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Chrysophytes in the southern part of Hyogo Prefecture, Japan (II). *Mallomonas*

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Seasonal occurrence of forty-three taxa of *Mallomonas* found in three ponds and a reservoir, Doro-ike Pond, Hoshino-ike Pond, Sengari Reservoir and Yasuba-ike Pond, situated in the southern part of Hyogo Prefecture, Japan is described. LM and EM descriptions are given for eleven taxa. Incorporating previously published data, it is suggested that twenty-nine taxa are widely distributed in Japan, whereas four other taxa, *M. striata, M. portae-ferreae, M. flora* and *M. splendens* occur in restricted regions.

Key Index Words: Chrysophytes—electron microscopy—Hyogo Prefecture—Mallomonas—*pond—reservoir.*

Several studies have been made on *Mallomonas* (Mallomonadaceae, Synurophyceae) in Japanese freshwater ponds and lakes, and forty-three taxa have been recorded: Takahashi (1959, 1977, 1978) reported thirty-five species, two varieties and three forms from about one hundred ponds and lakes, and Ito (1988) reported three species new to Japan from Lake Biwa, Shiga Prefecture. *Mallomonas* taxa so far recorded in Japan form thirty-one percent of one hundred and thirty-seven taxa which have previously been reported in the world (Asmund and Kristiansen 1986, Croome and Tyler 1986, Dürrschmidt 1986, Nicholls 1987a, 1987b, 1988a, 1989, Siver 1988, Wujek and Bland 1988, Cronberg 1989, Vigna and Kristiansen 1989). It suggests that many species have been overlooked in many floristic works so far undertaken, probably because the electron microscope was not used, and organisms are easily broken by fixation. In a previous paper, the present author reported chrysophyte flora including forty-three taxa of the genus *Mallomonas*, eight of which were reported as new to Japan from three ponds and a reservoir situated in the southern part of Hyogo Prefecture (Ito 1990). In this paper, seasonal occurrence of these taxa is given and eleven taxa which have not previously been described in Japan are described by transmission and scanning electron microscopy.

Materials and Methods

A detailed description of Doro-ike Pond, Hoshino-ike Pond, Sengari Reservoir and Yasuba-ike Pond, and procedures of sample collection, preparation and examination were given in a previous paper (Ito 1990).

Results and Discussion

Forty-three taxa of the genus *Mallomonas* found in Doro-ike Pond, Hoshino-ike Pond, Sengari Reservoir and Yasuba-ike Pond are listed below, as well as their previous records in Japan. Seasonal occurrence is shown in Table 1.

Sectio *Mallomonopsis* (Matvienko) Asmund et Kristiansen 1986

Series *Matvienkoanae* Asmund et Kristiansen 1986

Mallomonas matvienkoae (Matvienko) Asmund et Kristiansen 1986 in Opera Botanica 85: 1-128.

Basionym: *Mallomonopsis elliptica* Mat-

Table 1. Seasonal occurrence (Sp=March–May; Su=June–August; Au=September–November; Wi=December–February) of *Mallomonas* taxa collected from Doro-ike Pond, Hoshino-ike Pond, Sengari Reservoir and Yasuba-ike Pond in the southern part of Hyogo Prefecture, Japan.

