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REGULAR PAPER

The genus *Navicula* in ancient basins. I. Two novelties from the Black Sea

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Backgrounds and aims – In this paper results on *Navicula s. str.* species from the (sub)littoral zone of the Black Sea are presented. *Navicula pinnata* var. *pontica* Mereschk. was originally described from the Black Sea in the early 20th century but, due to mistakes, incorrectly referred to in the literature as *Navicula pennata* A.W.F.Schmidt var. *pontica* Mereschk. A second species, *Navicula parapontica* sp. nov. is described as new for science. Analysis of recent and historical diatom assemblages revealed that Mereschkowsky's taxon occurs abundantly. Nevertheless, it was subject of numerous misidentifications in the past; the same applies for the second species. The aim of our study was to clarify the identity and taxonomic position of these taxa.
Methods – This study is based on both historical and recent samples. Recent sampling was performed along the Ukrainian (Crimea) coast. In addition, samples from the Black Sea, originally collected and studied by Proshkina-Lavrenko in 1948–1951 and only recently rediscovered, have been analyzed. Results are based on light and scanning electron microscopy examination. We compared line drawings of Mereschkowsky's taxon with illustrations of similar taxa focusing especially on *Navicula pinnata* Pant. and *N. pennata* A.W.F.Schmidt.
Key results – Comparison of line drawings of Mereschkowsky's taxon revealed no resemblance to *N. pinnata*. Micrographs of *N. pennata* illustrated in our paper indicated that any infraspecific relationship between Mereschkowsky's taxon and *N. pennata* is unlikely. Hence, we propose a new name, *Navicula pontica* stat. nov. for Mereshkowsky's taxon. In historical samples *N. pontica* was accompanied by a similar, however, sufficiently different, species, described as new for science: *Navicula parapontica* sp. nov.
Conclusion – Our study resulted in a status change of a taxon originally described as *Navicula pinnata* var. *pontica*. In addition *N. parapontica* was described as new for science. These results will facilitate future identification of both abundant Black Sea littoral diatoms.

Key words – diatoms (Bacillariophyta), *Navicula*, new species, ancient marine basins, Black Sea.

INTRODUCTION

The Black Sea, similarly to the Caspian Sea, is an example of ancient marine basin with a long geological history. Both of the basins share a common geological past. The ancient floral components in both basins are dated to the Neogene (Upper-Tertiary, Karayeva & Makarova 1973). Benthic diatoms in the Black Sea have been studied during the whole last century, but in spite of that the taxonomic position of numerous species is still unclear. The studies of the Black Sea diatoms provide information on their biodiversity, ecology and evolution. The diatom assemblages we identify in the Black Sea are very interesting as they represent flora of an ancient marine basin that was isolated with limited water exchange for quite a long geological time. Hence we expect that some of the diatom taxa may represent ancestral floras.

The first study on Black Sea diatoms was performed by Mereschkowsky (1902). He found some endemic species in this ancient basin. Some attempts for understanding the relict diatom flora were undertaken by Mereschkowsky (1902) and Proshkina-Lavrenko (1955). They concluded that modern Black Sea diatom flora include some ancestral species. During the last few decades diatom assemblages of the Black Sea were studied by e.g. Guslyakov and his coworkers (Guslyakov et al. 1992) and by Nevrova and coworkers (Nevrova & Petrov 2009). The floral composition and the origin of the Black Sea diatom flora is the subject of our current project that involves the present authors. This research team is carry-

ing out intense LM and SEM studies and we hope to be able to show the biogeographic affinity of the Black Sea diatom flora.

In a series of recent publications dealing with the marine (brackish-water) littoral, Witkowski and coworkers have shown that regardless of the geographic location, *Navicula* Bory is the most species rich genus (Witkowski et al. 2009). A similar phenomenon is observed in the Black Sea diatom assemblages as *Navicula* is the most species rich diatom genus in this basin. To the group of highly species rich genera belong also *Nitzschia* Hassall and *Amphora* Ehrenb. Nevrova & Petrov (2009) searched the available literature dealing with the region studied and showed that in the material recently collected along the Black Sea coasts, 53 *Navicula* species (63 infraspecific taxa) were identified.

In this paper we present results of LM and SEM studies on *N. pinnata* var. *pontica* Mereschk. We have been able to show that despite the long period of studies it was misidentified with similar species, which however, show distinct differences in terms of valve ultrastructure. Here we propose new taxonomical status for the taxon described by Mereschkowsky as an independent species, *Navicula pontica*. The second species, misidentified with Mereschkowsky's taxon we describe as new for science as *Navicula parapontica* sp. nov.

MATERIAL AND METHODS

The material used in the present study was collected from different parts of the Black Sea littoral, particularly along the Crimean Peninsula, during the period of 1995–2008 (table 1). In addition, we got access to the rinsed material from the collection of Proshkina-Lavrenko rediscovered in the Botanical Institute of the Russian Academy of Sciences in St. Petersburg. We studied samples of Proshkina-Lavrenko that were collected during the 1948, 1950, 1951 seasons from seaweeds at Sevastopol, Novorossyisk Bay and Kamishovaya Bay (table 1).

Permanent diatom preparations were mounted with Naphrax®. Light microscopic (LM) observations were performed by means of a Nikon Eclipse E 600 equipped with a Plan-apochromatic oil immersion objective × 100 (1.4 n.a.) and a Nikon DS-5M digital camera (5Mpx). SEM examination was performed by means of Hitachi S-4500. The measurements were made by means of Image J software.

The diatom slides are stored in the Diatom Collection of A. Witkowski in the Institute of Marine Sciences at the University of Szczecin (SZCZ).

RESULTS

Navicula pontica (Mereschk.) Witkowski, Kulikovskiy, Nevrova & Lange-Bert., **comb. & stat. nov.**

Table 1 – Location of sampling stations in which the occurence of *Navicula pontica* and *N. parapontica* was reported.
Where possible the coordinates are given.

