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# Quaternary climate change in ancient lakes Ohrid and Prespa; high lake's resilience prevents catastrophic ecosystems collapses: the diatom evidence

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| Property | Unit | Lake Prespa | Lake Ohrid |
|---|---|---|---|
| Altitude | m asl | 849 | 693 |
| Catchment area | km$^2$ | 1300 | 2610 |
| Lake surface area | km$^2$ | 254 | 358 |
| Maximum depth | m | 48 | 288 |
| Mean depth | m | 14 | 155 |
| Volume | km$^3$ | 3.6 | 55.4 |
| Hydraulic residence time | yr | ~11 | ~70 |
| Average phosphorus TP concentration | mg P m$^{-3}$ | 31 | 4.5 |
| Number of endemic species | | ? | 300 |
| Drill site water depth | m | 14 | 243 |
| Length of composite record (this study) | m | 17.7 | 37.5 |
| Age | ka | 92.0 | 92.0 |
| Sample resolution for diatom analysis | cm, ka | 16, ca. 0.3–0.5 | 8, ca. 0.1–0.4 |
| Total number of analyzed slides | | 222 | 235 |

-Diatom response: temperature tresholds (wind activity, light, nutrients)
-Ultra- to oligotrophic for the last 92 ka, no indication for lake-level changes
-Prolonged and gradual transitions (MIS 5/4 and 2/1)
**RESISTANT ECOSYSTEM**

-Diatom response: driven by moisture availability
-Multiple shifts in productivity: (oligo-) meso- to eutrophic, lake-level changes
-Abrupt regime shifts (MIS 5b, LGM)
**RESILIENT ECOSYSTEM**