Taxa	Doro-ike P.				Hoshino-ike P.				Sengari Res.				Yasuba-ike P.			
	Sp	Su	Au	Wi	Sp	Su	Au	Wi	Sp	Su	Au	Wi	Sp	Su	Au	Wi
**M. akrokomos*	●	●	●	●	●	○	○	●	●	●	●	●	●	○	●	●
**M. tonsurata*	○	●	●	●	●	○	●	●	●	○	●	○	●	●	●	○
**M. crassisquama*	●	●	●	●	●	○	○	●	○	○		○	○		○	○
**M. mangofera* f. *mangofera*	●	●	●	●	○	○	○	○	○	○		○	○	○	○	●
**M. punctifera*	●	○	●	●	●	○	●	●	○				○		●	○
**M. papillosa* var. *ellipsoidea*	○	○	●	○	○	○	○	○				○	○		○	○
**M. harrisiae*	●	○	●	●	●	○	○	●	○						○	○
M. striata	○	○	○	○	○	●	○	●	○				○			○
**M. parvula*	○	○	○	○	○				○			○	○		○	○
**M. pumilio*	●		●	●	○				○				○	●		●
M. splendens	○	●	○	○		○			●							○
**M. elongata*					○	○	○	●	○	○		○	●	○	○	●
**M. heterospina*					●	○	○	●	●			○	○		○	○
**M. matvienkoae*	○	○	○	○	○		○	○					○	○		○
M. sp. No. 2	○	●	●	○		○								○		
**M. lelymene*	●	●	○	●	○											
**M. multisetigera*	○	○	○	○	○											
**M. eoa*	●	○	○	●					○			○				
**M. recticostata*									○						○	
△M. pillura f. *valdiviana*				●									○		○	○
**M. areolata*									●	○		●	●		○	●
**M. annulata*									●		○	○	○			○
M. sp. No. 1									○	○		○	●	○	●	●
**M. mangofera* f. *foveata*	○		○												○	
**M. ouradion*	●	○	○	○												
**M. cristata*	○	●	○	○												
△M. ocellata	○	○	○	○												
**M. caudata*									●	○	●	●				
**M. alpina*									●		○					
**M. conspersa*									○			○				
**M. grata*										●		○				
△M. rasilis										○		○				
△M. calceolus									○							
M. flora									○							
△M. bangladeshica										○						
△M. retifera										○						
**M. paxillata*											○					
M. portae-ferreae											○					
△M. insignis													●	○	●	●
**M. alata*													○		○	○
△M. mangofera var. *sulcata*													○			
**M. peronoides*															○	
**M. guttata*															○	

●: Cells collected; ○ Scales collected.
△: Taxa reported as new to Japan in a previous paper (Ito 1990).
*: Tax widely distributed in Japan.

vienko 1941 in Trudy. Inst. Bot. Kharkov 4: 41-47.

Distribution: Hokkaido, Yamagata Pref., Fukushima Pref., Hyogo Pref., Shimane Pref., Ehime Pref. (Takahashi 1978).

Series *Ouradiotae* Asmund et Kristiansen 1986

Mallomonas parvula Dürrschmidt 1982 in Can. J. Bot. 60: 651-656.

Distribution: Yamagata Pref. (Takahashi 1978), Shiga Pref. (Ito 1988).

Mallomonas ouradion Harris et Bradley 1958 in J. gen. Microbiol. 18: 71-83.

Basionym: *Mallomonopsis ouradion* (Harris et Bradley) Harris 1966 in J. gen. Microbiol. 42: 175-184.

Distribution: Hokkaido (Takahashi 1978)

Series *Peronoides* Asmund et Kristiansen 1986

Mallomonas peronoides (Harris) Momeu et Péterfi 1979 in Contr. Bot. Cluji-Napoca 1979: 13-20.

Basionym: *Mallomonopsis peroneides* Harris 1966 in J. gen. Microbiol. 42: 175-184.

Distribution: Yamagata Pref. (Takahashi 1978).

Mallomonas bangladeshica (Takahashi et Hayakawa) Wujek et Timpano 1984 in Trans. Kansas Acad. Sci. 87: 73-82.

Basionym: *Mallomonopsis peroneides* Harris var. *bangladeshica* Takahashi et Hayakawa 1979 in Phykos 18: 129-147.

Cells oblong ellipsoidal, covered with smooth bristles and three kinds of scales: 1) apical scales with a thorn-like projection at distal end, 2) oval body scales, 3) obovate rear scales. Body scales with many papillae and a subcircular ornament which has 9-13 lobes along its edge and 1-3 pores on its surface at distal part (Figs. 1 & 2).

Sectio *Multisetigerae* Asmund et Kristiansen 1986

Mallomonas multisetigera Dürrschmidt 1982 in Arch. Hydrobiol. Suppl. 63/Algol. Stud. 31: 121-163.

Distribution: Yamagata Pref. (Takahashi 1978).

Sectio *Papillosae* Asmund et Kristiansen 1986

Mallomonas calceolus Bradley 1964 in J. gen. Microbiol. 37: 321-333.

Cells ovoid, covered with smooth bristles and scales. Scales oval or suboval with widely spaced, scattered papillae on the shield (Fig. 3).

Mallomonas conspersa Dürrschmidt in Kristiansen and Andersen 1986, Crysophytes, aspects and problems.

Distribution: Yamagata Pref. (Takahashi 1959).

Mallomonas paxillata (Bradley) Péterfi et Momeu 1976 in Nova Hedwigia 27: 353-392.

Basionym: *Mallomonopsis paxillata* Bradley 1966 in J. Protozool. 13: 143-154.

