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Rediscovery and characterisation of *Frontonia fusca* (Quennerstedt, 1869) Kahl, 1931 (Ciliophora, Peniculia)*

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Abstract: *Frontonia fusca* (Quennerstedt, 1869) Kahl, 1931 was rediscovered from brackish water bodies with a salinity range of 4–25 ‰ on the Tyrrhenian and Ligurian coastlines (Mediterranean Sea) at Naples and in Tuscany, Italy. From the morphological point of view it is a typical member of this genus; it is about 100–170 μm long in vivo and has two contractile vacuoles with 6–9 collecting canals and 2–3 excretory pores, and two small micronuclei of the "endosomal" type. A very distinctive pigment spot on the right side of the anterior dorsal cortex is always presented. The dark-greenish pigment of the organelle has no autofluorescence and is located in small vacuoles 0.5–1.2 μm across and equally distributed during cell division between dividers within 45–60 min, again producing a spot in the same location of daughter cells. The ciliate is positive phototactic. *Frontonia fusca* has a strong food preference to diatoms and can easily survive in pure marine water, but not in non-saline one. Till now the species was found in Europe only. The general morphology and morphometry is redescribed according to observations of living and silver-impregnated cells. The population from the Tyrrhenian Sea is fixed as neotype. According to 18S rRNA molecular data, *Frontonia fusca* clusters with some other brackish water frontoniids, which clearly separate from the other representatives of the genus.

Key words: Brackish water, dark-green pigment, frontoniids, Italy, Mediterranean Sea, morphology, neotypification, phylogeny.

Introduction

The peniculines are one of the most common ciliates in many biotopes mainly due to representatives of two related genera – *Frontonia* and *Paramecium*. At present, the subclass Peniculia consists of two orders (Puytorac et al. 1987; Strüder-Kypke et al. 2000a, b; Lynn & Small 2002): (i) Urocentrida with the only family Urocentridae and (ii) Peniculida. The Peniculida include at least seven families, inter alia, the Frontoniidae and the Parameciidae, which are the most diverse and abundant ones. The taxon Frontoniidae consists of *Disematostoma*, *Wenrichia*, *Didieria*, *Paraclathrostoma*, and in particular *Frontonia* (Lynn & Small 2002). *Frontonia* is the largest genus of the group, comprising more than 40 species. However, only about 10 of them are quite common (Kahl 1931; Dragesco 1960, Dragesco & Dragesco-Kernéis 1986; Foissner & Wenzel 2004, Foissner et al. 1994, 2002) and the same number could be invalid species or some are synonyms. The genus is in urgent need of revision (Andreoli et al. 2007a; Long et al. 2008; Gao et al. 2008). One of the doubtful species is *Frontonia fusca* which was isolated in 2005 during my sampling in different Italian locations. In the present paper this quite rare peniculine is redescribed and neotypified. Phylogenetical analysis using 18S rRNA gene sequence of some representatives of the genus was done very recently (Andreoli et al. 2007a, b; Gao et al. 2008) showing that, for example, *Frontonia* is a non-monophyletic assemblage. According to these analyses, *F. fusca* is not a "classical" frontonid – for example, like *F. leucas* – but clusters with some other brackish water frontoniids, partly with new, undescribed species and is closely related rather with *Apofrontonia dohrni* (Fokin et al. 2006; Andreoli et al. 2007a).

Materials and methods

The neotype population of *F. fusca* was discovered in brackish water samples (10 ‰, 18 ‰ and 25 ‰ salinity) from coastline puddles in Naples, Tyrrhenian Sea, Italy. The samples also contained *Condylostoma* sp., *Prorodon* sp., *Acrospathidium* sp., small *Litonotus* spp. as well as *Paramecium duboscqui* in moderate and low abundance. The samples were collected during the spring-summer season in 2005 when the water temperature ranged from 15 to 25° C. Attempts to cultivate *F. fusca* in the laboratory were successful using the diatom *Phaeodactylum tricornutum* as food, but I did not get sufficient clonal material. Thus, all investigations were performed with non-clonal neotype populations from the laboratory.

* The article is dedicated to Prof. Wilhelm Foissner on the occasion of his 60th birthday.

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Later on *F. fusca* was found in a brackish water pond (salinity 4–14 ‰) close to the mouth of the river Serchio, Pisa district, Tuscany as well as in another site of the Ligurian Sea coastline near the village of Marina di Massa.

Live ciliates were observed for morphological details using differential interference contrast (DIC) microscopy with a Leitz (Germany) microscope at a magnification of 300–1250× with the help of a compression device (SKOVORODKIN 1990). Living cells were observed under UV-light with the fluorescent microscope Leica DMR (Germany) to check the nature of the pigmented spot. For examination of the swimming behaviour, ciliates were observed in a glass depression slide (3 ml) under a dissection microscope (Wild M3; Switzerland) at a magnification of 12.5–50×. Photoreactivity of *F. fusca* was checked in small Petri dishes, half decorated by a dark case and illuminated by natural light.

Ciliates were fixed with Champy's solution and then silver nitrate-stained after CORLISS (1953). Feulgen staining procedure after fixation in Bouin's fluid was used to reveal the nuclear apparatus.

Computer images, made from appropriate preparations at a magnification of 500–1250× with a digital camera (Canon S45) and automatically saved as JPG files, were used to measure living and fixed ciliates. Line drawings were based on micrographs of unsquashed living and impregnated cells.

Results

***Frontonia fusca* (QUENNERSTEDT, 1869) KAHL, 1931**

1841 *?Loxodes signatus* – DUJARDIN, Zoophytes, Atlas, Planche 11, Fig. 9.