Sampling location	Date of sampling	Depth (m)	Type of substrate
Recent sampling			
Laspi Bay, stt. L9601s – L9638m; 44°2510,5'N 33°4227,5'E	Jun. 1996	0.5–52	sand, silty-sand, stone, macrophytes (*Cystoseira crinita*, *Zostera marina*, *Phyllophora nervosa*, *Ceramium rubrum*, *Laurencia papillosa*, *Corallina mediterranea*, *Jania rubens*)
Northern Caucasus coast, Anapa, st. N9901m – N9953s; 44°5208,1'N 37°1744,0'E	Oct. 1999	0.5–50	silty-sand, *Cystoseira barbata*, *C. crinita*
Sevastopol Bay, st. S0101s – S0132s; 44°3719,1'N 33°3117'E	Jul. 2001	3–7	silty-sand
Omega Bay, st. Om0422; 44°3554,7'N 33°2651,6'E	Jul. 2004	1	sand
Balaklava Bay, stt. BB0601 – BB0617; 44°2911,2'N 33°3654,5'E	Oct. 2006	7–20	silty-sand
Cape Feolent, st. FE0812; 44°3053,2'N 33°2818,2'E	Aug. 2007	12	sand
Dvujakornaya Bay, stt. DVBS08_EP_8 – DVBS08_WP_8; 44°5928,1'N 35°2204,1'E	Aug. 2008	8–9	silty-sand
Sevastopol Bay	25 Nov. 1950		On the glass
Proshkina-Lavrenko samples			
Novorossyisk Bay	28 Aug. 1948; 2 Sep.1948; 29 Aug.1948		*Cladophora* sp., stones
Kamishovaya	27 Sep.1948		*Cystoseira crinita*

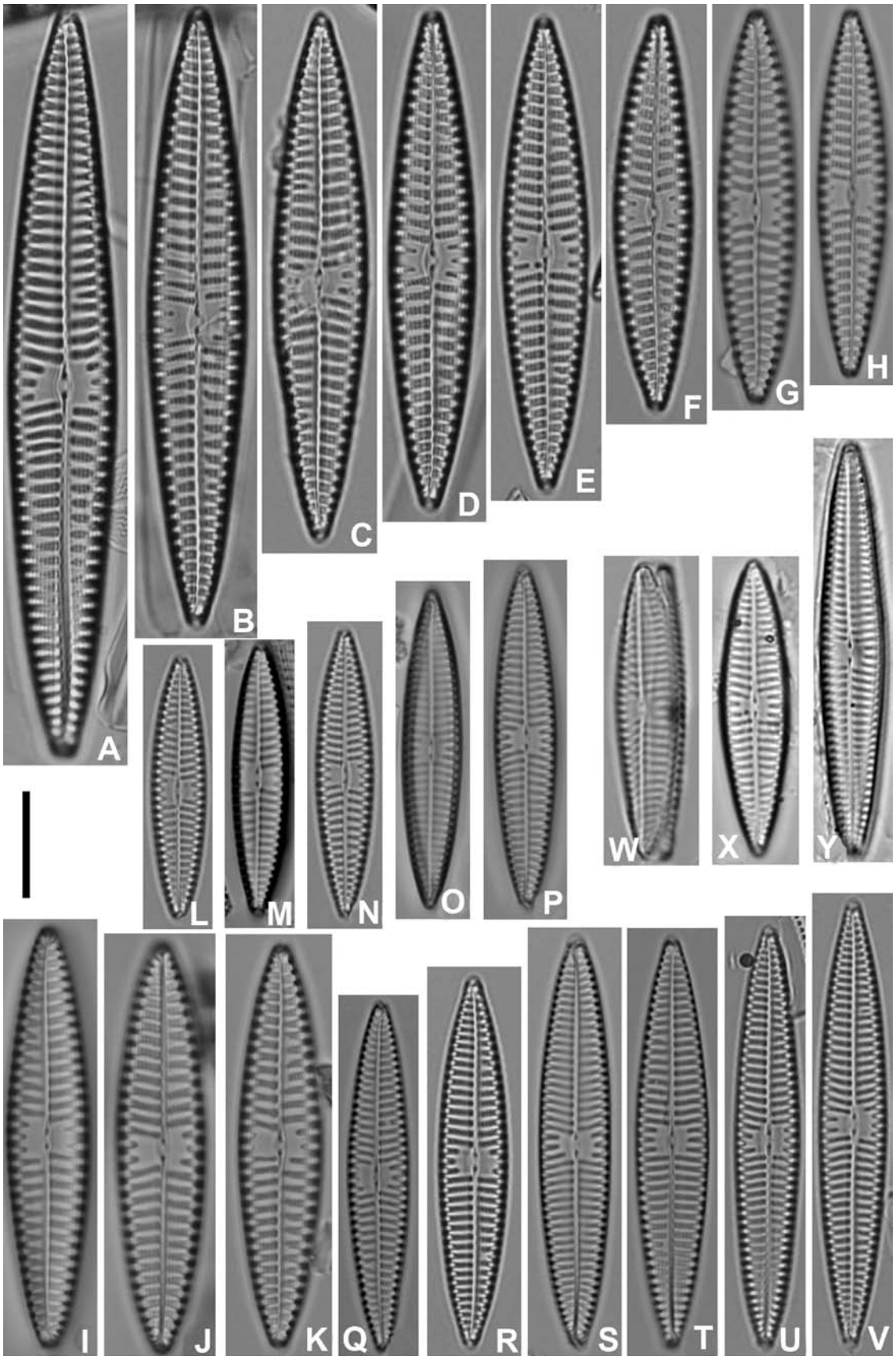

Figure 1 – A–K, *Navicula pontica*; L–Y, *Navicula parapontica* (L–V, from Proshkina-Lavrenko collection, W–Y, from Witkowski collection). Light micrograph. Scale bar = 10 μm.