Distribution: Yamagata Pref., Tokushima Pref. (Takahashi 1978).

Mallomonas papillosa Harris et Bradley 1957 in J. Roy. Microscop. Soc. Ser. 3, 76: 37-46, var. *ellipsoidea* Harris 1967 in J. gen. Microbiol. 46: 185-191.

Distribution: Hokkaido, Yamagata Pref., Fukushima Pref., Hyogo Pref., Tokushima Pref., Ehime Pref. (Takahashi 1978).

Mallomonas rasilis Dürrschmidt 1983 in Nord. J. Bot. 3: 423-430.

Cells ellipsoidal, covered with serrated bristles and two kinds of scales, small apical scales and body scales. Scales suboval with many papillae on the shield and proximal border having internal radial struts (Figs. 4 & 5).

Mallomonas guttata Wujek 1984 in Brenesia 22: 309-313.

Distribution: Yamagata Pref. (Takahashi 1978).

Sectio *Planae* Momeu et Péterfi 1979

Series *Fastigatae* Momeu et Péterfi 1979

Mallomonas caudata Ivanov 1899 in Bull. Acad. Imp. Sci. St.-Petersbourg 11: 247-262, emend. Krieger 1930 in Bot. Arch. 29: 258-329.

Synonym: *Mallomonas fastigata* Zacharias 1903 in Forschubgsber. Biol. Stat. Plön 10: 223-289.

Distribution: Hokkaido (Hada 1959), Yamagata Pref., Fukushima Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Hyogo Pref. (Takahashi 1978), Shimane Pref. (Akiyama 1964, Takahashi 1978), Tokushi-

ma Pref. (Takahashi 1978).

Sectio *Insignes* Asmund et Kristiansen 1986

Mallomonas insignis Penard 1919 in Bull. Soc. Bot. Genève 2e. sér. 11: 122-128.

Cells obovoid to elongate-ellipsoidal, 30-96 × 14-25 μm, bluntly pointed anteriorly and tapering to a tail of varying length, with three kinds of scales: 1) apical scales with a stout hollow spine terminating in a bi- or trifurcate tip, 2) oval body scales without spines, 3) tail scales with a slender hollow spine terminating in a bifurcate tip. The shield of three kinds of scales is marked with internal honecomb pattern of ribs and with papillae on the outer layer (Figs. 6-9).

Sectio *Punctiferae* Asmund et Kristiansen 1986

Series *Punctiferae* Momeu et Péterfi 1979

Mallomonas punctifera Korshikov 1941 in Trudy Inst. Bot. Kharkov 4: 50-76.

Synonym: *Mallomonas reginae* Teiling 1946 in Bot. Notiser 1946: 61-88.

Distribution: Yamagata Pref., Fukushima Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Shimane Pref., Tokushima Pref. (Takahashi 1978).

Sectio *Heterospinae* Momeu et Péterfi 1979

Series *Heterospinae* Asmund et Kristiansen 1986

Mallomonas heterospina Lund 1942 in New Phytol. 41: 274-292.

Distribution: Yamagata Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Ehime Pref. (Takahashi 1978).

Mallomonas harrisiae Takahashi 1975 in Phycologia 14: 41-44.

Distribution: Yamagata Pref., Hyogo Pref., Ehime Pref. (Takahashi 1978).

Sectio *Akrokomae* Asmund et Kristiansen 1986

Mallomonas akrokomos Ruttner in Pascher 1913, Die Süβwasserflora Deutschlands, Österreichs und der Schweiz 2, p. 7-95.

Distribution: Yamagata Pref., Fukushima Pref., Gifu Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Okayama Pref., Tokushima Pref. (Takahashi 1978).

Sectio *Striatae* Asmund et Kristiansen 1986

Series *Striatae* Momeu et Péterfi 1979

Mallomonas striata Asmund 1959 in Dansk Bot. Ark. 18: 1-50.

Distribution: Shiga Pref. (Ito 1988).

Mallomonas retifera Dürrschmidt 1982 in Can. J. Bot. 60: 651-656.

Cells ovoid or ellipsoidal, covered with slender bristles and two kinds of scales, small apical scales with a wing-like structure and larger body scales. Scales suboval with papillae on the dome and the anterior flanges and reticulation on the shield (Figs. 10 & 11).

Mallomonas flora Harris et Bradley 1960 in J. gen. Microbiol. 22: 750-777.

Distribution: Gifu Pref. (Takahashi 1978).