1869 *Panophrys fusca* n. sp. – QUENNERSTEDT, Acta Univ. lund. **6**: 9–11, Fig. 4, 5 (original description).

1931 *Frontonia (Panophrys) fusca* (QUENNERSTEDT 1869) – KAHL, Tierwelt Dtl. **21**: 321, Fig. 55_5 (combination with *Frontonia* and revision).

Remarks: The improved diagnosis and the description as well as all illustrations are based solely on the neotype material.

Improved diagnosis: Body size on average about 135 × 65 µm in vivo. Body elongate obovoidal with rounded ends, flattened up to 2:1.5. On average 80 ciliary rows. Two contractile vacuoles each with 2–3 excretory pores and 7–8 collecting canals. Pigment spot of dark-greenish colored granules invariably present on right side of anterior dorsal side. Buccal cavity occupying about one fifth of body length. Oral ciliature composed of three peniculi (made of 4 + 4 + 3 rows), and three vestibular and four postoral kineties. Two very small micronuclei of "endosomal" type. Rotates preferably clockwise about main body axis. Inhabits brackish and marine habitats.

Type material: For details on neotypification, see discussion. One neotype slide of silver nitrate-impregnated specimens (slide no. 23), collected from coastline puddle in Naples, Italy, sample no. 10 (sampling date 14 March 2005; collector FOKIN), permanent Feulgen staining preparation (slide 12) and Epon-embedded material for electron microscopic investigation have been deposited in the collection of the Museo di Storia Naturale e del Territorio dell'Università di Pisa, Calci (PI), Italy. Two further neotype slides of silver nitrate-impregnated specimens (slides no. F18 and F19), from a temporary laboratory population established from the sample no. 10 have been deposited in the slide collection of the Laboratory of Invertebrate Zoology, Biological Research Institute, St. Petersburg State University, St. Petersburg, Russia.

Voucher: The total frozen DNA of the species prepared from cells of the neotype population is available at the Department of Biology of the Pisa University, Protistology and Zoology Unit. The SSrRNA gene sequence of *F. fusca* was performed and used in previous investigations (ANDREOLI et al. 2007a, b), but is still ongoing to be submitted into the GenBank/EMBL database.

Type locality: Due to the neotypification, the sampling site of the neotype population is the new (valid) type locality of *F. fusca*: temporary brackish water puddles (sometimes connected to the sea) from the coastline in Naples (Tyrrhenian Sea, Italy) in front of the Villa Comunale (Naples Zoological Station "Anton DOHRN"; 40°50'N, 14°17'W). Some further details, see materials and methods. For a brief description of the original type locality (QUENNERSTEDT 1869), see discussion.

Description of neotype population: Cell shape as in typical *Frontonia* species, that is, anterior and posterior ends almost equally rounded (Fig. 1, 2, 4, 5, 8, 11, 13, 14–18). Body flattened up to 2:1.5. Size about 100–170 × 50–80 µm in vivo, but sometimes smaller cells could be found; majority of silver-impregnated specimens nearly 10–12 % shorter (Tab. 1). Body length:width ratio close to 2:1 (Fig. 11, 14, 15, 18; Tab. 1). Somatic cilia about 7–8 µm long in vivo; some caudal cilia look like slightly elongated. 75–92 meridianal ciliary rows visible on impregnated cells: 35–45 on ventral side (Fig. 17, 18) and 35–47 on dorsal one (Fig. 12, 13). Some median dorsal ciliary rows terminate before anterior suture by merging each other. According to impregnation picture, majority of basal bodies are dikinetids (Fig. 12, 19, 20), but all somatic units bear only one cilium (Fig. 6, 8–10, 16). Four postoral and three vestibular kineties made of triplets after impregnation because composed of

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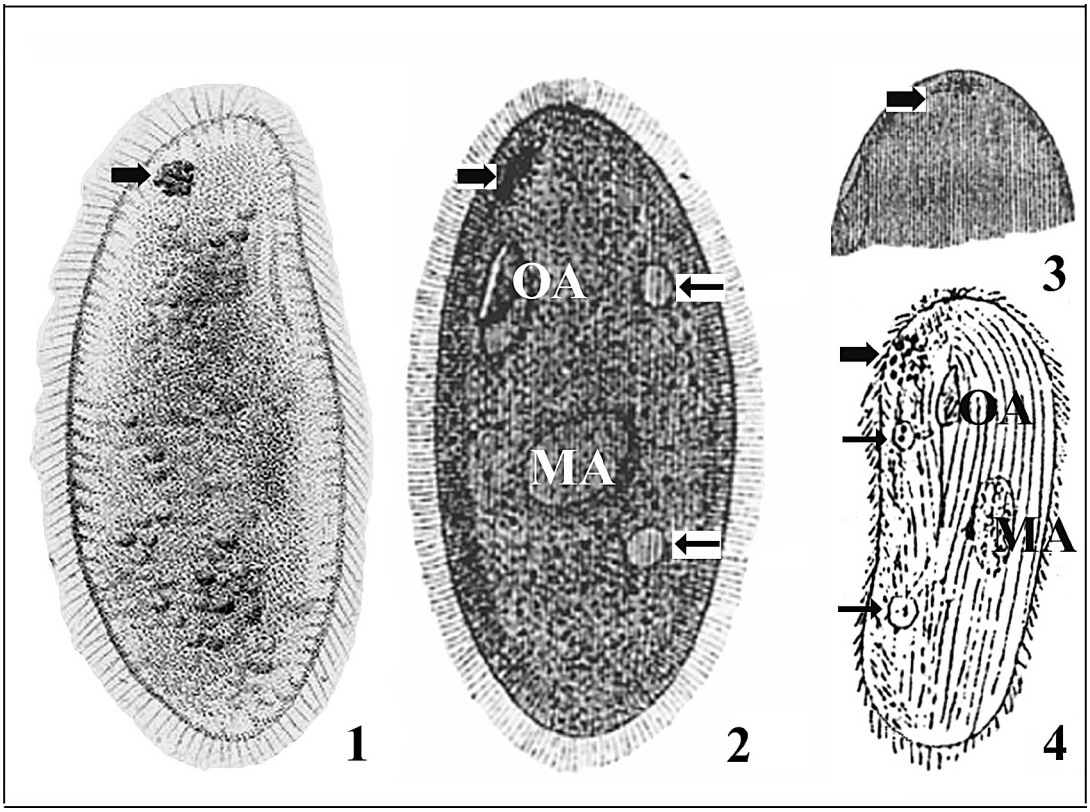