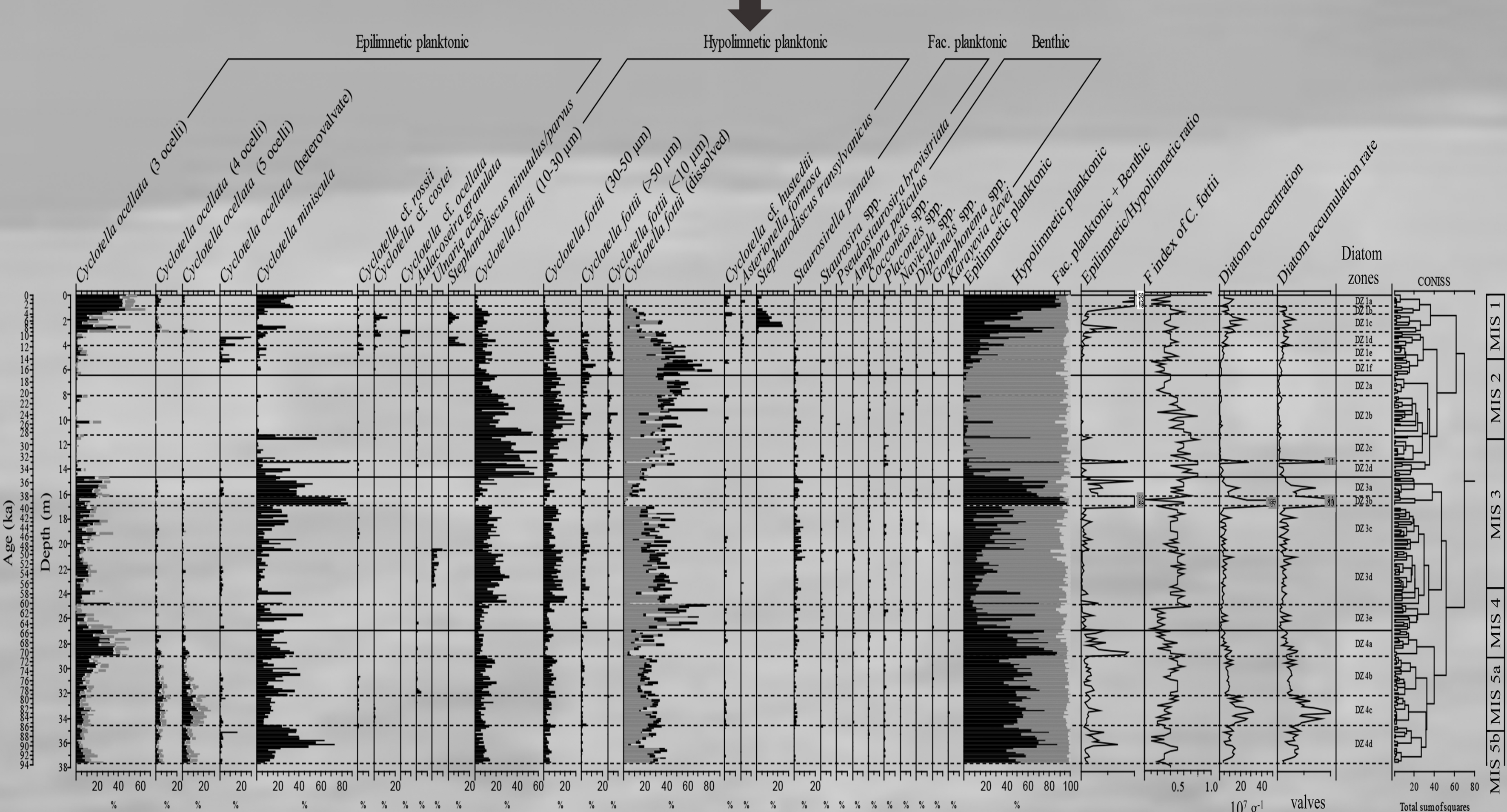



Fig 1. Stratigraphic diatom diagram showing species with >2 % abundance in Lake Ohrid DEEP site core, F index of *Cyclotella fottii*, DC and DAR. Diatom zone boundaries are defined by CONISS, Marine Isotope Stages (MIS) boundaries after Lisiecki and Raymo (2005).