Series *Actinolomae* Asmund et Kristiansen 1986

Mallomonas cristata Dürrschmidt 1981 in Phycologia 20: 298-302.

Distribution: Yamagata Pref. (Takahashi 1959).

Sectio *Mallomonas*

Series *Alpinae* Asmund et Kristiansen 1986

Mallomonas alpina Pascher et Ruttner in Pascher 1913, Die Süβwasserflora Deutschlands, Österreichs und der Schweiz 2, p. 7-95, emend. Asmund et Kristiansen 1986 in Opera Botanica 85: 1-128.

Synonym: *Mallomonas monograptus* Harris et Bradley 1960 in J. gen. Microbiol. 22: 750-777.

Distribution: Hokkaido, Fukushima Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Osaka Pref., Shimane Pref., Tokushima Pref., Ehime Pref. (Takahashi 1978).

Mallomonas areolata Nygaard 1949 in Kgl. Dan. Vid. Selsk. Biol. Skr. 7: 1-293.

Distribution: Yamagata Pref., Osaka Pref., Shimane Pref., Tokushima Pref., Ehime Pref. (Takahashi 1978).

Mallomonas elongata Reverdin 1919 in Arch. Sci. phys. nat. 1: 5-95.

Distribution: Yamagata Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Osaka Pref., Okayama Pref., Shimane Pref., Ehime Pref. (Takahashi 1978).

Series *Tonsuratae* Asmund et Kristiansen 1986

Mallomonas tonsurata Teiling 1912 in Svensk Bot. Tidskr. 4: 266-281, emend. Krieger 1930 in Bot. Arch. 29: 258-329.

Distribution: Hokkaido, Yamagata Pref.,

Fukushima Pref., Gifu Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Osaka Pref., Hyogo Pref., Okayama Pref., Shimane Pref., Tokushima Pref., Kumamoto Pref., Kagoshima Pref. (Takahashi 1978).

Series *Portaferreanae* Asmund et Kristiansen 1986

Mallomonas portae-ferreae Péterfi et Asmund 1972 in Stud. Univ. Babes-Bolyai Ser. Biol. 1: 11-18.

Distribution: Shiga Pref. (Ito 1988).

Series *Mallomonas*

Mallomonas crassisquama (Asmund) Fott 1962 in Preslia 34: 69-84.

Basionym: *Mallomonas acaroides* Perty 1851 emend. Ivanov 1899 var. *crassisquama* Asmund 1959 in Dansk Bot. Ark. 18: 1-50.

Distribution: Hokkaido, Yamagata Pref., Fukushima Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Hyogo Pref., Shimane Pref., Tokushima Pref., Ehime Pref. (Takahashi 1978).

Sectio *Pseudocoronatae* Asmund et Kristiansen 1986

Series *Lelymenae* Asmund et Kristiansen 1986

Mallomonas lelymene Harris et Bradley 1960 in J. gen. Microbiol. 22: 750-777.

Distribution: Fukushima Pref., Osaka Pref., Hyogo Pref. (Takahashi 1978).

Sectio *Annulatae* Asmund et Kristiansen 1986

Mallomonas pillura Harris 1967 in J. gen. Microbiol. 46: 185-191, f. *valdiviana* Dürrschmidt 1982 in Arch. Hydrobiol. Suppl. 63/Algol. Stud. 31: 121-163.

Cells spherical, $\pm 10\,\mu m$, covered with curved and delicate bristles and three kinds of scales: 1) apical scales with dome, 2) body scales with dome, 3) body scales without dome. The shield of three kinds of scales is marked with a reticulum of irregularly shaped meshes each enclosing a single pore or a group of few pores on the base plate (Figs. 12 & 13).

Mallomonas annulata (Bradley) Harris 1967 in J. gen. Microbiol. 46: 185-191.

Basionym: *Mallomonas papillosa* Harris et Bradley 1957 var. *annulata* Bradley 1966 in J. Protozool. 13: 143-154.

Distribution: Yamagata Pref. (Takahashi 1978), Shiga Pref. (Ito 1988), Ehime Pref. (Takahashi 1978).

Sectio *Torquatae* Momeu et Péterfi 1979

Series *Pumilae* Momeu et Péterfi 1979

Mallomonas pumilio Harris et Bradley 1957 in J. Roy. Microscop. Soc. Ser. 3, 76: 37-46, emend. Asmund, Cronberg et Dürrschmidt 1982 in Nord. J. Bot. 2: 383-395.

Distribution: Yamagata Pref., Shiga Pref., Ehime Pref. (Takahashi 1978).