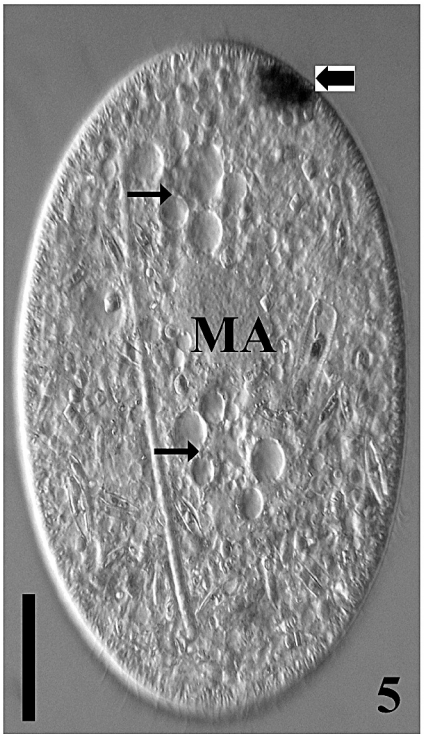

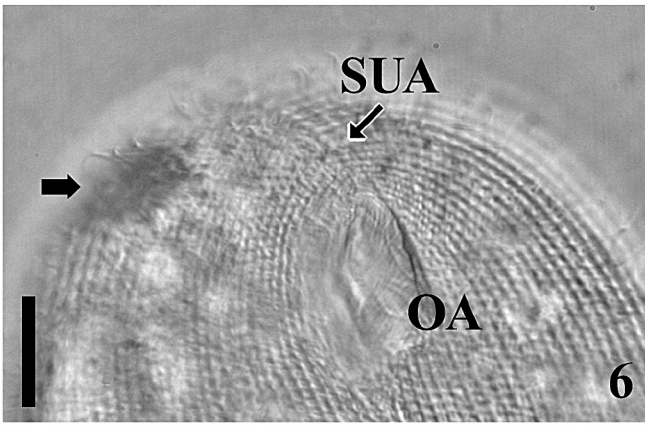

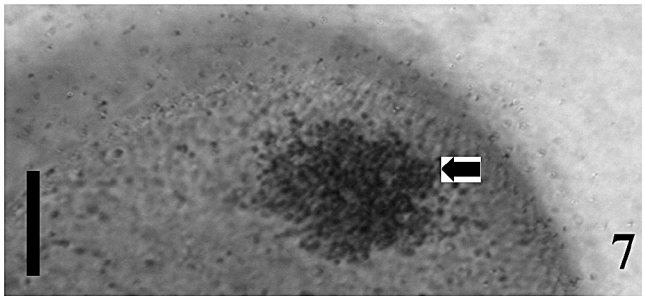

Fig. 1–7: Published images and distinctive features of *Frontonia fusca*. **1**: The first image of the ciliate given by Dujardin (1841) under the name "?*Loxodes signatus*" without any description. General shape, pigment spot, mouth position and trichocysts presence convinced me in these species identity. **2, 3**: Image of the ciliate made by Quennerstedt (1869) in his description of the species as *Panophrys fusca*. **4**: Sketch of *Frontonia* (*Panophrys*) *fusca* made by A. Kahl (1931, Fig. 55, 5) with all distinctive features of the species. **5**: Dorsal view of *F. fusca* cell isolated from natural population. In the cytoplasm many eaten diatoms are visible. **6**: Upper part of the ventral-lateral side of the ciliate with preoral suture and pigmented spot. **7**: Upper part of the dorsal side of the ciliate with pigmented spot. Living cells, DIC (**5, 6**); part of the cell impregnated with silver nitrate (**7**). Large arrows – pigmented spot; small arrows – contractile vacuoles; MA – macronucleus; OA – oral apparatus; SUA – preoral suture. Scale bar – 30 μm (**5**), 15 μm (**6, 7**). All material from the neotype population.

dikinetids and a parasomal sac (Fig. 19, 20; Tab. 2). Cytopyge extends in ventral portion of postoral suture (Fig. 15, 17, 18). Preoral and postoral sutures distinctive. Preoral one terminates on dorsal side not far away from cell' top; postoral suture longer and extends at the dorsal side at about 1/3 of body length (Fig. 6, 8–10, 13–15, 17–20). Oral apparatus middle-sized (about 25 μm or 1/5 of body length) and on ventral side commencing at about 20% of anterior body end (Fig. 6, 15–20); consists of three symmetrical, almost parallel and slightly curved peniculi on buccal length-side; peniculi I and II composed of four rows of basal bodies each, peniculus III – the smallest right one – made of three rows (Tab. 2); distinct paroral membrane on right side of buccal cavity

