mallomonas dimorphus* sp. nov. belongs to the Sectio *Heterospinae* in that its scales have a flat dome, a reticulated secondary layer and needle shaped bristles. However, this species is distinguished from other taxa in the Sectio by two different patterns of shield ornamentation and a dome ornamentation. *Mallomonas alpestris* sp. nov. belongs to Series *Torquatae* (Sectio *Torquatae*) characterized elongated domed collar scales, domeless body scales and rear scales with a short spine. However, it is different from all other taxa in the Sectio *Torquatae* as well as Series *Torquatae* by shield ornamentation of the body and rear scales with evenly spaced transverse ribs and papillae.

Keywords: Mt. Sinbul alpine wetland, new species, SEM, silica-scaled chrysophytes

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Introduction

Since the fine structures of *Mallomonas* scales were first reported by Fott (1955) using a transmission electron microscope (TEM), a great number of research on silica-scaled chrysophytes has been done using an electron microscope (EM) in different regions of the world. Added to this, over 400 taxa have been described from electron microscopy observations (Asmund and Kristiansen, 1986; Siver, 1991; 2002; Kristiansen, 2002; Kristiansen and Preisig, 2007; Nemcova *et al*., 2015; Gusev *et al*., 2017; Nemcova and Rott, 2018; Guiry and Guiry, 2021). The first EM study of silica-scaled chrysophytes in Korea was carried out by Takahashi (1978), who documented five *Mallomonas* taxa and one *Synura* species from a volcanic lake (called Baekrokdam) of Mt. Halla, Jeju Island. Thereafter, a number of investigations examined various regions of South Korea (Lee *et al*., 1994; Kim, 1995; 1997; Kim *et al*., 1995; Kim and Hwang, 2001; Kim and Takamura, 2001; Lee and Kim, 2007; Kim and Kim, 2008; Kim *et al*., 2009; Jo *et al*., 2013; Kim *et al*., 2014; Jeong *et al*., 2019). As of now, a total of 110 taxa of silica-scaled chrysophytes are known in South Korea, which are categorized as *Mallomonas* (64), *Synura* (13), *Chrysosphaerella* (4), *Paraphysomonas* (19) and *Spiniferomonas* (10) (Kim and Lee, 2015; Jo and Kim, 2017; Jeong *et al*., 2019).

As per Kristiansen and Lind (2004), out of 172 *Mallomonas* taxa reported at that time, 60% (103 taxa) are cosmopolitan species while the rest 40% (69 taxa) are endemic species. Given this argument, it is assumed that Korea is home to many more silica-scaled chrysophytes, although regional investigations are still lacking in wide range of areas across Central Asia, tropical Africa, and tropical South America.

The Mt. Sinbul alpine wetland is characterized by a remarkably high rate of desmids including several new taxa and freshwater algal community different from those in other wetlands in lower regions of the country, which, makes them an interesting habitat (Kim *et al*., 2020).

The purpose of the present study is to investigate the flora of silica-scaled chrysophytes in the Mt. Sinbul alpine wetland.

Materials and Methods

Sampling sites and environmental factors are presented in our previous paper (Kim *et al*., 2020). Samples were collected at monthly or irregularly intervals in the Mt. Sinbul alpine wetland located in the south-eastern part of South Korea from January 2018 to March 2020. During the January, sampling was not carried out due to dry or freezing condtions. All samples were collected with a plankton net (mesh size 10 μm) and a 1L plastic bottle. Sampled materials were immediately fixed with formalin. For observations via a scanning electron microscope (SEM, Hitachi S-4300), one drop of materials was put on a cover-glass, air dried, and platinum coated with an ion sputter device. The materials are deposited in the Department of Biology, Kyungpook National University and the National Institute of Biological Resources (NIBR). The species first reported in the Korean algal flora are marked with an asterisk on lists.

Results

Environmental conditions

During the study period, water temperature ranged from 0 to 33.4°C (average 21.3°C), pH was slightly acidic, recording between 5.49 and 6.19 (average 5.86); and electrical conductivity was significantly low, ranging from 15.0 to 44.8 μS cm^{-1} (average 22.0 μS cm^{-1}).

Silica-scaled chrysophytes flora

A total of 19 taxa were observed by SEM (Table 1). The list of species includes 13 *Mallomonas*, 3 *Synura*, 1 *Chromophysomonas*. 1 *Chrysosphaerella*, and 1 *Paraphysomonas*. Two new taxa (*Mallomonas dimorphus* sp. nov. and *M. alpestris* sp. nov.) and four taxa (*M. calceolus*, *M. leboimei*, *M. papillosa* var. *monilifera* and *M. portaeferreae* var. *reticulata*) are newly records from Korea.

**Mallomonas calceolus* Bradley (Fig. 1)

A few scales and bristles were found in spring. This taxon has the usual features of hooded V-rib, with arms confused with anterior submarginal ribs; a prominent dome; and smooth posterior flange. It has a shield, anterior submarginal ribs and a dome with sparse papillae. This species was found for the first time in Korea.