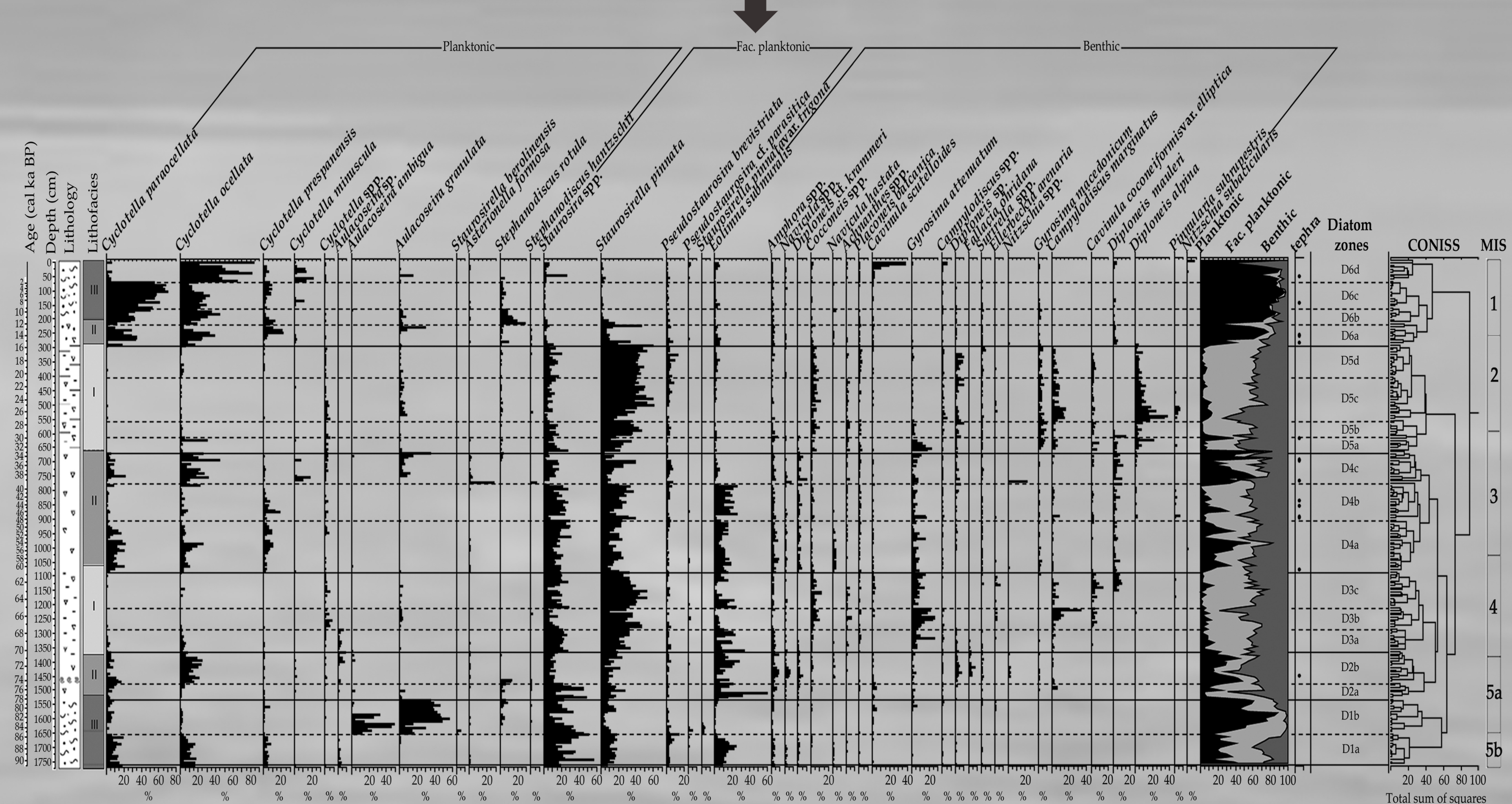



Fig. 2. Stratigraphic diatom diagram showing species with >2 % abundance in Lake Prespa core Co1215, displaying diatom zones defined by CONISS, lithology and lithofacies (Damaschke et al., 2013). IRD = Ice-rafted debris, Marine Isotope Stages (MIS) after Lisiecki and Raymo (2005).