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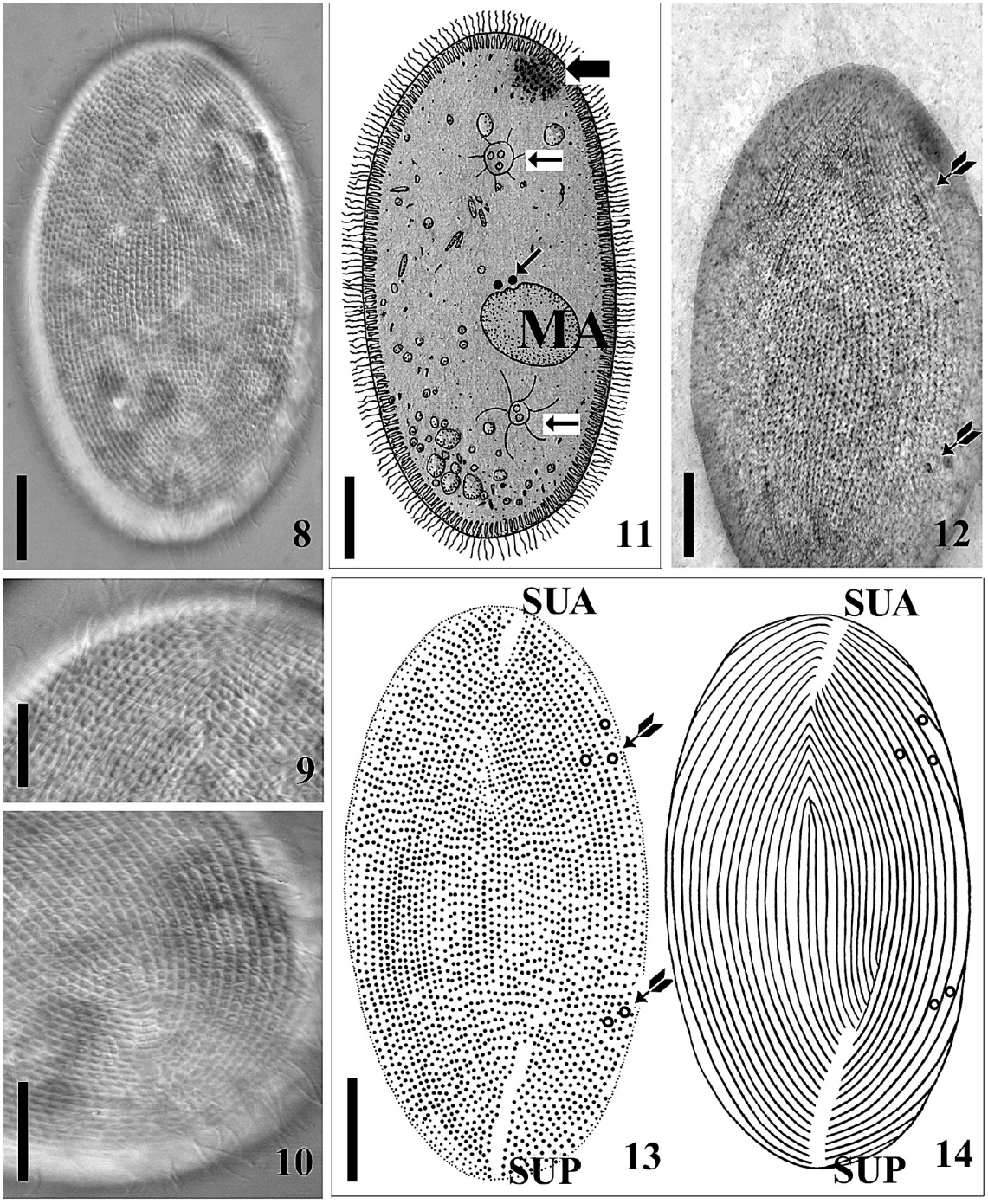

Fig. 8–14: Details of the dorsal morphology of *Frontonia fusca*. **8**: Partly deciliated cell. **9**: Upper part of the cell. Dorsal end of preoral suture is visible. **10**: Posterior part of the cell. Dorsal part of postoral suture is visible. All kinetosomal units are uniciliated. **11**: General scheme of the ciliate from dorsal side. Drawing made according to living and stained ciliates. **12**: Cell impregnated with silver nitrate. **13**: Kinetosome pattern of the ciliate. **14**: Kineties pattern of the ciliate. Living cells, DIC (**8–10**); Drawing made according to ciliates impregnated with silver nitrate (**13, 14**). SUP – postoral suture; inclined arrows – pores of contractile vacuoles; inclined simple arrow – micronuclei. Other indications and abbreviations are the same as in previous figures. Scale bar – 30 µm (**8, 11–14**), 15 µm (**9**), 20 µm (**10**). All material from the neotype population.

(Fig. 19, 20). Three vestibular kineties posteriorly gradually shortened from right to left (Fig. 19, 20). Four postoral kineties gradually shortened from left to right (Fig. 19, 20). Fibrillar apparatus associated with oral and vestibular ciliature consists of thin and relatively short nematodesmata likely separated from the rearmost vestibular kinety (number 3) and peniculus III.