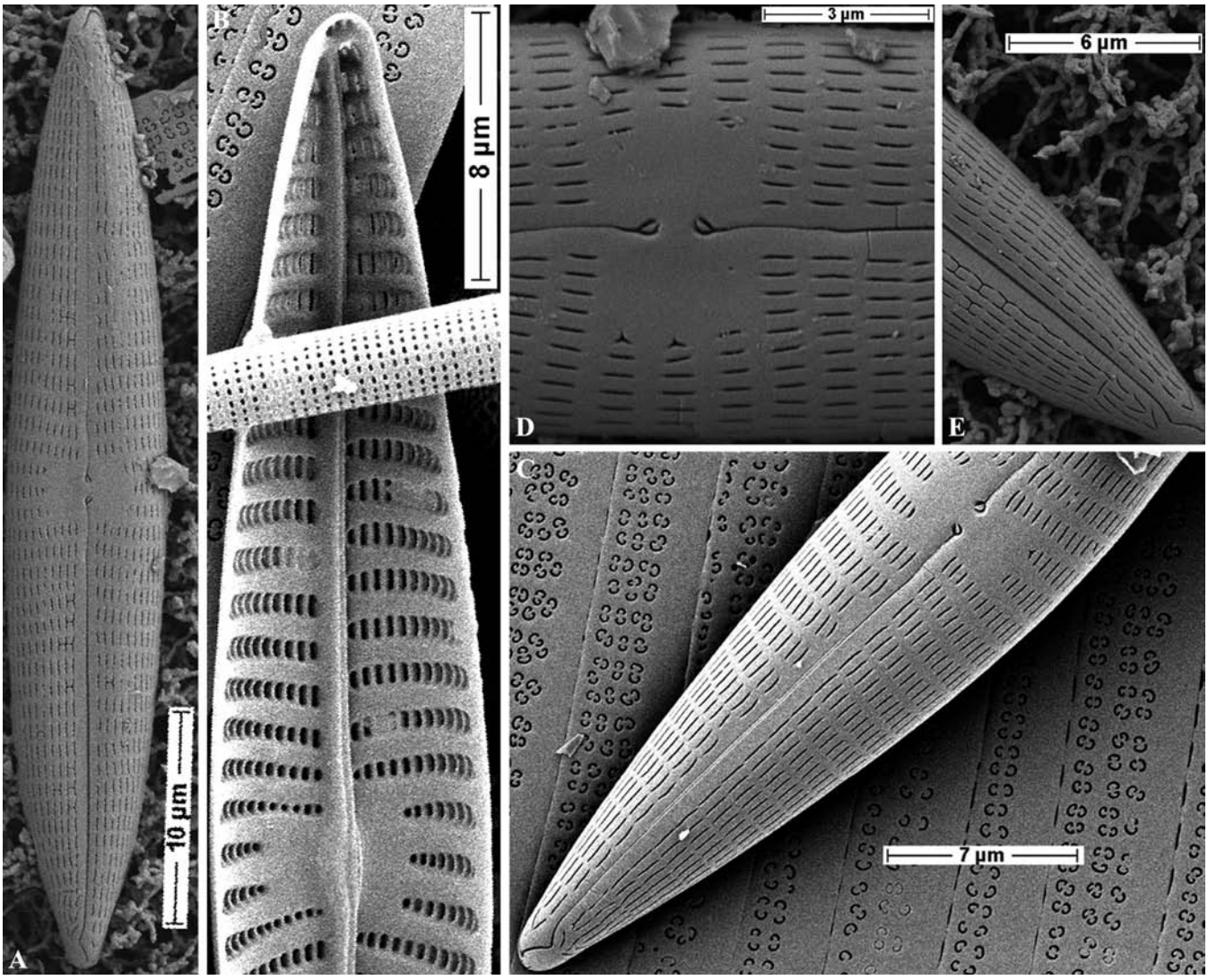

Figure 2 – Scanning electron micrograph of *Navicula pontica*: A, external view, note the external central raphe endings; B, internal view, note the oblique opening of the raphe slit and the internal proximal raphe endings; C, external valve view; D, external view of central area; E, external view of the valve apex.

Navicula pinnata var. *pontica* Mereschk., Journal de Botanique 16: 322–324, pl. 2, figs 14-18 (Mereschkowsky 1902). – *Navicula pennata* A.W.F.Schmidt (?) var. *pontica* Mereschk. sensu Proshkina-Lavrenko [Proshkina-Lavrenko 1963: 150, tabl. XIV/8 (non tabl. VI/11, tabl. XIV/9)] – *Navicula pennata* A.W.F.Schmidt var. *pontica* Mereschk. sensu Guslyakov et al. [Guslyakov et al. 1992: 41, tabl. LI/11, 12 (non tabl. LI/9, 10, 13–16)].

Descriptions – LM: Valves strictly lanceolate, ends rather acutely rounded, not protracted, 34–70 µm in length, 6–10 µm in width. Axial area very narrow throughout. Central area distinct, rather broad, irregularly rectangular. Raphe slightly lateral, almost straight with external central ends close to each other. External apical endings short curving towards the valve mantle. Transapical striae coarse, 7–10 in 10 µm, moderately radiate, proximally becoming less radiate to subparallel towards the ends. Lineolae resolvable in LM, conspicuously elongated apically, separated by comparatively very narrow transapical costae, 24–28 in 10 µm.

SEM: Valve face arched, only in the middle flat, gradually turning into valve mantle. The border between valve face and valve mantle not set off. Axial area narrow, linear, central area rectangular. Raphe straight, linear, in some specimens slightly bent, external central raphe endings slightly expanded, external apical raphe endings geniculate, strongly hooked in the same side (fig. 2A & C). Internally raphe slit opens strongly obliquely, proximal internal raphe endings straight, approximate, distal internal raphe endings terminate in a small helictoglossa (fig. 2B). Transapical striae composed of apically elongate, slit-like areolae.
Figs 1A–K, 2A–E, 4B–F.

Distribution – According to Mereschkowsky (1902) *Navicula pinnata* var. *pontica* was a common taxon in the Black Sea and was found everywhere in the littoral zone among macrophytes, however, he had not indicated the type locality of the new variety. Certain findings of this species are from Sevastopol, Novorossyisk and Kamishovaya Bay.