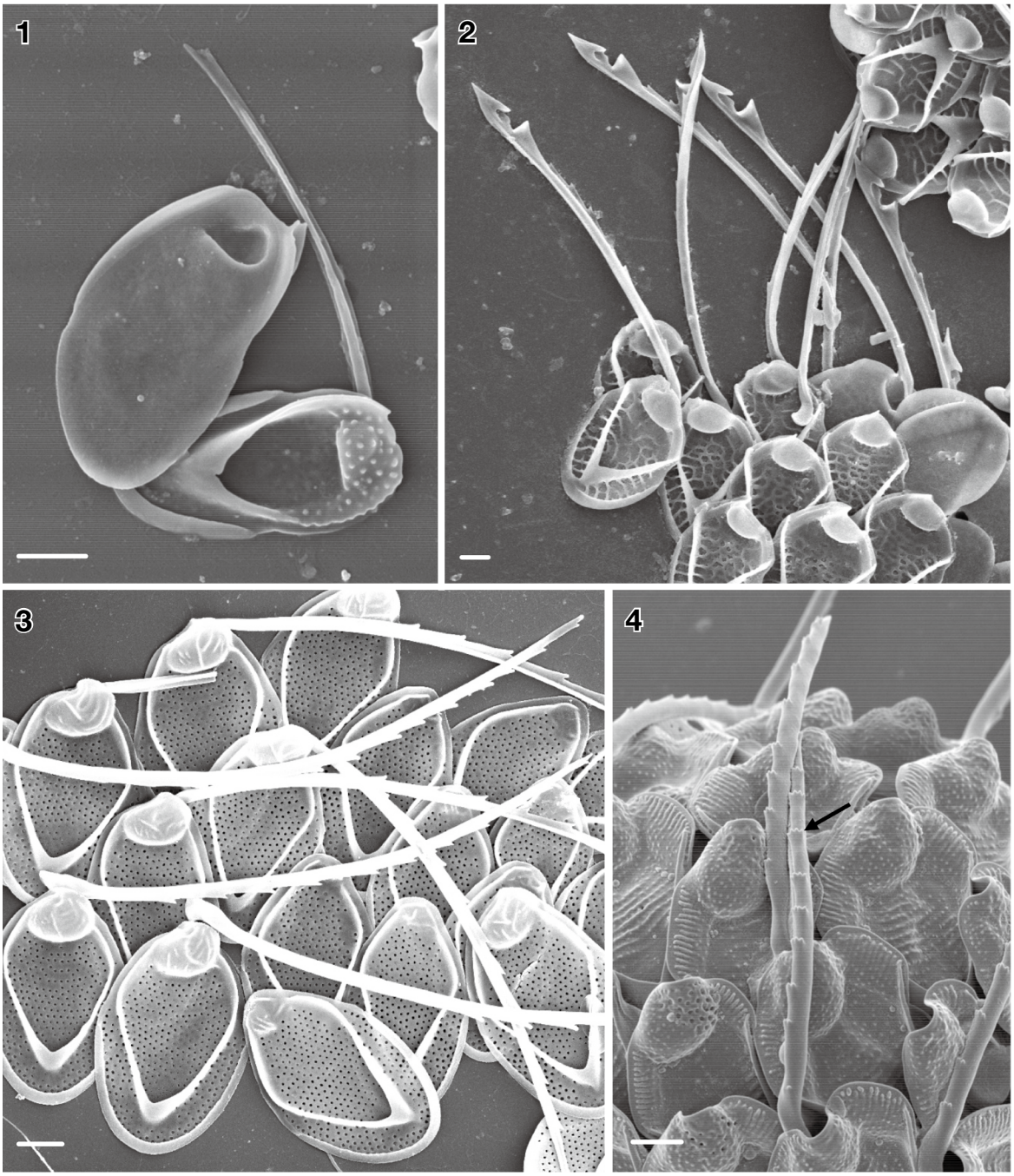
Mallomonas crassisquama (Asmund) Fott (Fig. 2)

This species is the most common and widely distributed species of *Mallomonas* and capable of tolerating a wide range of environmental conditions (Siver, 1991).

Table 1. A list of silica-scaled Chrysophytes of Mt. Sinbul mountainous wetland.

List of species	2018–2020											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Class Synurophyceae												
**Mallomonas calceolus*			+	+	+							
M. crasisquama			+	+	+							
M.elongata			+	+	+	+						
**M. leboimei*		+	+	+								+
M. lelymene		+	+	+	+					+		+
M. matvienkoae			+									+
M. papillosa		+	+	+								
**M. papillosa* var. *monilifera*			+	+								
**M. portaeferreae* var. *reticulata*			+									
M. striata			+									
M. tonsurata			+	+	+	+						
M. alpestris sp. nov.			+	+								
M. dimorphus sp. nov.		+	+	+								
Synura petersenii		+	+	+	+	+	+					
S. sphagnicola				+								
S. spinosa		+	+	+	+	+	+					
Chromophysomonas trioralis			+	+	+							
Chrysosphaerella brevispina		+	+	+	+							
Paraphysomonas vestita				+								+

* indicates new to Korea.



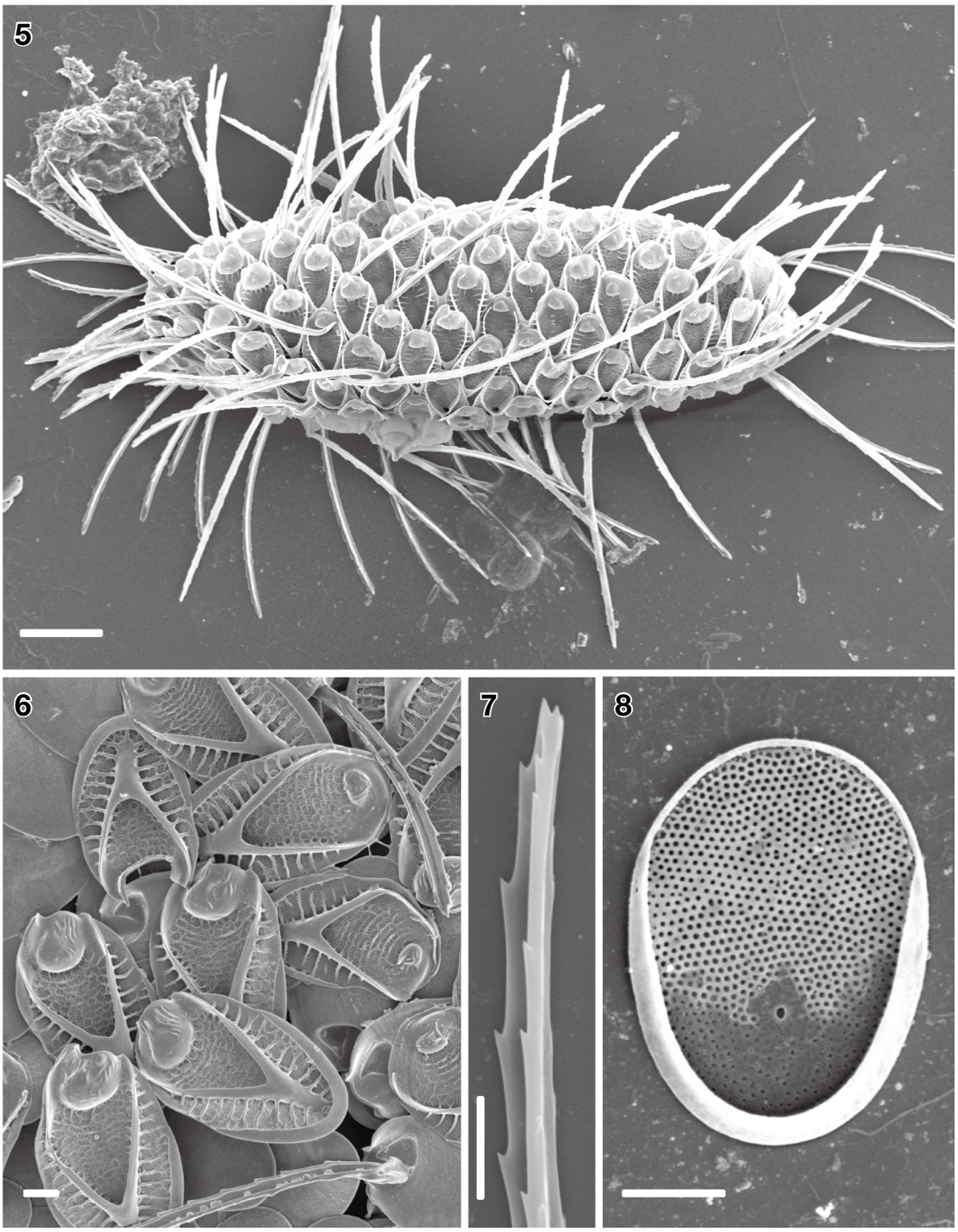
Figs. 1–4. Silica-scaled chrysophytes from Mt. Sinbul wetland. 1. *Mallomonas calceolus*, 2. *M. crassisquama*, 3. *M. elongata*, 4. *M. lelymene*. Scale bars = 1 μm.