Mallomonas alata Asmund, Cronberg et Dürrschmidt 1982 in Nord. J. Bot. 2: 383-395.

Distribution: Yamagata Pref. (Takahashi 1978).

Series *Eoae* Asmund et Kristiansen 1986

Mallomonas eoa Takahashi 1963 in Bull. Yamagata Univ., Agr. Sci. 4: 169-187.

Distribution: Yamagata Pref., Osaka Pref. (Takahashi 1978).

Mallomonas ocellata Dürrschmidt et Croome 1985 in Nord. J. Bot. 5: 285-298.

Cells ovoid or ellipsoidal covered with smooth bristles and three kinds of scales: 1) collar scales with dome, 2) rhombic body scales, 3) small rear scales. The shield of three kinds of scales is marked with more or less rounded pits. At the bottom of each pit the base plate is visible, centrally with a somewhat thickened area (Fig. 14).

Series *Mangoferae* Asmund et Kristiansen 1986

Mallomonas mangofera Harris et Bradley 1960 in J. gen. Microbiol. 22: 750-777, f. *mangofera*

Distribution: Yamagata Pref., Hyogo Pref., Shimane Pref., Tokushima Pref. (Takahashi 1978).

Mallomonas mangofera f. *foveata* Dürrschmidt 1983 in Pl. Syst. Evol. 143: 175-196.

Distribution: Yamagata Pref. (Takahashi 1978).

Mallomonas mangofera var. *sulcata* Dürrschmidt 1983 in Pl. Syst. Evol. 143: 175-196.

M. mangofera var. *sulcata* differs from *M. mangofera* var. *mangofera* in having grooves

running along the submarginal rib on the shield of scales (Fig. 15).

Mallomonas grata Takahashi 1963 in Bull. Yamagata Univ., Agri. Sci. 4: 169-187.

Distribution: Yamagata Pref. (Takahashi 1978).

Series *Doignonianae* Asmund et Kristiansen 1986

Mallomonas recticostata Takahashi 1972 in Bot. Mag. Tokyo 85: 293-302.

Distribution: Yamagata Pref., Shimane Pref. (Takahashi 1978).

Appendix

Mallomonas splendens (G. S. West) Playfair 1921 in Proc. Linn. Soc. N. S. Wales 46: 99-146, emend. Croome, Dürrschmidt et Tyler 1984 in Nova Hedwigia 41: 463-470.

Synonym: *Lagerheimia splendens* G. S. West 1909 in J. Linn. Soc. Bot. 39: 1-88.

Cells cylindrical, 25-28 × 8.5-11 μm, with four smooth spines at both ends and three kinds of scales: 1) oblong apical scales with dome, 2) rhomboidal body scales, 3) broadly ovate posterior scales with dome. Three kinds of scales with an outer minute papillose layer and an internal reticulum (Figs. 16 & 17).

Distribution: Shimane Pref. (Akiyama 1964).

Unidentified species

Mallomonas sp. No. 1

This species resembles *M. acaroides* Perty emend. Ivanov, but differs from it in having a wing-like structure of the anterior flange of scales (Fig. 18).