Resting extrusomes (trichocysts) about 4 µm long and 1 µm wide, spindle-shaped with conical tip, the "*Paramecium*" type, round in cross section, numerous and more or less perpendicularly arranged to cell surface (Fig. 5, 15); exploded organelles elongate nearly 6–7 times and look like as transparent spines (Fig. 11, 15, 21, 23, 29). Macronucleus in mid-body, slightly ellipsoidal, and 25–35 × 20–25 µm (Fig. 5, 11, 15, 21, 22). Two very small (1.5–2.0 µm) micronuclei close to macronucleus, that is, of the "endosomal" morphological type (Fig. 11, 15, 22). Two contractile vacuoles with 6–9 radial collecting canals (not always good visible) and with 2–3 excretory pores each, located dorso-laterally in first and last third of cell (Fig. 5, 11, 15, 21, 25). Cytoplasmic crystals of different size and food vacuoles mainly filled with diatoms (Fig. 5, 15, 21, 22).

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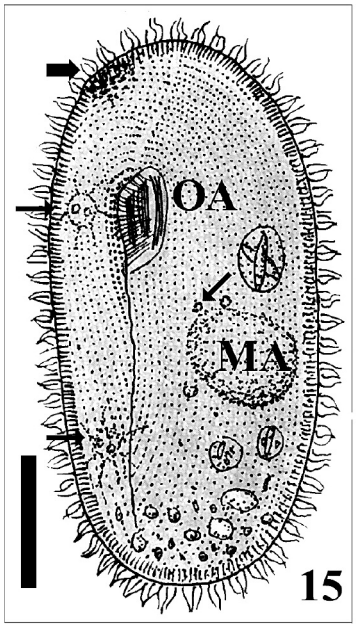

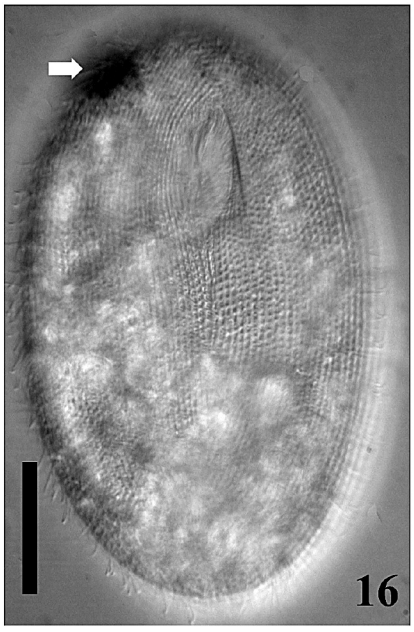

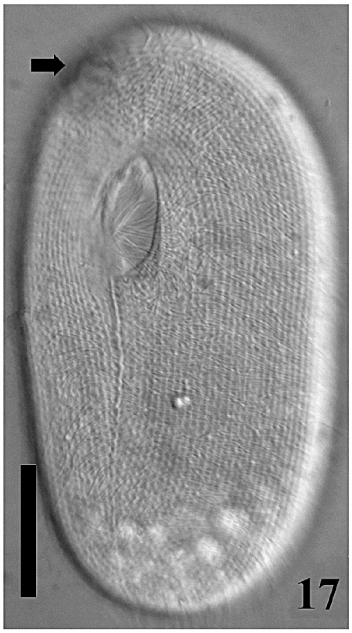

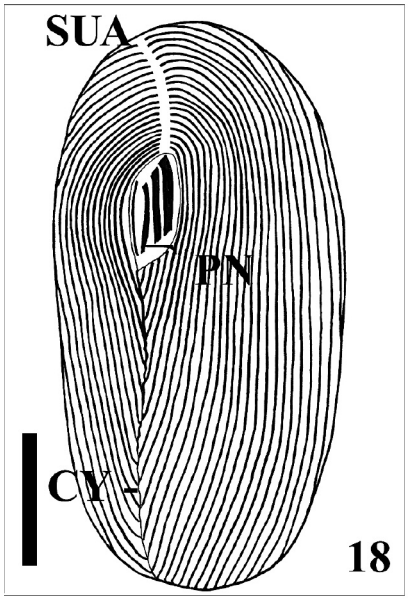

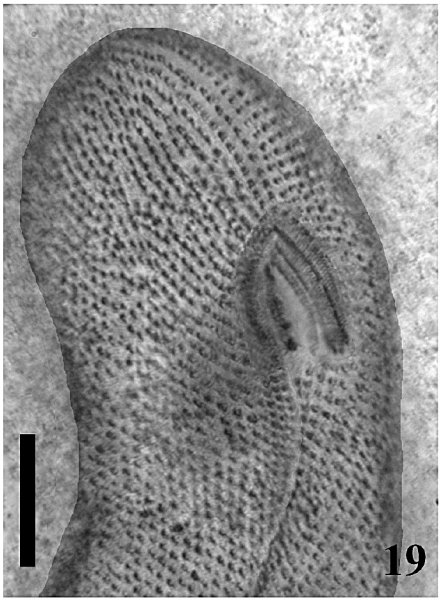

Fig. 15–20: Details of the ventral morphology of *Frontonia fusca*. **15**: General scheme of the ciliate' cell from ventral side. **16**: Partly deciliated cell. **17**: Ventral surface of the ciliate. **18**. Ventral kineties pattern of the ciliate. **19**. Anterior part of cell impregnated with silver nitrate. **20**: Scheme of the ciliate's oral region according to silver nitrate impregnation. Drawing made according to morphology of living and impregnated ciliates (**15**); living cells, DIC (**16, 17**); schemes of the ciliate's ventral morphology according to living and silver nitrate impregnated cells (**18, 20**). CY – cytopyge; PO – postoral kineties; PN – peniculi; PN1–3 – different peniculi; VC – vestibular kineties. Scale bar – 30 µm (**15–18**), 25 µm (**19**) and 20 µm (**20**). All material from the neotype population.