***Mallomonas elongata* Reverdin (Fig. 3)**

This species has a cosmopolitan distribution, capable of tolerating a wide range of environmental conditions, and it prefers cold water (Siver, 1991).

****Mallomonas leboimei* Bourrelly (Figs. 5–7)**

Numerous cells were found in cold water during winter and spring. This taxon's main features are as follows: remarkably large cells and scales; a strongly hooded V-rib; a considerably various shield ornamentation; and delicate, regularly spaced, transverse ribs occasionally connected by cross ribs. The posterior flange with stout struts is more widely spaced than the ribs of the shield. Its dome is marked with ribs or is in a smooth shape. This species is

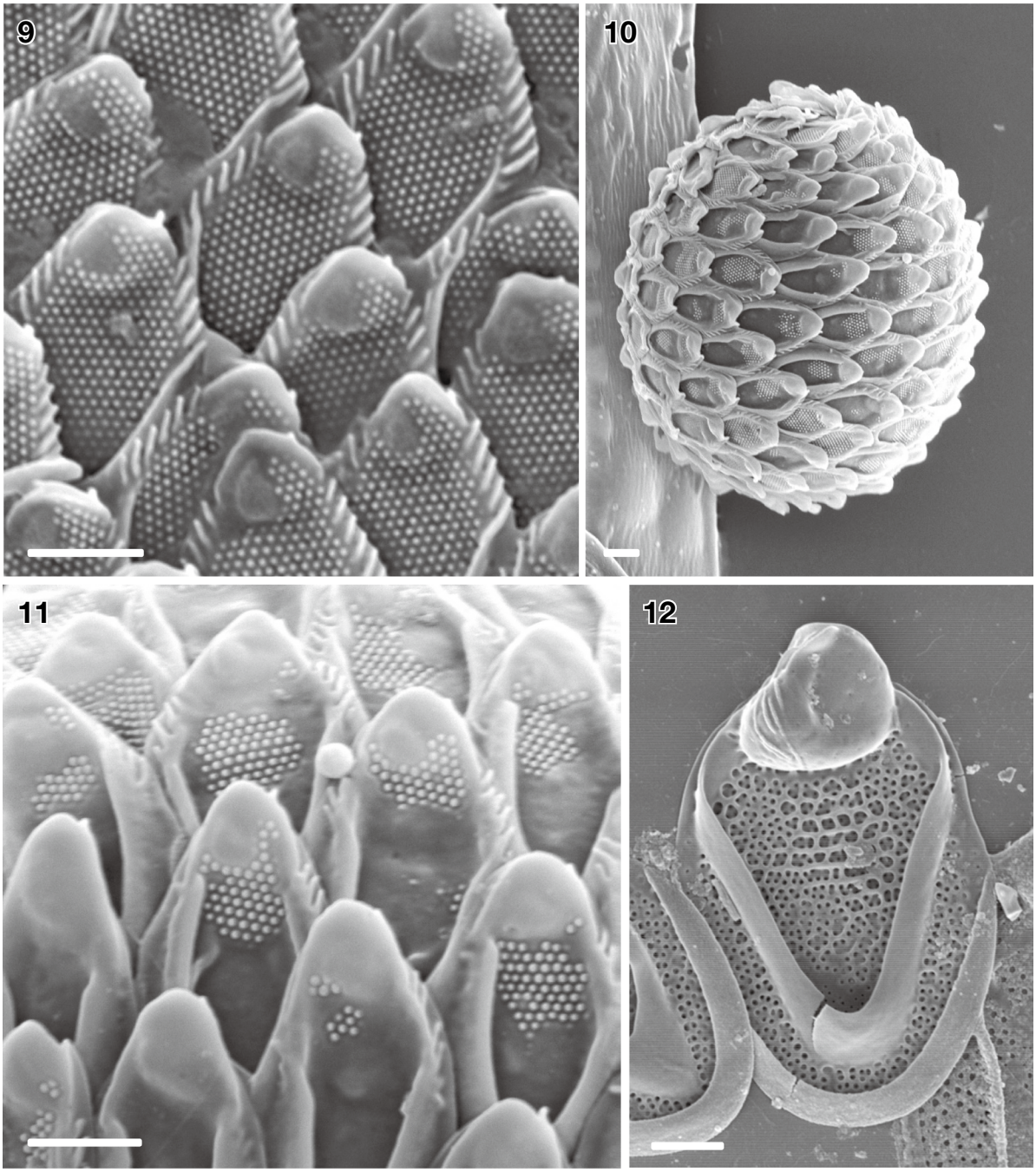


Figs. 5−8. Silica-scaled chrysophytes from Mt. Sinbul wetland. 5−7. *Mallomonas leboimei*, 5. Whole cell of *Mallomonas leboimei*, 6. Showing the scales with very small or large dome, 7. Bristles, 8. *M. metvienkoae*. Scale bars = 5 (5 μm), 6−8 (1 μm).

distributed across the northern temperate region. It was not recorded in Korea previously.

Mallomonas lelymene Harris & Bradley (Fig. 4)

This species has a cosmopolitan distribution and numerous cells were found in cold season. This species is easily distinguished within the genus by its considerably large scales and several types of wings partly surrounding scale apexes such as those ornamented with closely spaced cross ribs and few dots; with rudimentary ribs and few dots;



Figs. 9–12. Silica-scaled chrysophytes from Mt. Sinbul wetland. 9. *Mallomonas papillosa*, 10, 11. *M. papillosa* var. *monilifer*, 12. *M. portae-ferreae* var. *reticulata*. Scale bars = 1 μm.

and only with few scattered dots or of smooth type. The bristles are short, slightly curved and serrated with 3–4 teeth (Fig. 4, arrow).

