

**Distribution:** *Pinnularia borealis* var. *subislandica* was found on Mt. Šar Planina, western Macedonia, Mt. Pelister, south-western Macedonia and in the region of Mariovo and near the city of Prilep in central Macedonia. On Mt. Pelister this taxon was observed as epiphytic on mosses from the temporary Lake Bolnici I, near glacial Lake Golemo, at 2225 m a.s.l.

On Mt. Šar Planina *P. borealis* var. *subislandica* was observed within the epipelon of Lake Golemo Karanikoličko (at 2185 m a.s.l.) and Lake Crno (at 2165 m a.s.l.). This taxon was also found as epiphytic on the macrophyte vegetation from a stream above Lake Crno and from Lake Golemo Karanikoličko.

In central Macedonia *P. borealis* var. *subislandica* was found in the region of Mariovo as epiphyte on macrophytes from a wet rock before the village of Dunje and in a sample of the organic sediment of an old well in the village of Zabrčani, near the city of Prilep.

**Observations:** The valve width for *P. borealis* var. *subislandica* given in the protologue ( $W = 9.4\text{--}11.5\ \mu\text{m}$ ) is slightly higher than observed herein. The truncate valve apices, also observed in the specimens from Macedonia, distinguish this taxon from the remaining varieties within *P. borealis* (Krammer [7]).

In general, it is difficult to differentiate the infraspecific taxa from the *P. borealis* complex: var. *borealis*, var. *islandica*, var. *scalaris* and var. *subislandica*. All of these taxa share linear-elliptic or linear-lanceolate valves, with narrow to moderately broad axial area, more or less rhombic-lanceolate central area and rather equal striae orientation and density. Nevertheless, a distinction was made due to the shape of the valve apices. Both *P. borealis* var. *borealis* and *P. borealis* var. *islandica* have unprotracted valve ends, but the valve apices in the latter one are particularly broader rounded. *Pinnularia borealis* var. *scalaris* can be distinguished by the weakly protracted valve apices, whereas *P. borealis* var. *subislandica* by the truncate valve apices.

The difficulties around the identification of the *P. borealis* taxa were recently also outlined by Souffreau et al. [18]. The authors studied 52 *P. borealis* strains from different geographical regions (South and North America, Antarctica, Europe), which included three morphological varieties: var. *borealis*, var. *islandica* and var. *scalaris*. Identical eight lineages have been recovered by two different and independent markers, and a distinct continental Antarctic lineage has been evidenced. Only one morphological variety (var. *islandica*) has been

restricted to a single lineage, whereas the other two have been scattered throughout the phylogeny. Furthermore, a reasonable doubt has been associated with the "identification based on valve morphology alone" for the examined species complexes, with methodologies like geometric morphometrics and DNA barcoding suggested as possible assistance (Souffreau et al. [18]). Nevertheless, regarding the *P. borealis* complex we decided to follow existing morphospecies concepts and use existing names. Molecular evidence for this complex from Macedonia is yet not available and the application of additional methodologies, which might prove helpful in identification, would require a rather different approach than the one adopted here.

***Pinnularia dubitabilis* Hustedt var. *dubitabilis* [17] (Figs 4: 11–20)**

Valves rectangular, linear, with parallel to weakly convex margins and unprotracted, rounded to truncate apices. Valve length 28.0–40.0  $\mu\text{m}$ , and valve width 7.0–8.5  $\mu\text{m}$  ( $n = 30$ ). Axial area very broad, 1/2 of valve width or wider, linear to lanceolate. Axial area rarely narrower, 1/4 of valve width, only in shortest specimens. Central area absent, rarely vaguely defined with 1–2 shortened striae from both sides. Raphe weakly lateral, outer raphe fissures linear to weakly curved, and inner fissures linear. Proximal raphe endings deflected towards one valve side, terminated with large and distinct, round to tear-drop shaped central pores. Distal raphe fissures sickle-shaped, clearly discernible in LM. Transapical striae broad, very short and marginal. Striae distantly spaced, parallel throughout, rarely becoming weakly convergent near valve apices, 4–5 in 10  $\mu\text{m}$ . Interstriae of equal or greater width than striae.