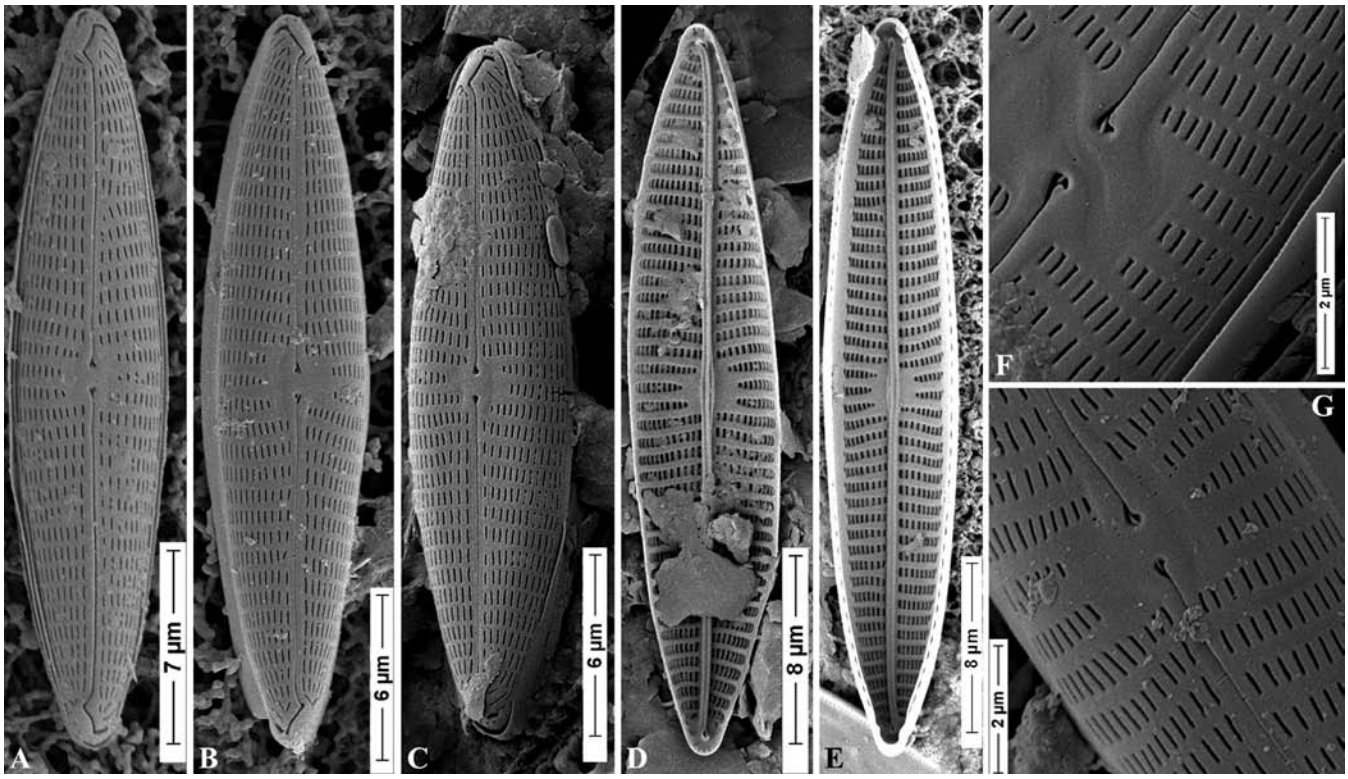

Figure 3 – Scanning electron micrograph of *Navicula parapontica* sp. nov. (A–E, from Witkowski collection; F–G, from Proshkina-Lavrenko collection); A–C, external valve view; F & G, external view of central area; D & E, internal valve view.

Navicula parapontica Witkowski, Kulikovskiy, Nevrova & Lange-Bert., **sp. nov.**

Navicula pennata A.W.F.Schmidt (?) var. *pontica* Mereschk. sensu Proshkina-Lavrenko [Proshkina-Lavrenko 1963: 150, tabl. XIV/9 (non tabl. VI/11, tabl. XIV/8)] – *Navicula pennata* A.W.F.Schmidt var. *pontica* Mereschk. sensu Guslyakov et al. [Guslyakov et al. 1992: 41, tabl. LI/14, 16 (non tabl. LI/9–12, 13, 16)] – *Navicula* sp. 134/2 (in Witkowski et al. 2000: pl. 134/10).

Diagnosis differens versus *Navicula pontica* (Mereschk.) Witkowski, Kulikovskiy, Nevrova, Lange-Bert.

Frustula aspectu cingulorum rectangulata leviter constricta in medio (marginibus non rectis). Valvae stricte lanceolatae apicibus fere acute rotundatis non protractis. Longitudo 22–38 µm (nec 32–70 µm), latitudo 5–6 µm (nec 6–10 µm). Raphe filiformis fere recta poris centralibus fere dense sitis inter se fissurisque terminalibus curte hamatis in limbum valvae. Area axialis angustissima recta. Area centralis nec ampla nec parva circiter rectangulata striis 2–3 mediis distincte abbreviatis (ita vix differt). Striae transapicales 12–14 (nec 7–10) in 10 µm moderate radiantes in media parte valvarum tum minus radiales vel subparallelae ad apices versus. Lineolae densissime sitae inter se non aspectabiles (versus 24–28 in 10 µm bene discernendae microscopio photonico). Aspectus ultramicroscopicus externus internusque vide tabula 29–35. Lineolae 35–40 in 10 µm comparate valde elongatae apicaliter inter costas transapicales angustissimas. Raphosternum angustum non elevatum super faciem valvae. Extrema externa centralia raphis bifurcata apparentia poris principalibus deflexis ad latus secundum valvae. – Types: holo-: slide no. 13957 (see fig. 1U) in collection of A. Witkowski, Institute of Marine Sciences, University of Szczecin (SZCZ), 27 Sep. 1950, leg. A. I. Proschkina-Lavrenko; iso-: slide no. ZU7/31 in Hustedt Collection, Alfred Wegener Institute, Bremerhaven, Germany. – Type locality: Kamishovaya Bay near Sevastopol, Black Sea.

Description – Differential diagnosis versus *Navicula pontica* (Mereschk.) Witkowski, Kulikovskiy, Nevrova & Lange-Bert.

LM: Frustules rectangular in girdle view but with slightly constricted margins in the middle (not simply straight). Valves strictly lanceolate with rather acutely rounded, not protracted ends. Length 22–38 µm (not 32–70 µm), breadth 5–6 µm (not 6–10 µm). Axial area very narrow throughout. Central area moderately large, transapically approximately rectangular, defined by 2–3 shortened striae. Raphe filiform, almost straight with external central endings close to each other; apical external endings short curving to the valve mantle. Transapical striae 12–14 (not 7–10) in 10 µm, moderately radiate proximally becoming less radiate to subparallel towards the ends. Lineolae cannot be resolved in LM (vs. 24–28 in 10 µm in *Navicula pontica*).