Mallomonas sp. No. 2

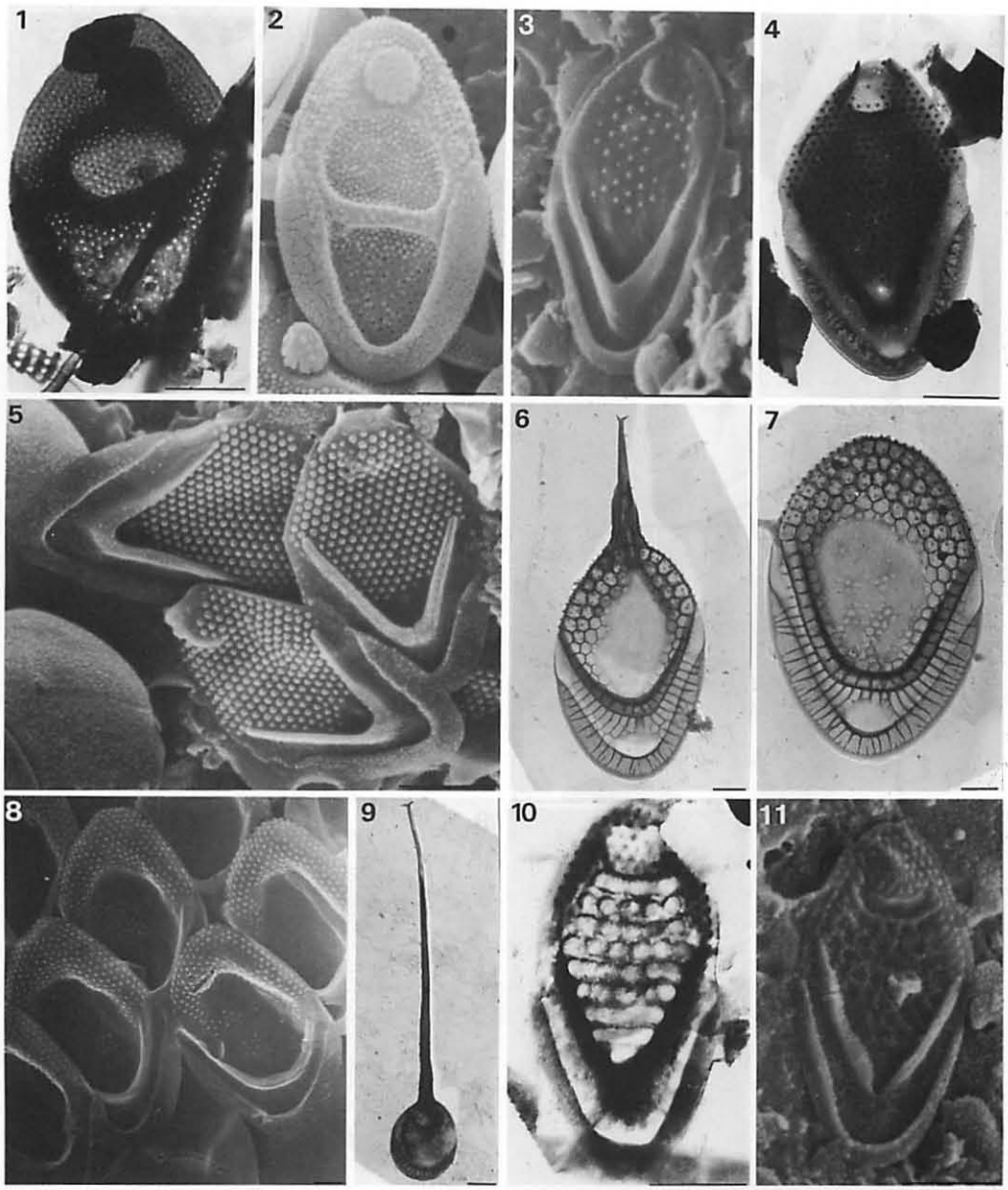
This species resembles *M. mangofera* f. *gracilis* Dürrschmidt, but differs from it in having circular or elongate pores on the shield of scales (Fig. 19).

Taking previously published data on the occurrence of *Mallomonas* taxa into account, twenty taxa recorded here are regarded as widely distributed in Japan (Takahashi 1978, Ito 1988). Studies have covered most districts of Japan, from Lake Ikeda in Kagoshima Prefecture to Lake Abashiri in Hokkaido. These taxa are indicated by asterisks in Table 1. Of these, *M. tonsurata, M. akrokomos* and *M. crassisquama* have been found in more than twenty ponds and lakes mainly in the Tohoku, Kinki, Chugoku and Shikoku districts. Water temperature and pH range during the occurrence of these three taxa have been reported: 0-31°C and 5.47-9.0 for *M. tonsurata*, 0.3-24°C and 3.8-8.5 for *M. akrokomos* and 0.3-27°C and 5.2-9.0 for *M. crassisquama* (Gutowski 1989, Hartmann and Steinberg 1989). *M. tonsurata* and *M. crassisquama* are classified as eurythermal and indifferent to pH (Takahashi 1978, Roijackers 1986). *M. akrokomos* is classified as eurythermal and acidophilious, although it also occurs in many alkaline lakes (Takahashi 1978, Hartmann and Steinberg 1989). It should be noted that these three taxa were collected in all sites as well as in almost all the sampling time (Table 1). The present author therefore agrees that these taxa are eurythermal, and this may be a major reason of their wide distribution.