Mallomonas matvienkoae (Matvienko) Asmund & Kristiansen (Fig. 8)

This species is distinguished from those of Series Matvienkoae in that it has a finely meshed reticulum only in a distal half of the scale and its proximal area of the scale has a large subcircular pore. This species is widely distributed across the world, capable of tolerating a wide range of environmental conditions. Several isolated scales were found.

***Mallomonas papillosa* Harris & Bradley (Fig. 9)**

This species has a cosmopolitan distribution and, numerous cells were found during spring. Its shield is completely covered with densely packed and regularly arranged rows of papillae. It has a dome partially with papillae, often on the right side. Anterior flanges have 3−6 parallel struts evenly spaced.

****Mallomonas papillosa* var. *monilifera* Harris (Figs. 10, 11)**

Several cells were found in spring. It has a shield partially covered with densely packed papillae on the anterior part. By contrast, its dome and the posterior area of the shield do not have papillae in most case. It has anterior flanges with 2−5 parallel struts evenly spaced. This species is distributed across the northern temperate region. It was not recorded in Korea previously.

****Mallomonas portaeferreae* var. *reticulata* Gretz, Sommerfeld & Wujek (Fig. 12)**

It is found to have several isolated sub-oval body scales with protruding dome were found. Dome is large, with weakly developed ribs. This variety is distinguishable due to its particular reticulation of the shield. It was recorded in North and South America (Kristiansen and Preisig, 2007).

***Mallomonas striata* Asmund (Fig. 13)**

This species, with cosmopolitan distribution, is one of the most common species of *Mallomonas*, which is found in various environmental conditions (Siver, 1991). Isolated scales were found in this study.

***Mallomonas tonsurata* Teiling emend. Krieger (Fig. 14)**

This species is a cosmopolitan, widely distributed taxon living in a wide range of environmental conditions (Siver, 1991). Numerous cells were found in this study.

Sectio *Heterospinae* Momeu & Péterfi

***Mallomonas dimorphus* sp. nov. Han Soon Kim (Figs. 15−20)**

Description. The cells are small (16.5−18 × 22−24 μm), subglobose or ellipsoid with a rather short protruding collar. Its scales are arranged in transverse rows. Each scale is overlapped with the scales positioned behind them in the same row and by the scales in the row above and below them (Fig. 15). Three types of scales were found, the base plate of all of which are perforated with small and evenly spaced pores. All of them possess an upturned posterior rim encircling half the scale. (i) 5−6 apical scales are asymmetric and, elongated-oblong, with one lateral edge being concave, a relatively large and flat dome, the anterior part slightly narrowed, and the apex projected with short papillae (Fig. 16, arrowhead). Its shield is divided into anterior and posterior parts by a well-developed longitudinal rib that connects to an anterior submarginal rib (Fig. 16, arrow). The anterior half is covered with well-developed straight or irregularly curved parallel or reticulated ribs, most of which continue with those of the dome. The posterior half is marked with irregularly fine and sparse ribs and large reticulation ribs. (ii) Body scales are broad elliptical to oval with a proximal rim, variously developed ribs and a relatively small flat dome. Its shield area enclosed by continuous submarginal ribs is covered with ribs in various thicknesses and patterns; and is separated into anterior and posterior areas by a slight to strongly hooded V-shaped rib (some scales with a round or U-shaped rib) continues with submarginal ribs. The rib patterns of the anterior half including the dome consist of labyrinth-like systems of semicircular ribs and straight or irregularly curved ribs, most of which continue with those of the dome. The distal portion of the continuous submarginal ribs is marked with small papillae (Fig. 17, arrow). In the proximal area, thick ribs form 3−6 large meshes or pores which are subdivided by less prominent ribs (Fig. 18, arrows). Short ribs extend at 90° angles onto the flange along two-thirds of the continuous submarginal ribs in the proximal area. (iii) The following is present: two types of smaller body scales, symmetric scales with circular ribs instead of a V-rib structure (Fig. 19, arrow) and only smaller-sized asymmetric scales (Fig. 20, arrow) similar to body scales.

Its cells are mostly covered with bristles, which are short (11−12 μm long), slightly curved, smooth and, strongly tapering to a fine point (Fig. 20).