**Distribution:** *Pinnularia dubitabilis* var. *dubitabilis* was observed in aerial habitats on mountain of Osogovo and in the region of Mariovo, and in various habitats, glacial lakes and peat bogs, on Mt. Šar Planina. On Mt. Osogovo, eastern Macedonia, it was found in a mixed sample of mosses and algal filaments from a wet rock near Stari Grad. In the region of Mariovo, central Macedonia, this taxon was observed as epiphytic on macrophytes from a wet rock before the village of Dunje.

On Mt. Šar Planina *P. dubitabilis* var. *dubitabilis* was observed on several localities: Lakes Belo and Golemo Karanikoličko and a peat bog near Ceripašina. Lake Belo is located at an altitude of 2265 m a.s.l. in a rocky basin surrounded by grassland, and is fed by several streams as well as the snow-melt and rain fall. *Pinnularia dubitabilis* var. *dubitabilis*

was observed within the epilimnion of Lake Belo. This taxon was found as an epiphyte on the macrophyte vegetation from Lake Golemo Karanikoličko, located at an altitude of ca. 2300 m a.s.l. At somewhat lower altitude, 2150 m a.s.l. this taxon was observed as epiphytic on mosses from a peat bog near Ceripašina.

**Observations:** A single specimen of *P. dubitabilis* var. *minor* is depicted in Krammer [7]. It is distinguished from the nominate variety by the very short and marginally positioned striae. The valve size given in the protologue (length = 20.0–25.0  $\mu\text{m}$ , width = 6.5–6.8  $\mu\text{m}$ ) is overlapping with

the valve size of the nominal variety (length = 23.0–40.0  $\mu\text{m}$ , width = 6.0–7.0  $\mu\text{m}$ ). According to Krammer [7] *P. dubitabilis* var. *dubitabilis* was not observed in Europe. However, there are few other records of this taxon from elsewhere under different names as *P. borealis* f. *rectangularis* Carlson, *P. borealis* var. *rectangulata* Hustedt or *P. eburnea* (Carlson) Zanon.

However, sufficient morphological differences to distinguish the specimens depicted here from *P. dubitabilis* var. *dubitabilis* are not present.

### Key for identification of *Pinnularia* section *Distantes* from Macedonia

1. Valve wider than 20  $\mu\text{m}$  ..... 1
1. Valve narrower than 20  $\mu\text{m}$  ..... 4
2. Valve wider than 30  $\mu\text{m}$  ..... *P. lata*
2. Valve narrower than 30  $\mu\text{m}$  ..... 3
3. Valve longer than 80  $\mu\text{m}$ , ornamentation on valve face present ..... *P. micevskii*
3. Valve shorter than 80  $\mu\text{m}$ , ornamentation on valve face absent ..... *P. subalpina*
4. Valve wider than 10  $\mu\text{m}$  ..... 5
4. Valve narrower than 10  $\mu\text{m}$  ..... 9
5. Valve apices protracted ..... *P. rabenhorstii* var. *franconica*
5. Valve apices not protracted ..... 6
6. Valve apices rounded ..... 7
6. Valve apices truncate ..... *P. rabenhorstii* var. *rabenhorstii*
7. Valves linear, with consistently parallel margins ..... *P. idsbensis*
7. Valve with convex margins ..... 8
8. Valves linear-elliptic, valve apices narrowly rounded ..... *P. lata* var. *minor*
8. Valves linear-lanceolate, apices broadly rounded ..... *P. borealis* var. *islandica*
9. Valves rectangular, striae very short ..... *P. dubitabilis*
9. Valves linear to linear lanceolate, axial area narrow ..... 10
10. Valve apices truncate ..... *P. borealis* var. *subislandica*
10. Valve apices rounded ..... 11
11. Valve apices weakly protracted ..... *P. borealis* var. *scalaris*
11. Valve apices not protracted ..... *P. borealis* var. *borealis*