M. peronoides, M. multisetigera, M. conspersa, M. guttata, M. cristata, M. alata, M. mangofera, f. *foveata* and *M. grata* have previously been found in one to three localities in Yamagata Prefecture and *M. ouradion* in one locality in Hokkaido (Takahashi 1978). These nine taxa (marked also by asterisks in Table 1) may be widely distributed in Japan because they also occur in Hyogo Prefecture (this study) and they have been collected from various types of ponds and lakes in other countries (Asmund and Kristiansen 1986, Dürrschmidt 1986, Hallförs and Hallförs 1988, Nicholls 1988b, Cronberg 1989).

Some species seem to show relatively narrow distribution and they occur in restricted regions: *M. striata* and *M. portae-ferreae* are distributed only in the Kinki districts, *M. flora* in the Chubu and Kinki districts, and *M. splendens* is distributed in the Kinki and Chugoku districts (Akiyama 1964, Takahashi 1978, Ito 1988, this paper).

Eight *Mallomonas* taxa recorded for the first time in Japan (Ito 1990) were found in one or two sites, and only scales were collected for six taxa except *M. insignis* and *M. pillura* f. *val-*

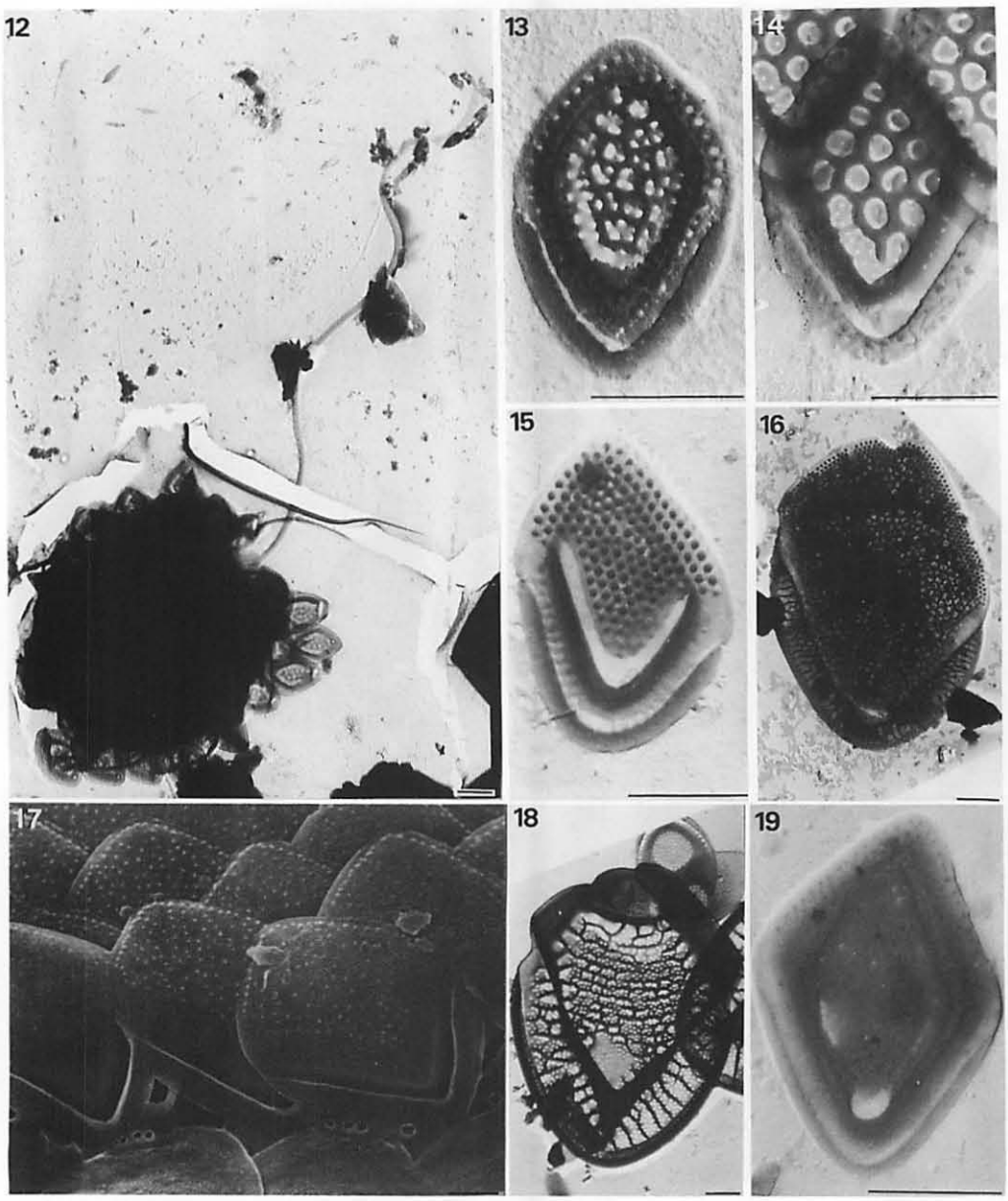


Figs. 1 & 2. *M. bangladeshica*; Fig. 1. a body scale (Transmission electron microscopy: TEM), Fig. 2. a body scale (Scanning electron microscopy: SEM). Fig. 3. *M. calceolus*, a scale (SEM). Figs. 4 & 5. *M. rasilis*; Fig. 4. a body scale (TEM), Fig. 5. body scales (SEM). Figs. 6–9. *M. insignis*; Fig. 6. an apical scale (TEM), Fig. 7. a body scale (TEM), Fig. 8. body scales (SEM), Fig. 9. a tail scale (TEM). Figs. 10 & 11. *M. retifera*; Fig. 10. a body scale (TEM), Fig. 11. a body scale (SEM). Scale bar=1 μm.

diviana (Table 1). The following six taxa have previously been reported from more than two continents as described below, and so they can be regarded as cosmopolitic species.

M. bangladeshica: North America, South America, Asia, Africa (Asmund and Kristiansen 1986, Cronberg 1989).

M. calceolus: Europe, North America, South America, Australia (Asmund and



Figs. 12 & 13. *M. pillura* f. *valdiviana*; Fig. 12. a whole mount cell (TEM), Fig. 13. a domeless body scale (TEM). Fig. 14. *M. ocellata*, a body scale (TEM). Fig. 15. *M. mangofera* var. *sulcata*, a body scale (TEM). Figs. 16 & 17. *M. splendens*; Fig. 16. a body scale (TEM), Fig. 17. body scales (SEM). Fig. 18. *Mallomonas* sp. No. 1, a scale (TEM). Fig. 19. *Mallomonas* sp. No. 2, a scale (TEM). Scale bar=1 μm.