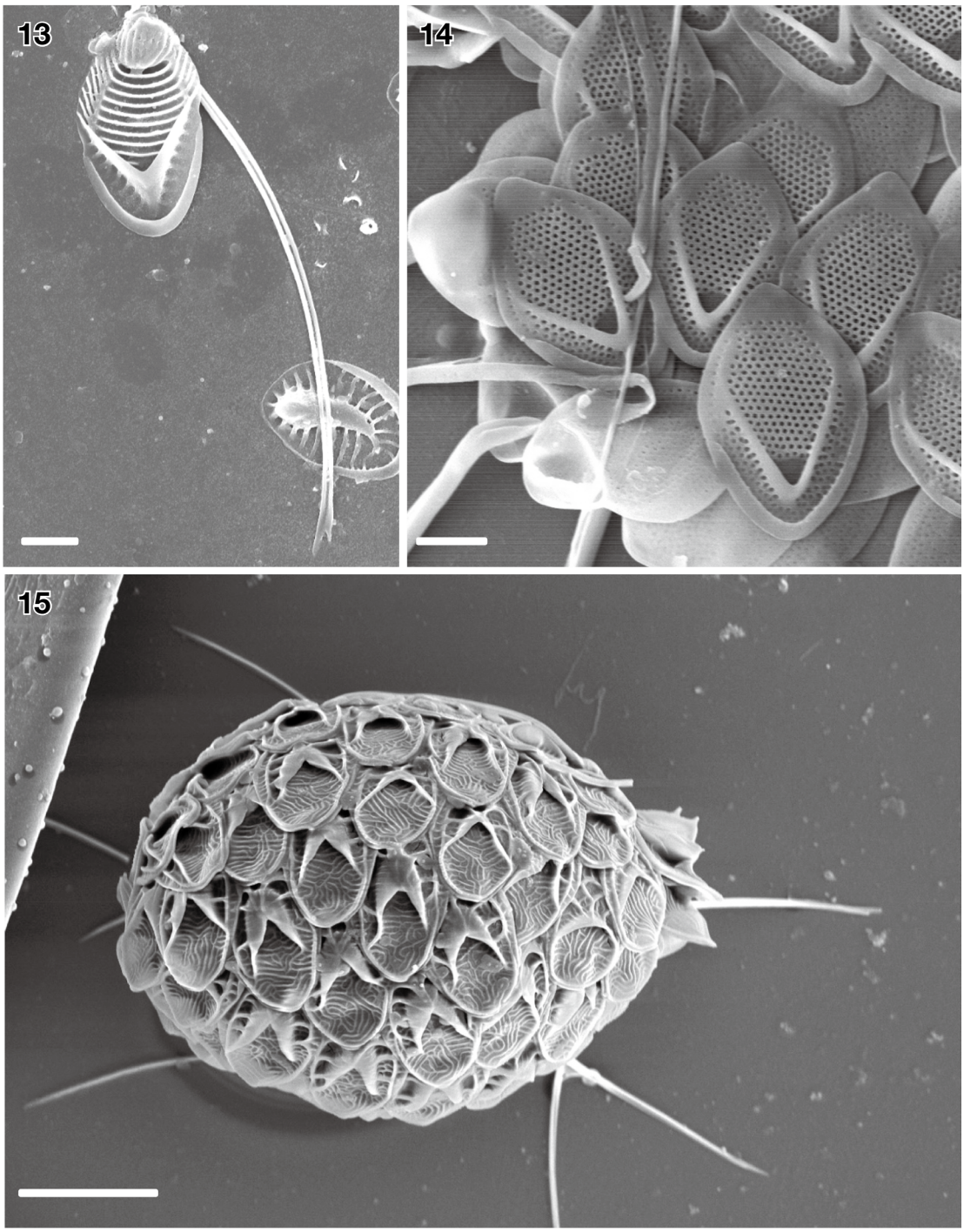
Dimension. Cells 16.5−18 × 22−24 μm, Apical scales 4−4.2 × 5.3−5.5 μm, Large body scales 3.2−4.2 × 5−6 μm, Small body scales 2−2.7 × 3.7−5 μm, Bristles 11−12 μm long.

Type locality. Mt. Sinbul wetland, Sangbuk-myeon, Ulju County, Ulsan Megacity, South Korea (129°00.03′E, 35°25.32′N, sea level 745 m, pH 5.5−6.2, water temperature 0−9.1°C, EC 15.2−44.8 μS cm^{-1}).

Holotype. Fig. 15 (iconotypus) from materials collected on March 27, 2020 deposited at the Herbarium of Kyungpook National University (KNU), Daegu (KNUSBW2020 0327).

Etymology. The specific epithet "*dimorphus*" refers to the fact that the ornamentation of the shield has two types of patterns.

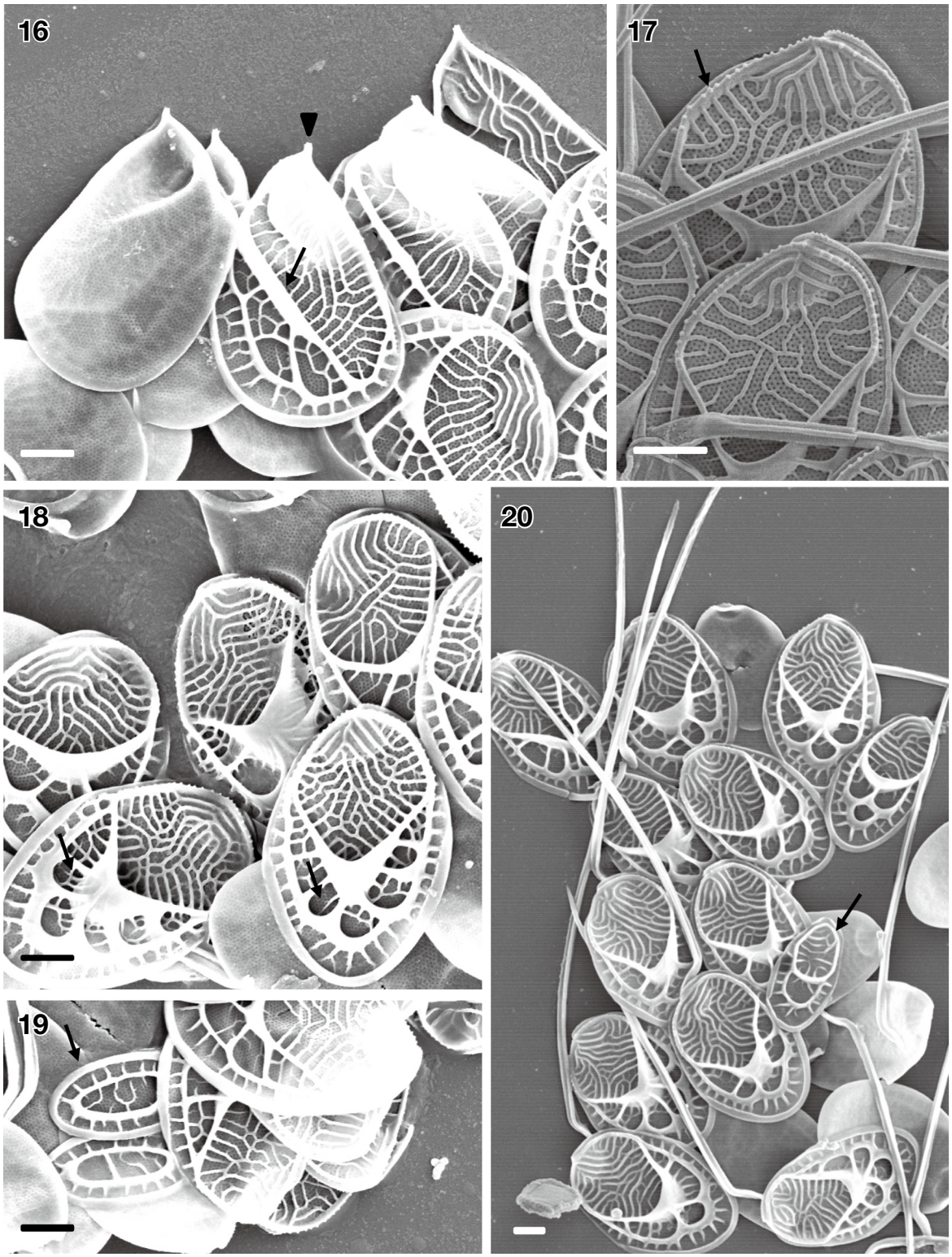
Sectio *Torquatae* Momeu & Péterfi
Series *Doigonianae* Asmund & Kristiansen