SEM: Valve surface slightly arched, only in the middle flat, abruptly turning towards the mantle (fig. 3A–C). The contact between valve surface and the mantle clearly set off (fig. 3F & G). Valve mantle free of areolae (fig. 3F). The raphe sternum externally straight and does not appear elevated (fig. 3A–C), internally is narrow (fig. 3D & E). External central raphe endings appear bifurcated with the central pores deflected to the secondary side of the valve. Apical external

raphe endings strongly hooked to the same side. Areolae apically elongated, 40–44 in 10 µm, separated by comparatively very narrow transapical costae. Raphe slit internally opens strongly laterally, internal central raphe endings simple, very close to each other, apical internal raphe endings terminate in a small helictoglossa (fig. 3D & E).
Figs 1L–Y, 3A–G. Figure 1U is made from the holotype.

Distribution – Very abundant in the different ecosystems of Black Sea. This species was recently found in Sevastopol, Karkinitsk, Novorossyisk, Kamishovaya, Tendrovskiy, Dzarylgachskiy, Odessa, Puccolanovaya (near Karadag) Bays; Crimean littoral; Tuzlov, Shabolatsk, Dnestr, Suhom, Hadzibeisk, Kualnick, Tiligulsk Limans.

Etymology – *para* in Greek language means at the side of, i.e. close to *Navicula pontica*.

DISCUSSION

Here we try to explain in brief history of *Navicula pontica* stat. nov. This taxon was originally described by Mereschkowsky (1902) from the Black Sea as a variety of *Navicula pinnata* Pant. and is referred to as *Navicula pinnata* (?) var. *pontica* Mereschk. (cf. Proshkina-Lavrenko 1963) or simple as *Navicula pinnata* var. *pontica* Mereschk. (http://calacademy.org/research/Diatoms/names/index.asp).

In his description, Mereschkowsky (1902) compares this taxon with *Navicula pinnata* and *Navicula spuria* Cleve. Mereschkowsky, establishing a variety of *Navicula pinnata*, has taken into consideration: stria density in the central part of the valve, central area shape and distinctly lineolated striae. Unfortunately, he referred to Cleve (1895) to compare the three taxa in question. Cleve (1895) did not provide a line drawing for *Navicula spuria*. Instead Mereschkowsky (1902) compared his taxon with the doubtful drawing of *Navicula spuria* published in Peragallo & Peragallo (1897–1908: pl. XII/5). However, the latter authors did not show the lineolate striae of *N. spuria*. Similarly Mereschkowsky (1902) justified his identification only with the text describing Pantocsek's species *Navicula pinnata* as published by Cleve (1895). As he did not refer to Pantocsek (1889) we suppose that Mereschkowsky had no possibility to consult the line drawing of *Navicula pinnata* "iconotype". For comparison purposes the line drawings of *Navicula pinnata* and *Navicula pinnata* var. *pontica* are depicted in this paper (cf. fig. 4A–F). These line drawings evidently show that the two species in question are not similar at all. However, as stressed by Mereschkowsky, in his comment, *Navicula pinnata*, based on the description published by Cleve (1895), seemed to be the best choice for the variety occurring in the Black Sea. Taking the above into consideration we propose a new solution for the taxon in question, *Navicula pontica* (Mereschk.) comb. & stat. nov. Our decision is based on analysis of Mereschkowsky's line drawing and comparison with the line drawings he has included to validate his thoughts on this taxon. Even if we assume that Mereschkowsky's taxon name was an error, *N. pinnata* var. *pontica* instead of *N. pennata* var. *pontica*, we have been able to show that *Navicula pennata* A.W.F.Schmidt in Schmidt et al. (1874–1959: pl. 48, figs 41–43; cf. our fig. 5A–C) is a fairly different species and Mereschkowsky's taxon cannot be considered a variety of the latter species. Analysis of the published material from the Black Sea (e.g. Proshkina-Lavrenko 1955, 1963, Guslyakov et al. 1992) shows that the taxonomic concept of this species has consequently been stable.

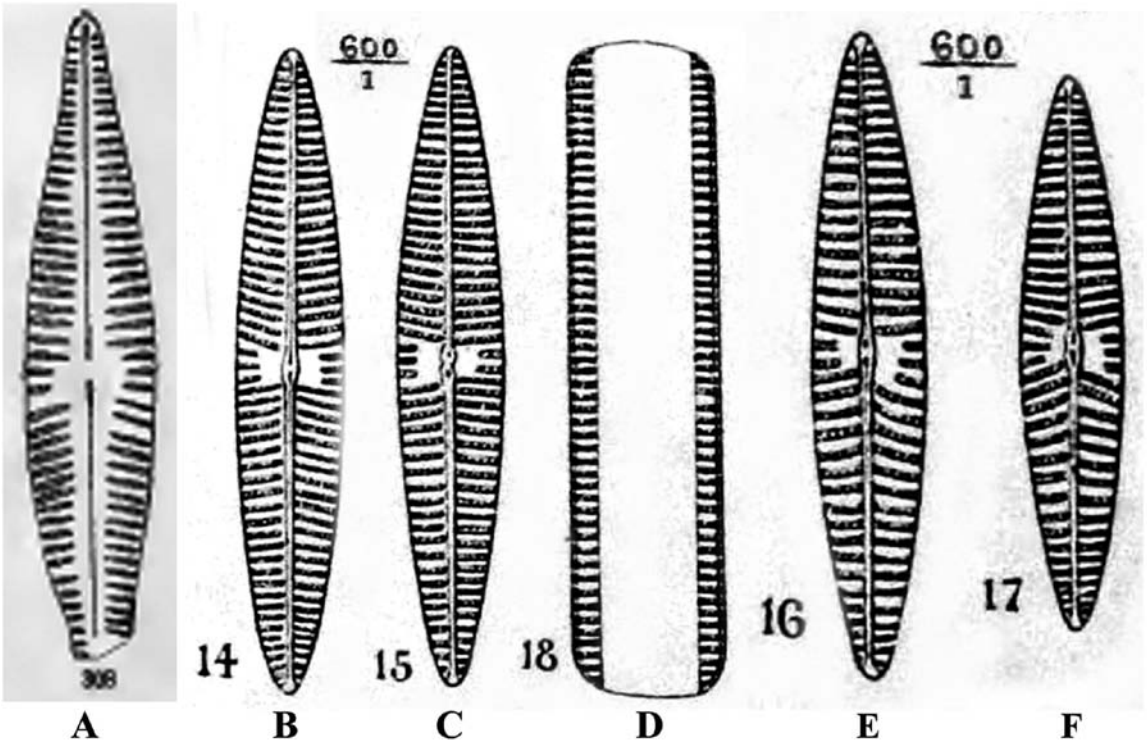

Figure 4 – A, line drawing (iconotype) of *Navicula pinnata* Pant. (Pantocsek 1889); B–F, line drawings (iconotype) of *Navicula pinnata* var. *pontica* Mereschkovsky (Mereschkovsky 1902).