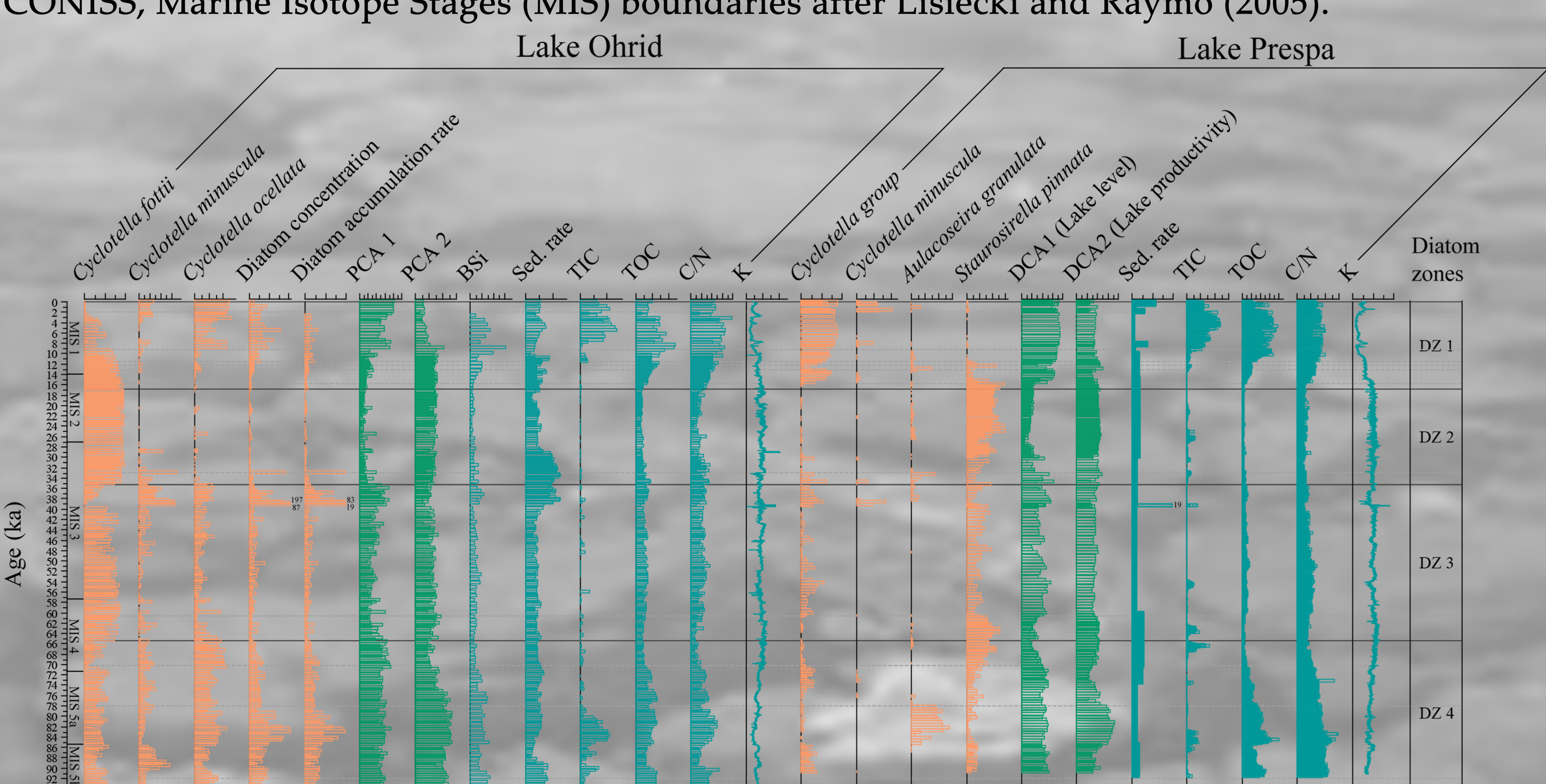



Fig. 3. Comparison diagram between Lake Ohrid DEEP site core and Lake Prespa core Co1215 showing the relative abundance data of selected diatom species and (bio)geochemical data. DZ 1–4 from Lake Ohrid core DEEP; dotted lines mark the six diatom zones of Lake Prespa core Co1215.

## MODEL PREDICTIONS:

Due to the underground connection through Mt. Galicica, a potential 20 m water-level decrease of Lake Prespa can cause a five-fold increase of its phosphorus concentration, which may lead to a 30% increase of the P load from Lake Prespa to Lake Ohrid.

## AIMS:

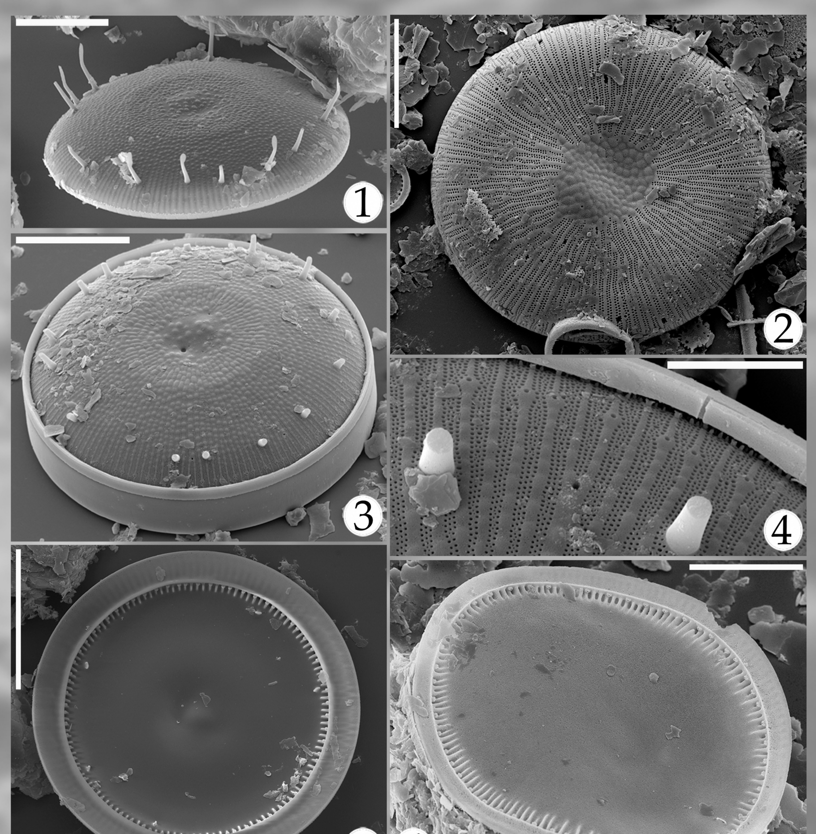
Assess the potential interconnectivity between the lakes and understand the role of Lake Prespa as possible driver of lake-level and/or nutrient shifts in Lake Ohrid over the past 92.0 ka.