Very distinctive pigment spot about 15–18 µm in size always present on right side of anterior dorsal side (Fig. 1–7, 11, 15–17, 21, 25, 27, 29); dark-greenish colour of organelle caused by pigment located within about 80–160 small vesicles (granules) about 0.5–1.2 µm across. Location of spot apparently connected with ciliate's cortex layer. Pigment granules quite equally distributed during cell division between dividers within 45–60 min. The migration of some granules to the opisthe started already at the beginning of the macronucleus division (Fig. 27, 28). Then they are again producing a spot in the same position in both daughter cells (Fig. 29). The pigment has no autofluorescence (Fig. 25, 26), and it seams to be a liquid inside of vesicles.

The ciliate is preferably swimming with clockwise rotation (right spiral) about main body axis, but some-

Table 1: Morphometric data on *Frontonia fusca*[1]

Characteristics	mean	SD	Min	Max	CV	n
Body, length	123.7	27.0	90	150	22	20
Body, width	59.5	7.2	45	70	12	20
Cytostome, length	24.7	1.5	22	27	6.1	16
Macronucleus, length	29.1	1.75	25	35	6.0	14
Macronucleus, width	22.0	1.5	20	25	6.8	14
Somatic ciliary rows, number	80	5.2	75	92	6.5	10
Excretory pores, number	2.25	0.54	1	3	23.8	10
Micronucleus, number	1.8	0.4	1	2	22.2	10
Micronucleus, diameter	1.65	0.2	1.5	2	13.9	10

[1] Data based on Chatton-Lwoff silver-impregnated cells. Macro- and micronuclei were measured from Feulgen stained ciliates. Measurements in µm. mean – arithmetic mean; SD – standard deviation; Min – minimum; Max – maximum; CV – coefficient of variation in percentage; n – number of cells investigated.

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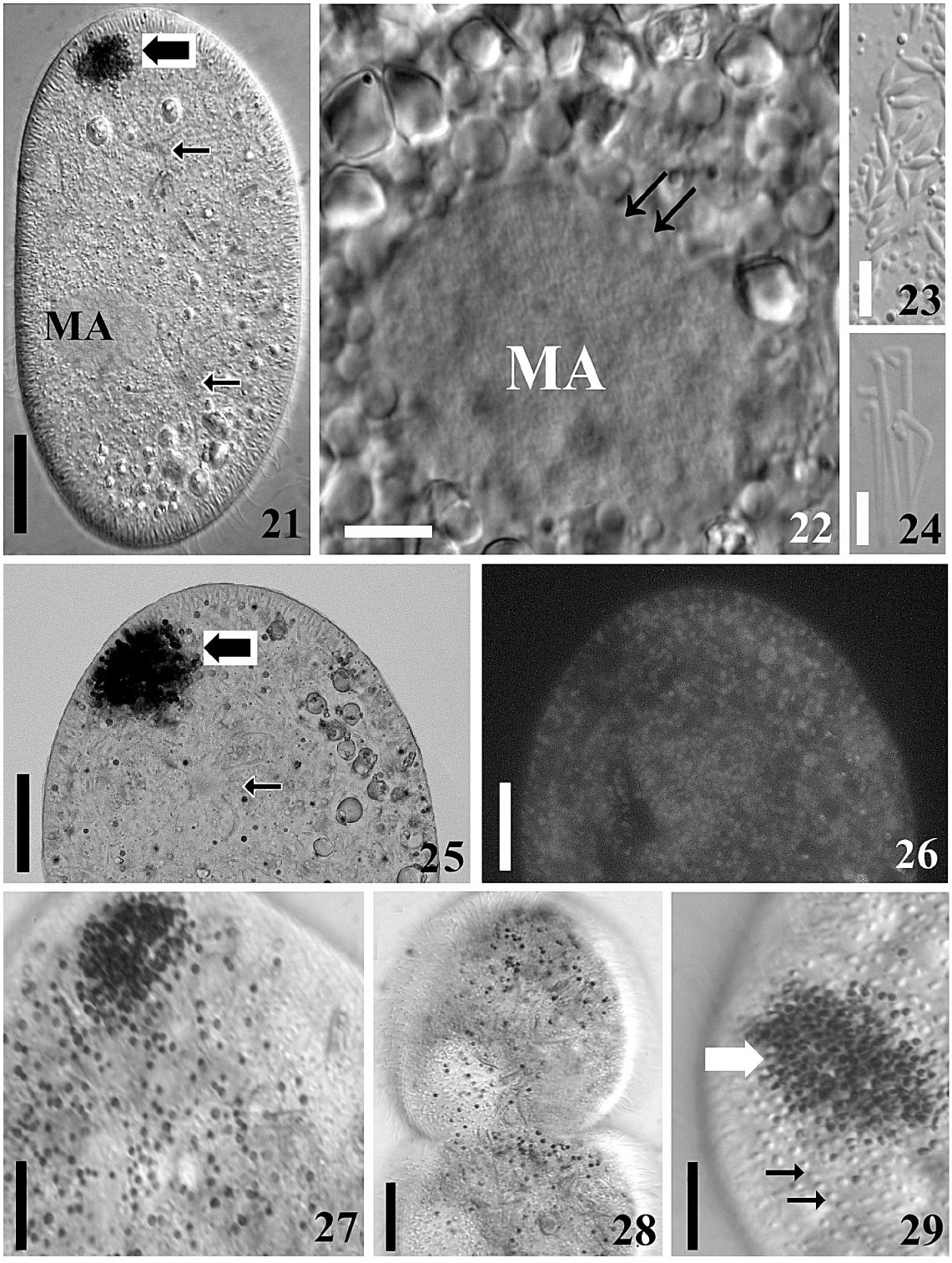