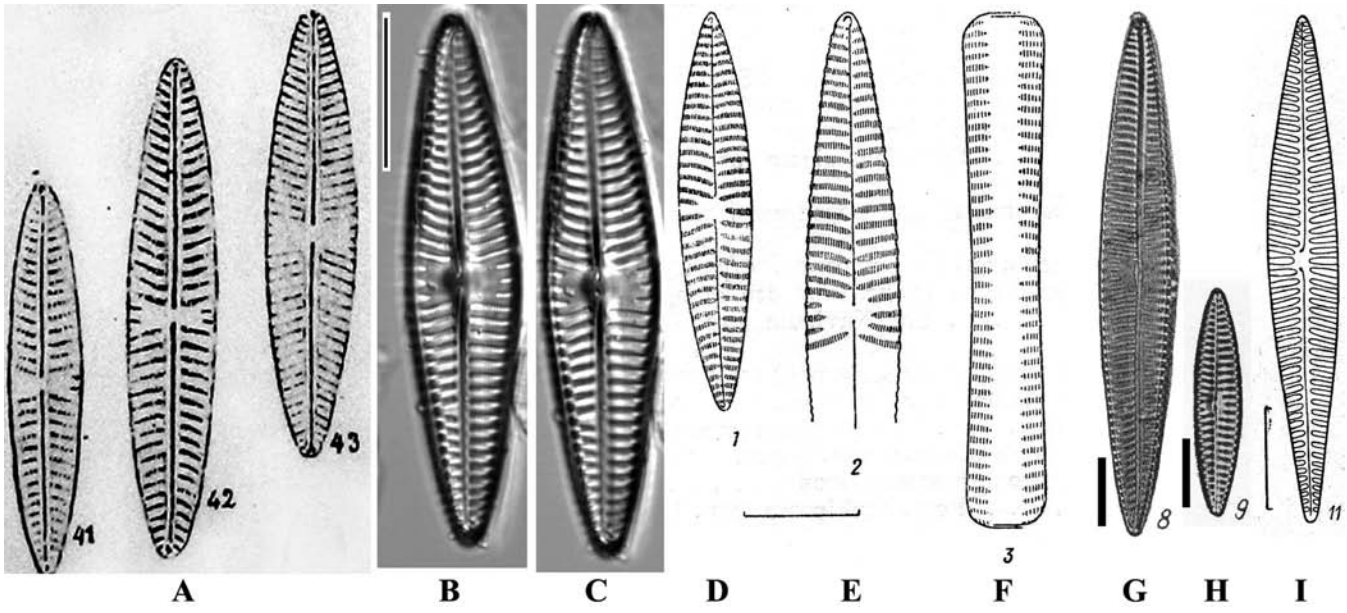

Figure 5 – A, line drawings (iconotype) of *Navicula pennata* A.W.F.Schmidt (Schmidt 1876); B & C, *Navicula pennata* A.W.F.Schmidt from the original slide (courtesy of Friedel Hinz Hustedt Collection, AWI Bremerhaven); D–F, *Navicula pennata* A.W.F.Schmidt (?) var. *pontica* Mer. sensu Proschkina-Lavrenko 1955 (line drawings from Proschkina-Lavrenko 1955: 83); G–I, *Navicula pennata* var. *pontica* Mer. sensu Proshkina-Lavrenko 1963 (figs 47, 48 originate from Proshkina-Lavrenko 1963: pl. 14/8, 9; 49 is line drawing from Proshkina-Lavrenko 1963: pl. 6/11). Scale bars for 44–46, 47, 49, 51–56 = 10 µm. Scale bars for A–D & F–I = 10 µm.

It seems that very similar names of two established species, i.e. *Navicula pinnata* Pant. and *N. pennata* A.W.F.Schmidt, were the reason for the series of erroneous identifications. Proshkina-Lavrenko (1955), in her book on planktonic diatoms of Black Sea, for the first time confused *Navicula pinnata* Pant. var. *pontica* with *Navicula pennata* A.W.F.Schmidt var. *pontica*, identifying it as *Navicula pennata* A.W.F.Schmidt var. *pontica*. In her drawings Proschkina-Lavrenko (1955) has shown valves that conform to the iconotype of Mereschkowsky (see figs 51–53). However, in the description Proshkina-Lavrenko gave a very broad size range and length range in particular (table 2). This indicates that she has included in Mereschkowsky's taxon also the species that we describe here as new for science, i.e. *Navicula parapontica*. Later on, she repeated this description in her comprehensive book on benthic diatoms of the Black Sea (Proshkina-Lavrenko 1963); cf. our table 2. However, she illustrated three different species. The drawing in her plate VI fig. 11 illustrate another, yet unnamed taxon which was common in her samples (most probably to be described as a new species), the next drawing illustrates the true Mereschkowsky's taxon (op.cit.: pl. XIV fig. 8), and finally a third valve which conforms to our *Navicula parapontica* sp. nov. (Proshkina-Lavrenko 1963: pl. XIV fig. 9; see our fig. 5D–F).

Later on, Karayeva (1972), in her study on Caspian Sea diatoms, identified *Navicula pennata* var. *pontica*, repeating the error of Proshkina-Lavrenko. Karayeva (1972) gave a general description almost following Mereschkowsky (1902) and Proshkina-Lavrenko (1955, 1963), but the size range (length and breadth) is larger (table 2). However, the only illustration of this species (Karayeva 1972: pl. VI/49) does not conform to the true *Navicula pinnata* var. *pontica* concept of Mereschkowsky. The Caspian Sea specimen has convergent striae at the apices, whereas in Mereschkowsky's taxon

Table 2 – **Morphometric data of *Navicula pontica* as given in various published sources.**
Original taxonomic nomenclature is used in this table.