## RESULTS:

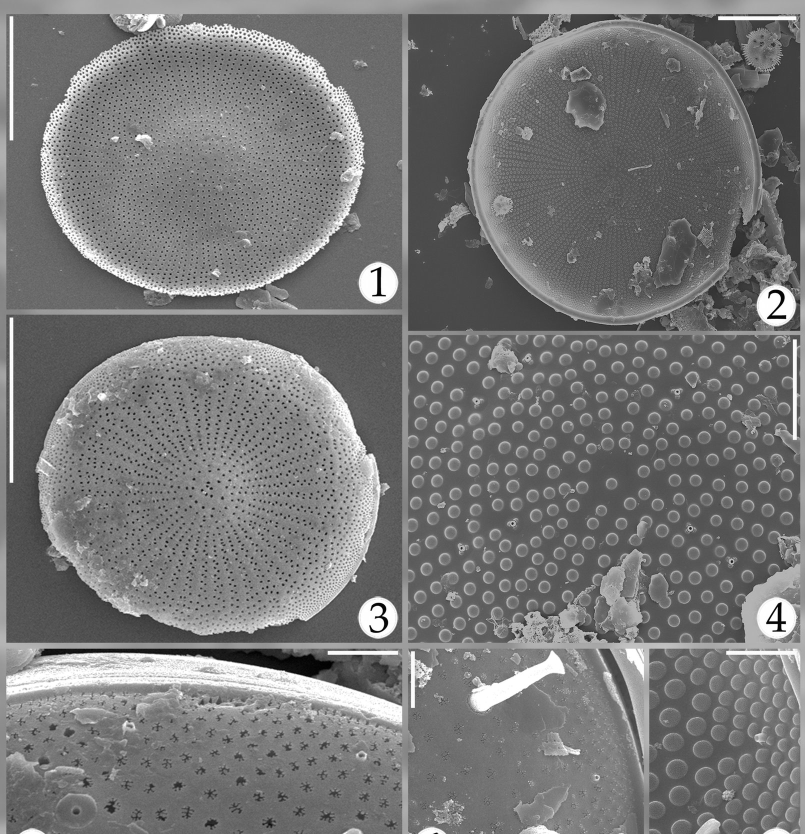
✔ The comparison provides sufficient evidence to disregard the theory of Prespa-dependent regime shifts in Ohrid.

✔ Complete collapse of the ecosystems functionality and loss of their diatom communities did not happen in either lake.