Kristiansen 1986, Hallförs and Hallförs 1988, Cronberg 1989, Hartmann and Steinberg 1989).

M. rasilis: Europe, North America, South America, Asia, Australia, Africa (Asmund and Kristiansen 1986, Cronberg 1989, Hartmann and Steinberg 1989).

M. insignis: Europe, North America, Asia, Australia (Asmund and Kristiansen 1986, Croome and Tyler 1988, Kristiansen 1989).

M. retifera: Europe, South America (Asmund and Kristiansen 1986, Hartmann and

Steinberg 1989).

M. pillura f. *valdiviana*: Europe, North America, South America (Asmund and Kristiansen 1986, Hartmann and Steinberg 1989).

M. calceolus and *M. insignis* are eurythermal because they have been collected from subarctic, temperate and tropical regions. They could be widely distributed in Japan and further investigations treating many more ponds and lakes may confirm their common occurrence. *M. bangladeshica* has mostly been reported from the tropics with an exception of its occurrence in Kansas, U.S.A. (Wujek and Timpano 1984), suggesting that the species prefers warm water. In this study a few scales were collected only in August in Sengari Reservoir. *M. bangladeshica* may be found only in summer in Japanese ponds and lakes. The present author suggests that *M. ocellata* and *M. mangofera* var. *sulcata* are rare species. *M. ocellata* was described from a shallow pond in Malaysia (Dürrschmidt and Croome 1985) and *M. mangofera* var. *sulcata* was described from a meadow pond in Chile (Dürrschmidt 1983). They had not been collected ever since they were first described until the present author found them in Doro-ike Pond and Yasuba-ike Pond, respectively. The fact that only a single scale of *M. mangofera* var. *sulcata* and a few scales of *M. ocellata* were collected during the period of study may reflects their rare occurrence.

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伊藤裕之：兵庫県南部産黄金藻（II）．*Mallomonas* 属

兵庫県南部に位置する泥地，星野池，千苅貯水池，安場池から出現した43種類の *Mallomonas* 属について季節変化を調査した。また日本で以前に記載のなかった11種類について，電子顕微鏡を用いた記載を行った。本調査結果と従来の記録から，これらの種類の日本における分布を考察し，29種類は日本に広く分布するが，*M. striata, M. portae-ferreae, M. flora, M. splendens* の4種類は限られた地域に出現することを示唆した。（652 神戸市兵庫区楠谷町37–1　神戸市水道局水質試験所）