Species	Length (µm)	Breadth (µm)	Stria density in 10 µm	Areola density in 10 µm	Reference
Navicula pinnata (?) var. *pontica* Mereschkowsky	34–62	7.6–14	6.5–8	-	Mereschkowsky 1902
Navicula pennata A.W.F.Schmidt (?) var. *pontica* Mereschkowsky	18–53	5–8	8–10	25–28	Proshkina-Lavrenko 1955
Navicula pennata A.W.F.Schmidt (?) var. *pontica* Mereschkowsky	18–70	5–8	7–10	25–28	Proshkina-Lavrenko 1963
Navicula pennata A.W.F.Schmidt var. *pontica* Mereschkowsky	30–76.4	5.5–12.6	8–9	-	Karayeva 1972
Navicula pennata A.W.F.Schmidt var. *pontica* Mereschkowsky	23–42	5–8	7–12	-	Guslyakov et al. 1992

Table 3 – Comparison of different *Navicula* species discussed in this paper.

Feature	*N. pontica* (Mereschk.) comb. & stat. nov.	*N. normalis* Hust.	*N. spuria* P.T.Cleve	*N. pennata* A.W.F.Schmidt	*N. pinnata* Pant.	*N. cancellata* Donkin	*N. parapontica* sp. nov.	*N. directa* (W.Sm.) Ralfs	*N. tripunctata* (O.F.Müll.) Bory
Valve shape	Strictly lanceolate, ends acutely rounded	Lanceolate with slightly convex margins and acute subrostrate apices	Lanceolate with very acute ends	Linear-lanceolate with subacute apices	Lanceolate with very evident protracted ends	Linear-lanceolate arched about transapical axis with cuneate, sub-acute to broadly to broadly rounded apices	Strictly lanceolate, ends acutely, rounded, not protracted	Narrowly lanceolate with sub-acute apices	Linear-lanceolate to linear, ends wedge-shaped, obtusely rounded
Length, µm	34–70	53	90–150	68–95	62–125	40–90	22–38	72–120	30–70
Width, µm	6–10	9	13–21	11–14	?	12–15	5–6	7–12	6–10
Stria orientation	Moderately radiate proximally becoming less radiate to subparallel to the ends	Radiate, parallel near apices	Slightly radiate in the middle, parallel to the ends	Radiate throughout	Slightly radiate in the middle, parallel to the ends	Slightly radiate in the middle, parallel at the apices	Moderately radiate proximally becomes less radiate to subparallel to the ends	Parallel	Weakly radiate, becoming parallel, weakly convergent at the ends
Stria density in 10 µm	7–10	10–12	7	5–6	7.5	5–8	12–14	4–11	9–12
Lineola density in 10 µm	24–28	32	21–24	20	?	?	35–40	?	32
Axial area	Very narrow	Very narrow	Very narrow	Narrow	Relatively large, ¼ valve	Narrow	Very narrow	Very narrow	Very narrow
Central area	Irregularly rectangular	Rather large, elliptic	Small, irregularly rounded	Large, quadrangular	Relatively large, circular	Relatively large	Approximately rectangular	Small	Almost rectangular, slightly asymmetric
External sternum	Not evident	?	(?) evident	Not evident	?	Evident	Evident, depressed in the middle of the central area	?	Not evident
Reference	This study	Witkowski et al. 2000	Cleve 1895; Peragallo 1897–1908	Witkowski et al. 2000	Pantocsek 1889; Cleve 1895	Witkowski et al. 2000	This study	Witkowski et al. 2000	Cox 1979; Lange-Bertalot 2001

transapical striae are always parallel or slightly radiate. In addition both taxa have fairly different Voigt discordances. The central area in the Caspian Sea specimen is more asymmetric, circular (not irregularly rectangular), whereas external central raphe endings are more strongly curved to the secondary valve side. In Mereschkowsky's taxon external central raphe endings are straight or (in SEM) slightly curved to the primary side (fig. 2C). The above means that the occurrence of *N. pinnata* var. *pontica* in the Caspian Sea needs to be verified.

Also, Guslyakov and coworkers lumped four different species under *Navicula pennata* var. *pontica* (Guslyakov et al. 1992: pl. LI/9–16). Our analysis of Guslyakov's illustrations reveals that only two images (op. cit.: pl. LI/11, 12) represent the true taxon of Mereschkowsky; two other images doubtless illustrate the newly described *Navicula parapontica* (op. cit.: pl. LI/14, 16). The remaining specimens belong in two other as yet unnamed species. The above references included the taxa in question and were accompanied by LM illustrations. The names, following the error of Proshkina-Lavrenko, were cited in other publications, however, no images were included there. Gerasimiuk et al. (2009) compiled a list of diatom taxa identified from the Ukraine territory and included *Navicula pennata* A.W.F.Schmidt var. *pontica* Mereschk.

In summary of the above, due to the unclear concept of Mereschkowsky's taxon and a series of errors following a publication by Proshkina-Lavrenko, we propose a change in status and a specific name of the taxon in question. We propose a new name *Navicula pontica* (Mereschk.) comb. & stat. nov. Within the shape and size range as outlined for Mereschkowsky's taxon by Proshkina-Lavrenko (1955, 1963), we have been able to establish a second species, i.e. *Navicula parapontica*. The name of the second species implies close relationship, but now both taxa are very clearly distinguished from each other (cf. table 3). The major differences in LM are: larger size, lower stria density and clearly resolvable lineolae in the transapical striae of *Navicula pontica*. In SEM the major differences are that *Navicula pontica* has an arched valve surface and areolated valve mantle, whereas in *Navicula parapontica* the valve surface is flat and the mantle bears no areolae (figs 2C, 3F & G). *Navicula pontica* seems to belong to the "complex of species" with large valves with low striae density and lineolae resolvable in LM. Included in this group are *Navicula directa* (W.Sm.) Ralfs in Pritchard, *Navicula normalis* Hust., and *Navicula pennata* A.W.F.Schmidt. They possess a number of morphological features that allow them to be distinguished under LM (table 3; cf. also Witkowski et al. 2000). The second species, *Navicula parapontica*, shows close relationship to the group of *Navicula* species that conform to the generitype, i.e. *Navicula tripunctata* (Cox 1979, Lange-Bertalot 2001).