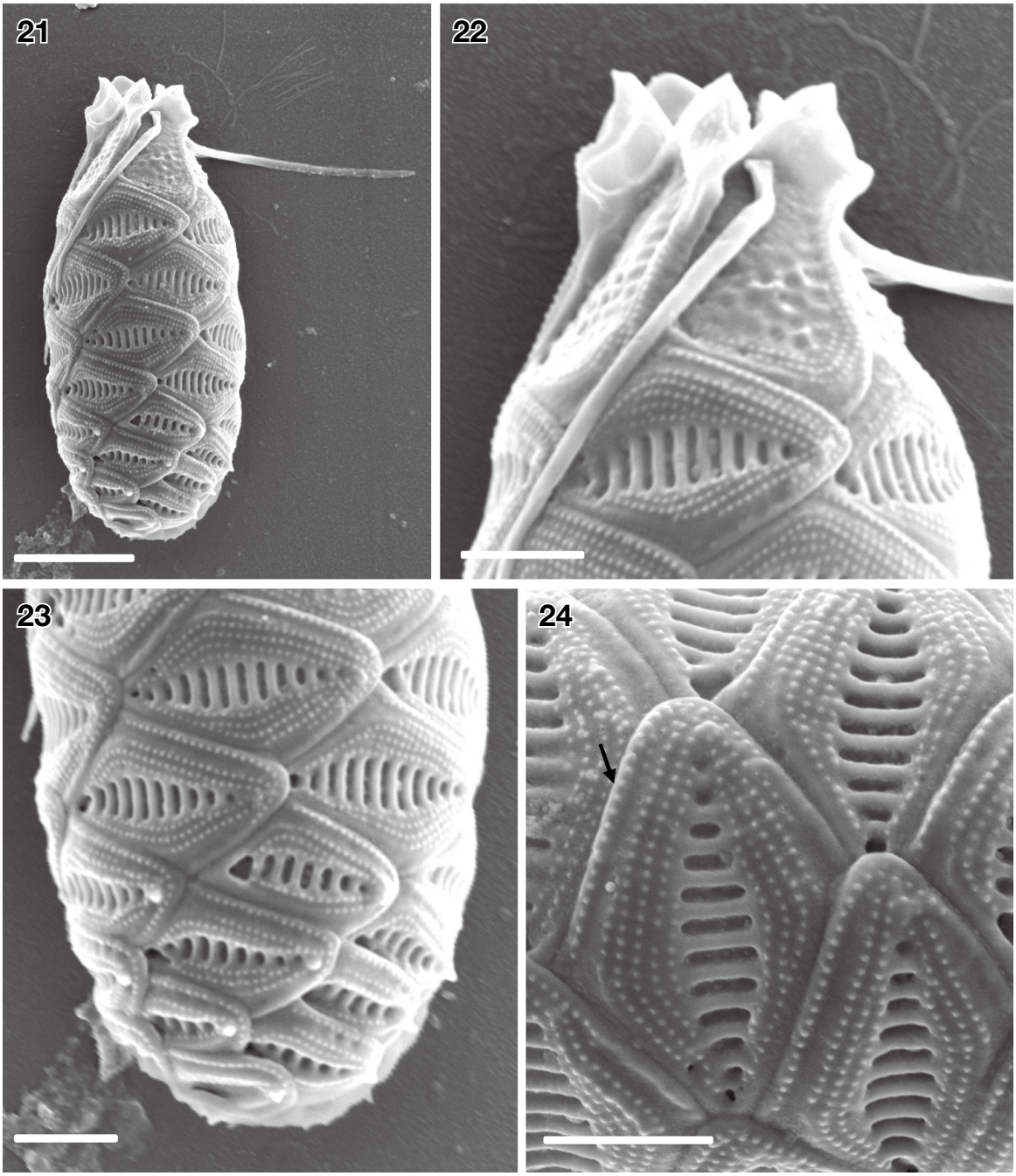
Figs. 13–15. Silica-scaled chrysophytes from Mt. Sinbul wetland, 13. *Mallomonas striata*, 14. *M. tonsurata*, 15. Whole cell of *M. dimorphus* sp. nov. Scale bars = 13, 14 (1 μm), 15 (5 μm).

***Mallomonas alpestris* sp. nov.**
Han Soon Kim (Figs. 21–24)

Description. Its cells are small (4.5–5 × 9.5–11 μm), elongated ellipsoid with a broadly rounded posterior end and a distinctively protruding collar. There are three types of scales: domed collar scales; domeless body scales; and domeless rear scales with a short spine, and this has short apical bristles. Scales are arranged in transverse rows and each scale is overlapped by the scales positioned behind them in the same row and by the scales in the row above