Fig. 21–29: The main peculiar morphological characteristics of *Frontonia fusca.* **21**: Contractile vacuoles morphology. Two vacuoles with collection channels are visible. **22**: Nuclear apparatus and part of the cytoplasm with crystals. **23**: Intact trichocysts in crashed cell. **24**: Exploded trichocysts. **25**: Part of the ciliate' cell with pigmented spot in light microscope. **26**: The same in ultraviolet illumination. **27**: Process of pigment's granules moving at the beginning of the ciliate division. **28**: Pigment's granules distribution in dividers before their separation. **29**: Anterior dorsal part of divider after 1 h. Living cells, DIC (**21–27**). Small black horizontal arrows – trichocysts, all abbreviations are the same as in previous figures. Scale bar – 30 μm (**21**), 15 μm (**25, 26**), 10 μm (**27, 29**), 25 μm (**28**), 6 μm (**22–24**). All material from the neotype population.

times can switch to the left spiral as well, especially when salinity was changed. *Frontonia fusca* could be easily transferred into media with different salinities (up to 35‰ at least), but could not survive in freshwater. Cells are positive phototactic. No symbionts were found either in the cytoplasm or in the nuclear apparatus of the ciliate. Resting cysts not observed.

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Table 2: Morphometric and some biological data on *Frontonia* spp. with two contractile vacuoles found in brackish or marine water.

Characteristics	*F. fusca*[1]	*Frontonia* sp.[1]	*F. elliptica*[2]
Body, length in µm	100–170	60–100	80–200
Body, width in µm	45–75	30–45	30–50
Cytostom/body length	1/5	1/5	1/5
Somatic kineties, number	75–90	65–80	90–110
Macronucleus, size in µm	25–35 x 20–25	15–20 x 10–15	15–17 x 8–10
Macronucleus, form	ellipsoidal	ellipsoidal	oval
Micronucleus number, type	2, endosome	1, compact	1, compact
Micronucleus, size in µm	1.5–2.0	5–7	4–5 ?
Peniculi I, II, III, number of rows	4 + 4 + 3	5 + 5 + 4	5–6 + 5–6 + 5–6
Vestibular kineties, number	3	4	4
Postoral kineties, number	4	4	4
Collecting canals	6–9	–	6–7?
Contractile vacuole pores, number	2–3	1	1–2
Pigment granules	+	–	–
Swimming rotation	Preferably to the right	To the left	?
Food preferences	diatoms only	diatoms mainly	?

[1] Original data.
[2] According to KAHL (1931); DRAGESCO & DRAGESCO-KERNÉIS (1986); FOISSNER & WENZEL (2004). ? – data not presented or presented in figures only; – – characteristic is absent.

Discussion

Neotypification: No useable type material (type or voucher slides) is available so far from any *F. fusca* population. The original description (QUENNERSTEDT 1869) is incomplete and based on a few specimens. Thus, it seems wise to define *F. fusca* by the designation of a neotype (ICZN 1999; FOISSNER et al. 2002). Validation of a neotype according to Article 75.3 of the ICZN (1999) should be proved by publication of several particulars: (i) The systematic status of *F. fusca* was not considered as valid species after KAHL (1931). (ii) About differentiation of *F. fusca* from related taxa, see next paragraphs of the discussion chapter and Table 2. (iii) The neotype specimen (Fig. 19) represented neotype population from the Tyrrhenian coastline (Naples, Italy) is described in detail (see above); thus, recognition of the neotype designated is ensured. (iv) It is generally known that no type material is available from species described by QUENNERSTEDT. (v) There is strong evidence that the neotype is consistent with *F. fusca* as originally described by QUENNERSTEDT (1869). For a detailed comparison, see following paragraphs. (vi) However, the neotype does not come from a very near site to the original type locality (Baltic Sea, Island Gotland, Sweden). Neotype population of the ciliate was found in the southern part of the Tyrrhenian Sea (coastline of Naples, Italy); distance about 1500 km; nevertheless, both sites are brackish water. As generally known, most ciliates, especially marine ones – are cosmopolitans (PATTERSON et al. 1989; FINLAY et al. 1996), so that this point should not be over-interpreted. A detailed description of the new type locality, that is, the sample site of the neotype population, is given in the chapter material and methods and the results section. (vii) The slide containing the neotype specimen and some further specimens, including those depicted in the present paper, of the neotype population is deposited in the collection of the Museo di Storia Naturale e del Territorio dell'Università di Pisa, Calci (PI), Italy.

The brackish water ciliate fauna is not yet deeply investigated. Very likely for that reason, *F. fusca* was not found again after KAHL (1931). However, quite obviously the species is a rare one. Even in the last important publication of that great ciliate's fauna investigator this distinctive peniculine species was not mentioned (FOISSNER & WENZEL 2004). However, as some ciliates do, probably, *F. fusca* has a naturally long lasting epidemic dynamics. For instance during almost four years of sampling in the same Italian localities, I succeeded to get this ciliate only in 2005 (in different locations), but nowhere in the rest of three years.