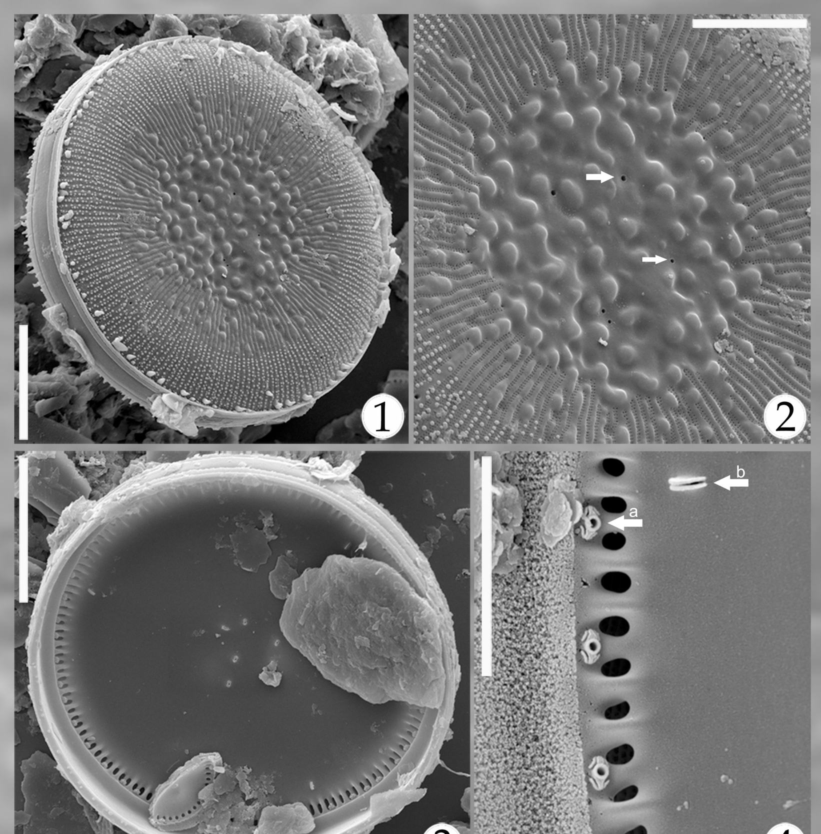
**HIGH ECOSYSTEM RESISTANCE/RESILIENCE ➡ NO CATASTROPHIC EVENTS**



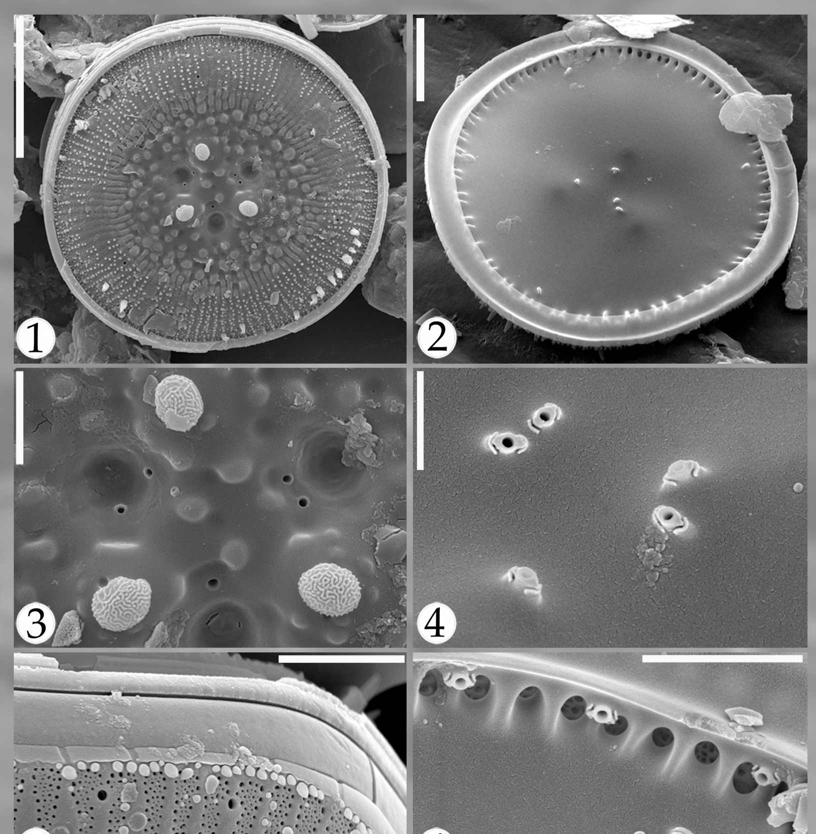
**Lake Ohrid**
Figs 1–6. SEM. *Cyclotella fottii* Hustedt. Figs 1–4. external valve views. Figs 5, 6. internal valve views. Scale bars: Figs 1, 3, 5 = 20 µm; Figs 2, 6 = 10µm; Fig. 4 = 5.



**Lake Ohrid**
Figs 1–7. SEM. *Stephanodiscus* sp. Scale bars: Figs 1–3 = 20 µm; Fig. 4 = 5 µm; Figs 5–7 = 2 µm.



**Lake Prespa**
Figs 1–4. SEM. *Cyclotella prespanensis* Cvetkoska, Hamilton, Ognjanova-Rumenova & Levkov. Scale bars: Figs 1, 3 = 10 µm; Fig. 2 = 5 µm; Fig. 4 = 3 µm.



**Lake Prespa**
Figs 1–6. SEM. *Cyclotella paraocellata* Cvetkoska et al. Scale bars: Fig. 1 = 10 µm; Fig. 2 = 5 µm; Figs 3, 5, 6 = 2 µm; Fig. 4 = 1 µm.

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