Navicula pontica and *Navicula parapontica* have special siliceous projections into the dilated proximal external raphe ends. However, these structures distinguish the two taxa very well. In *Navicula pontica* the projections are larger and triangular (fig. 2A & B), whereas in *Navicula parapontica* they are thin and narrow (fig. 3D & E). This ultrastructural

Table 4 – Average values of abundance of *Navicula parapontica*,
Content of the major heavy metals and toxic substances and the variation range (in brackets) recorded in the bottom sediments of the southwestern Crimea area (the Black Sea).

Area / Average values	Laspi Bay	Adjacent area of Sevastopol Bay	Sevastopol Bay	Balaklava Bay
N. parapontica ($\times 10^7$ cells·m^{-2})	227.3 (2.8–1300)	440.5 (6.0–3564.0)	1.1 (0.25–2.9)	0.06 (0.0000001–0.056)
Hg, (μg·g^{-1} DW)	0.04 (0.03–0.05)	0.32 (0.15–0.88)	3,15 (0.17–18.0)	0.78 (0.25–2.0)
Cu, (μg·g^{-1} DW)	7.36 (3.40–11.32)	26.17 (20.00–36.55)	121.7 (21.2–419.0)	153.5 (33.8–350.0)
Pb, (μg·g^{-1} DW)	3.69 (3.50–5.00)	25.21 (15.0–37.5)	168.2 (5.0–1120)	320.7 (51.2–885.0)
Zn, (μg·g^{-1} DW)	12.0 (6.0–33.0)	18.17 (3.8–61.2)	209.5 (37.5–625.0)	221.0 (53.0–600.0)
Cr, (μg·g^{-1} DW)	1.91 (1.51–2.62)	10.73 (7.5–20.0)	36.22 (9.3–88.8)	30.6 (2.5–67.5)
Mn, (μg·g^{-1} DW)	6.3 (1.6–7.0)	178.3 (140.0–230.0)	351.92 (168.0–850.0)	324.4 (175.0–470.0)
DDT, (ng·g^{-1} DW)	2.8 (1.8–3.0)	64.2 (14–247)	22.2 (1.5–77.7)	18.4 (1.5–93.0)
Polychloro biphenyls, (ng·g^{-1} DW)	5.4 (6.0–8.0)	155.0 (40–604)	395.3 (60.0–1975.0)	118.4 (2.0–435.0)
Chloroform-extracted-bitumens (mg·g^{-1})	0.1 (0.05–0.2)	1.3 (1.2–2.3)	1.8 (0.6–3.2)	Not measured
Oil hydrocarbons (mg·g^{-1})	0.11 (0.09–0.16)	0.38 (0.14–0.90)	7.20 (1.46–15.36)	Not measured
Policyclic aromatic hydrocarbons (μg·g^{-1} DW)	Not measured	Not measured	4490.4 (8–30063.5)	8359.1 (921–26033)

feature is constant, though its role and origin are unclear. So far it has been observed in both marine/brackish and freshwater species, such as e.g. *Navicula genestoermeri* Witkowski, Lange-Bert., Kociolek & Bak, *Navicula bakiana* Witkowski & Lange-Bert., *Navicula tripunctata* (O.F.Müll.) Bory, *Navicula jakovljevicii* Hust., *Navicula praeterita* Hust., and *Navicula concentrica* J.Carter (Krammer & Lange-Bertalot 1985, Reichardt 1992, Lange-Bertalot 2001, Witkowski et al. 2009).

Distribution and ecology of *Navicula pontica* and *N. parapontica*

In terms of biogeography *Navicula pontica* has a rather limited distribution and we suppose that it may be an endemic species of the Black Sea. Comparison with an illustration by Karayeva (1972) shows clearly that *N. pontica* is absent in the Caspian Sea. To the best of our knowledge *N. pontica* was not illustrated from the neighboring areas, e.g. from the Mediterranean or the Atlantic coast. *Navicula parapontica* apparently has a broader distribution. A single valve of species conforming to *N. parapontica* was illustrated by Witkowski et al. (2000: pl. 134/10) from the Norwegian Sea.

It is interesting that *Navicula pontica* was recorded only in samples collected during the first half of the last century. It was more abundant in samples collected near Sevastopol. Surprisingly in recent samplings from this area we did not observe *Navicula pontica*. Two explanations are possible for this fact. The first reason could be that most samples collected by Proshkina-Lavrenko originated from seaweeds or higher plants, whereas the subsequent studies focused on benthic diatom communities from variable substrates. The second explanation, more evident to us, is that the environment was subject to dramatic changes during the second half of the last century due to in general strong anthropogenic pressure. We believe the second reason played the major role, and in this case we consider *Navicula pontica* a species sensitive to pollution and eutrophication. Likewise, other species that were found by Proshkina-Lavrenko (1963) in this area, such as *Navicula glabriuscula* var. *ellipsoidales* Proshk.-Lavr., *Stauroneis salina* var. *maeotica* (Pant.) Proshk.-Lavr., *Climaconeis inflexa* (Bréb. ex Kütz.) E.J.Cox, are observed now almost only in protected areas of the Black Sea.

Unlike *Navicula pontica*, *Navicula parapontica* is the dominant species amongst genus *Navicula* in the Black Sea. It is related to the group of eurythermal, eurybiontic and heliophilous species, inhabiting mainly the upper part of the sublittoral zone (0–10 m) and well adapted to stress conditions, e.g. the influence of waves and currents, high insolation, and broad amplitude of temperature (Proshkina-Lavrenko 1963, Guslyakov et al. 1992, Nevrova et al. 2003). This species also possesses a high tolerance to the influence of environmental factors (mostly of anthropogenic impact) and is characterized by high frequency of occurrence in all regions of the Black Sea investigated (table 4). *Navicula parapontica* contributes significantly (6 to 11.2%) to the average similarity of benthic diatoms in locations of the southwestern Crimea that have been investigated (Petrov & Nevrova 2007). This species was characterized by the highly stable abundance in both polluted and unpolluted habitats along the Crimean coast of the Black Sea (Nevrova et al. 2003).

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