The most distinctive morphological feature of the species is a permanent dark-greenish pigment spot in the right anterior dorsal side of the cell. Pigment granules are not so uncommon in *Frontonia* species. It is a typical property for *F. atra* (KAHL 1931; FOISSNER et al. 1994), but pigment granules are different in size and colour. Moreover, they are distributed quite randomly in the cytoplasm. In *F. acuminata* highly refractive pigment granules are producing a spot in the similar part of the ciliate cortex (FOISSNER et al. 1994) or, which could be a misobservation, on the left anterior ventral side of the

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cell (KAHL 1931; FOISSNER & WENZEL 2004). However, this spot has not the same colour as in *F. fusca*. Another brackish water species coloured by pigmented granules is *F. microstoma* (ROQUE 1961), but there is no spot of pigment granules.

During my sampling in Italy I have found two more examples of pigmented frontoniids, which have to be described as new species. In one of them the greenish granules are distributed quite randomly in the cytoplasm and another one has a black spot made of different pigment granules than in *F. fusca*. In *F. fusca* it is apparently a photosensitive organelle corresponding to ecological preferences of the ciliate (shallow water and diatoms as a food). The sequence of pigment granules distribution during the cell division in *F. fusca* shows that it is a very precise mechanism, which could be of special cytophysiological interest.

Another distinctive characteristics of *F. fusca* are two contractile vacuoles with 2–3 pores in each of them. There are very few frontoniids from brackish water with this feature: just two more (except *F. fusca*) – *F. elliptica* and *Frontonia* sp. have been found yet in brackish (marine) habitats (Tab. 2). Both ciliates could be considered as different populations of the same species (*F. elliptica*), as many of it's features are rather common (Tab. 2). Unfortunately, all descriptions of *F. elliptica* have no clear indication about collecting canals of the contractile vacuole (KAHL 1931; DRAGESCO & DRAGESCO-KERNÉIS 1986; CAREY 1992), but in one of the figures they were shown (KAHL 1931). In my Naples and Tuscany samples the ciliate which has no collecting canals in couple of the contractile vacuole was discovered. Because of this contradiction I have to consider these two frontoniids so far as different species. The full description of that *Frontonia* sp. is still ongoing.

It should be particularly stressed that *F. fusca* has quite unusual extrusomes for frontoniids, really looking *Paramecium*-like. Also the fibrillar apparatus associated with oral and preoral ciliature (nematodesmata) is rather weakly developed as compared with some other species of the genus (FOISSNER et al. 1994, 2002). The oral nematodesmata are a very peculiar feature for members of the family Frontoniidae (PUYTORAC et al 1987; LYNN & SMALL 2002). As a distinctive characteristic of the ciliate, a long postoral suture terminating in the border between last and middle thirds of the dorsal surface should be mentioned. Such a prolonged postoral suture was recorded, to my knowledge, till now only for *F. tchibisovae* (LONG et al. 2008). The position and shape of the postoral suture could be a suitable feature in alpha-taxonomy of the group (FOISSNER et al. 2002). Usually dorsal ciliary rows are almost bipolar, except a few which extend between sutures (FOISSNER et al. 2002). On the dorsal side of *F. fusca* about 15 ciliary rows from the postoral suture are terminating before the preoral one by fusion of each other (Fig. 8, 12, 14). It seams a unique case for *Frontonia* spp.

Summarising all of these peculiarities of *F. fusca*, we can admit that the position of the species in the genus *Frontonia* could be quite special. Phylogenetic analyses using 18S rRNA gene sequence of some representatives of the genus (including *F. fusca*) were done very recently (ANDREOLI et al. 2007a, b) showing that *Frontonia* is non-monophyletic. In particular, *Frontonia* is split into three subgroups. One is composed of *F. fusca* and three other yet undescribed species. Two of them also have two contractile vacuoles (one also with pigment granules) and the third one is reminiscent of *F. didieri* (LONG et al. 2008), but almost twice smaller than the one described by Chinese and Saudi Arabian colleagues. All of the frontoniids are brackish water ciliates. It seams that in future we have to split the genus and retain the name *Frontonia* only for the group containing the type species.

The original description of *F. fusca* was done by the well-known Swedish zoologist August W. QUENNERSTEDT (1837–1926) in his review of Swedish ciliate fauna (QUENNERSTEDT 1869; Fig. 2, 3). He found just a few specimens isolated from a marine habitat. As it was done in the island Gotland, Baltic Sea (low salinity), the type habitat of *F. fusca* should be considered as brackish water. However, he precisely indicated the main features of the species, namely, the length of the cell (0.12 mm), dorso-laterally cell's compression, mouth position, two contractile vacuoles, the irregularly shaped greenish-black spot formed by numerous small granules, and the food organisms (diatoms). He also indicated that one figure (*Loxodes signatus*; without any description) from DUJARDIN (1841) probably refers to the same species (Fig. 1). KAHL (1931) did not much improve these descriptions as he did not check the morphology of the ciliate in detail. KAHL mentioned a cell size of 150–200 µm and a distribution in the North and Baltic Sea as well as in the Atlantic Ocean and in particular in a brackish water puddle in the city of Cuxhaven, Elba river mouth, Germany. However, in KAHL'S figure (1931; Fig. 4) two contractile vacuoles with several pores and one small micronucleus are shown.

Acknowledgements

This research was supported by a grant from the Italian Ministry of University and Research – MIUR (Ministero Italiano dell' Università e della Ricerca), to the author. I am grateful to Prof. R. LARSSON (University of Lund) for providing a copy of the QUENNERSTEDT description of *Paronophrys fusca* and a very useful translation of the description from Swedish.

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Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: Denisia

Jahr/Year: 2008

Band/Volume: 0023

Autor(en)/Author(s): Fokin Sergei I.

Artikel/Article: Rediscovery and characterisation of Frontonia fusca (QUENNERSTEDT, 1869) KAHL, 1931 (Ciliophora, Peniculia) 251-259