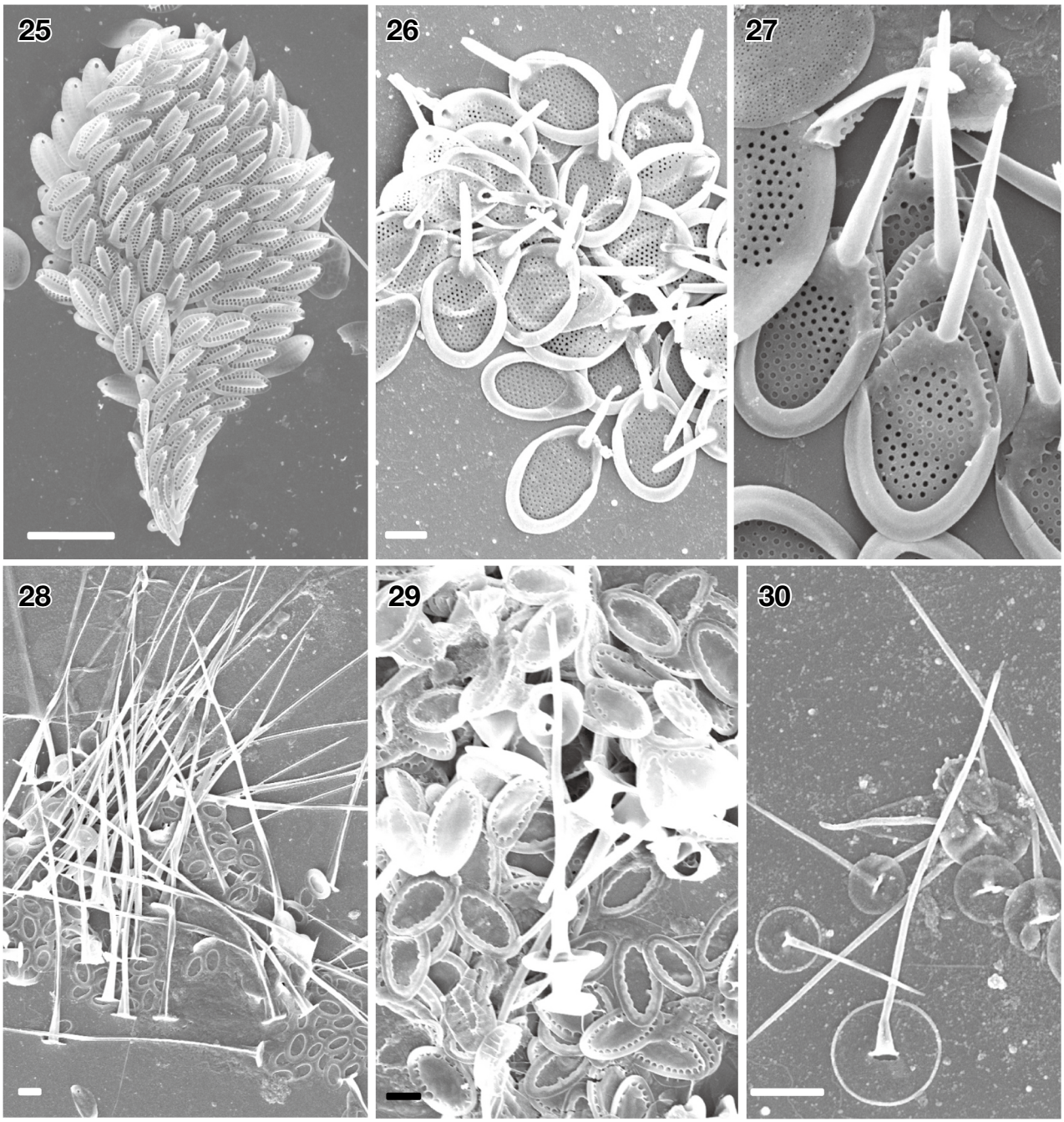


Figs. 16–20. *Mallomonas dimorphus* sp. nov., 16. Apical scales with short papilla (arrow head) and longitudinal rib (arrow), 17. Body scales showing flat dome marked with irregularly ribs such as labyrinth, perforated base plate and small papillae (arrow) on the anterior submarginal rib, 18. Body scales showing hooded V-shaped rib, large meshes or pores and strutted posterior flange, 19, 20. Showing the small scales (arrows) with circular ribs and short, smooth needle like bristles. Scale bars = 1 μm.



Figs. 21–24. *Mallomonas alpestris* sp. nov., 21. Whole cell with two needle shaped bristles, 22. Collar apical scales, 23. Body scales and rear scales with short stout spine, 24. Showing the shield with 9–10 transverse ribs and papillae of 3–4 rows and anterior flange with a row of papillae (arrow). Scale bars = 21 (5 μm), 22–24 (1 μm).

and below them (Fig. 21). (i) 5–6 collar scales are asymmetric, small triangular shaped with a narrow dome bearing a distal pointed peak and a broadly rounded proximal end, and are covered with a more or less weakly developed reticulum of circular meshes. The submarginal ribs are ornamented with small papillae (Fig. 22). (ii) Body scales are rhomboid, without a dome. The shield is marked with 6–10 remarkably stout transverse ribs and papillae of 2–4 longitudinal rows. The ribs get shorter from the middle towards the anterior and posterior ends of the shields. The arms of the V-rib are fused with anterior submarginal ribs forming continuous submarginal ribs with 3–5 rows of small papillae. The rows of papillae are reduced from the middle towards the anterior and posterior ends of the



Figs. 25–30. Silica-scaled chrysophytes from Mt. Sinbul wetland. 25. Scales of *Synura petersenii*, 26. Scales of *S. sphagnicola*, 27. Scales of *S. spinosa*, 28. Plate and spine scales of *Chromophysomonas trioralis*, 29. Plate and spine-scales of *Chrysosphaerella brevispina*, 30. Several scales with short and long spine of *Paraphysomonas vestita*, Scale bars = 1 μm.

shields. The anterior flange has one row of papillae (Fig. 24, arrow). (iii) Domeless rear scales are in a small rhomboid shape, with a short stout conical spine. The structures of the shield and flanges are similar to those of body scales. The base plate of body and rear scales are perforated. Associated only with apical collar scales, bristles are short (3.8–4.5 μm long), approximately one-half or less of the cell length, slightly curved, smooth and slightly acutely tapered (Figs. 21, 22).

Dimension. Cells 4.5–5 × 9.5–11 μm, Apical scales 1.8–1.9 × 3–3.2 μm, Body scales 1.8–1.9 × 2.5–2.7 μm, Rear scales 1.4–1.5 × 1.6–1.7 μm, Bristles 3.8–4.5 μm long.

Type locality. Mt. Sinbul wetland, Sangbuk-myeon, Ulju County, Ulsan Megacity, South Korea (129°00.03′E,

35°25.32′N, sea level 745 m, pH 5.5−6.2, water temperature 0−9.1°C, EC 15.2−44.8 μS cm^{-1}).
Holotype. Fig. 21 (iconotypus) from materials collected on March 27, 2020 and deposited at the Herbarium of Kyungpook National University (KNU), Daegu (KNUSBW2020 0327).
Isotype. Collection of specimens on SEM stub deposited at the Herbarium of KNU, Daegu, Korea, KNUSB200314.
Etymology. The specific epithet "*alpestris*" refers to its occurrence in the subalpine region.

***Synura petersenii* Korshikov (Fig. 25)**

This species, one of the most common ones of *Synura*, has a cosmopolitan distribution (Kristiansen and Preisig, 2007). Numerous cells are observed frequently in cold season.

***Synura sphagnicola* (Korshikov) Korshikov (Fig. 26)**

This species is a widely distributed taxon across the world (Kristiansen and Preisig, 2007). Several scales were found.

***Synura spinosa* Korshikov (Fig. 27)**

This species is a widely distributed taxon across the world (Kristiansen and Preisig, 2007). Several scales were found.

***Chromophysomonas trioralis* (E. Takahashi) Preisig & D.J. Hibberd (Fig. 28) (Syn.: *Spiniferomonas trioralis* E. Takahashi)**

This species is a widely distributed taxon across the world (Kristiansen and Preisig, 2007). Several scales were found.

***Chrysosphaerella brevispina* Korshikov (Fig. 29)**

This species is a widely distributed taxon across the world (Kristiansen and Preisig, 2007). Several scales were found.

***Paraphysomonas vestita* (A. Stokes) De Saedeleer (Fig. 30)**

This species is a widely distributed taxon across the world (Kristiansen and Preisig, 2007). The cell, scale and spine dimension of this species are known to be variable. Several small and large scales bearing short and long spine were found.

Discussion

Twenty taxa of silica-scaled chrysophytes were observed by SEM from the Mt. Sinbul alpine wetland. Of these, two new species, *Mallomonas dimorphus* sp. nov., *M. alpestris* sp. nov., and four newly recorded species of *Mallomonas* from Korea were identified. Most of silica-scaled chrysophytes from the Sinbul mountainous wetland were cosmopolitan or widely distributed species except *M. portaeferreae* var. *reticulata*, which is only reported from north and South America.

Mallomonas dimorphus sp. nov. belongs to the Sectio *Heterospinae* in that its scales have a flat dome, a reticulated secondary layer, and needle shaped bristles. However, this species is distinguished from other taxa in the Sectio that it has needle shaped bristles and two different patterns of shield ornamentation and a dome ornamentation. It is characterized by the shield ornamentation of labyrinth-like ribs in the distal area of the scale, large reticulate pores and struts in the posterior area of the scale and a strongly hooded cross rib such as V-rib which is not observed in any other taxa of Sectio *Heterospinae* (Table 2). As for the posterior half shield ornamentation, *Mallomonas dimorphus* sp. nov. has similar feature to *M. heterospina*, *M. harrisiae*, *M. hindonii* and *M. pugio*. Also, the apical scales of *M. harrisiae*, *M. hindonii*, and *M. pugio* are similar in shape to

Table 2. Summary of major characteristics in *Mallomonas* taxa of Sectio *Heterospinae*.

	Ponted apical scale	Dome ornamentation	Body scale reticulum	Posterior flange	Bristle
M. hamata	−	Smooth	−		Needle and hooked
M. americana	−	Smooth	Open		Needle and hooked
M. canina	−	Smooth	Open		Needle and hooked
M. heterospina	−	Smooth or a few ribs	Dense		Needle and hooked
M. harrisiae	+	Ribs	Dense	Struts	Simple needle
M. pugio	+	Ribs	Dense		Needle with tooth
M. hindonii	+	Smooth	Open	Struts	Needle with tooth
M. multiunca	−	Ribs	Dense	Struts	Hooked with apical spine
M. dimorphus sp. nov.	+	Ribs	Dense	Struts	Simple needle

Table 3. Summary of major characteristics in *Mallomonas* taxa of Sectio *Torquatae*.

	Shield structure (body and rear scale)	Collar scale structure	Anterior submarginal rib	Anterior flange	Caudal spine
M. ocalensis	Alternating ribs of thick and thin (up to 19)	Reticulated ribs	Continuous with V-rib, papillae	Struts	Short
M. amazonica	6−7 robust ribs, one bifurcate, window with 4−6 pores at proximal	Similar to those of body scale	Continuous with robust V-rib, papillae	Smooth	Very short
M. doignonii	Narrow, straight, extending into struts, curved or forked ribs (about 15)	Transverse ribs	Continuous with V-rib, papillae	Struts, a low of pore	Long
M. fuegiana	Interrupted ribs by grooves	Straight or curved, regularly spaced ribs	Stout raised	Struts	Short
M. torquata	Transverse ribs and meshwork in the center	Reticulum	Continuous with V-rib, papillae	Struts	Long
M. dickii	12−22 fine transverse ribs, occasionally branched	Tansverse ribs, Ladder-like ribs along ventral	2−3 rows of papilla	Struts and pores	Short

this taxon. Nevertheless, these taxa do not have a rib ornamentation which resembles a labyrinth on the distal area of the scale. Although the shield ornamentation of this species is similar to that of *M. heterospina*, *Mallomonas dimorphus* sp. nov. differentiates itself by having a strongly hooded cross rib seen as a V-rib, labyrinth-like ribs in the distal area of the scale and large reticulate pores in the posterior area of the scale and without hooked bristles.

The Sectio *Torquatae* established by Momeu and Péterfi (1979) have collars of elongated domed scales, domeless body scales, and caudal scales with spine. Thereafter, Kristiansen and Preisig (2007) subdivided it into four Series, *Mangoferae*, *Eoae*, *Pumilae*, and *Torquatae*, according to with or without of papillae; whether the shield has circular or angular mesh; and whether pore or ribs exist. They included in the *Torquatae* Series the *Mallomonas* taxa with scales covered with ribs in regular or irregular patterns.

Mallomonas alpestris sp. nov. which have elongated domed collar scales, domeless body scales and rear scales with a short spine, belongs to Series *Torquatae*, Sectio *Torquatae*. However, *Mallomonas alpestris* sp. nov. is different from all other taxa in the Sectio *Torquatae* as well as Series *Torquatae* due to the body and rear scales with a shield ornamented with evenly spaced transverse ribs and papillae. Also, body and rear scales of this species show a shield ornamented with 6−10 short, evenly spaced parallel transverse ribs and 1−4 rows of papillae, and anterior submarginal ribs with a row of papilla. The shield of collar scales is marked with a reticulum and papilla. These features of *Mallomonas alpestris* sp. nov. are clearly different from those of all other species in the Series *Torquatae*, although this species is similar to *M. ocalensis*, *M. amazonica*, *M. doignonii*, *M. fuegiana*, *M. torquata*, and *M. dickii* in that the shield with transverse ribs. In addition, *Mallomonas alpestris* sp. nov. does not have struts on the anterior flange, which is a common characteristic of Series *Torquatae*, but this species has a row of papilla on the anterior flange instead of struts. These features of *Mallomonas alpestris* sp. nov. do not appeared in any other taxa within Series *Torquatae* (Table 3). *Mallomonas alpestris* sp. nov. has three distinctive features from all the taxa within Series *Torquatae*. Firstly, it has 6−10 short evenly spaced ribs and 1−4 rows of papillae continued with anterior submarginal ribs on the shield of body scales and rear scales. Secondly, a row of papillae is observed in this species instead of strut, which are commonly shared among all taxa within Series *Torquatae* with parallel transverse ribs on the shield. The third feature of this species is the reticulum structure and papilla rows on the shield and anterior submarginal ribs of collar scale.

With these distinctive features, we propose that the present two specimens should be designated as a new species.

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