

# New findings of Middle Miocene (Badenian) bony fish otoliths in Northern Croatia

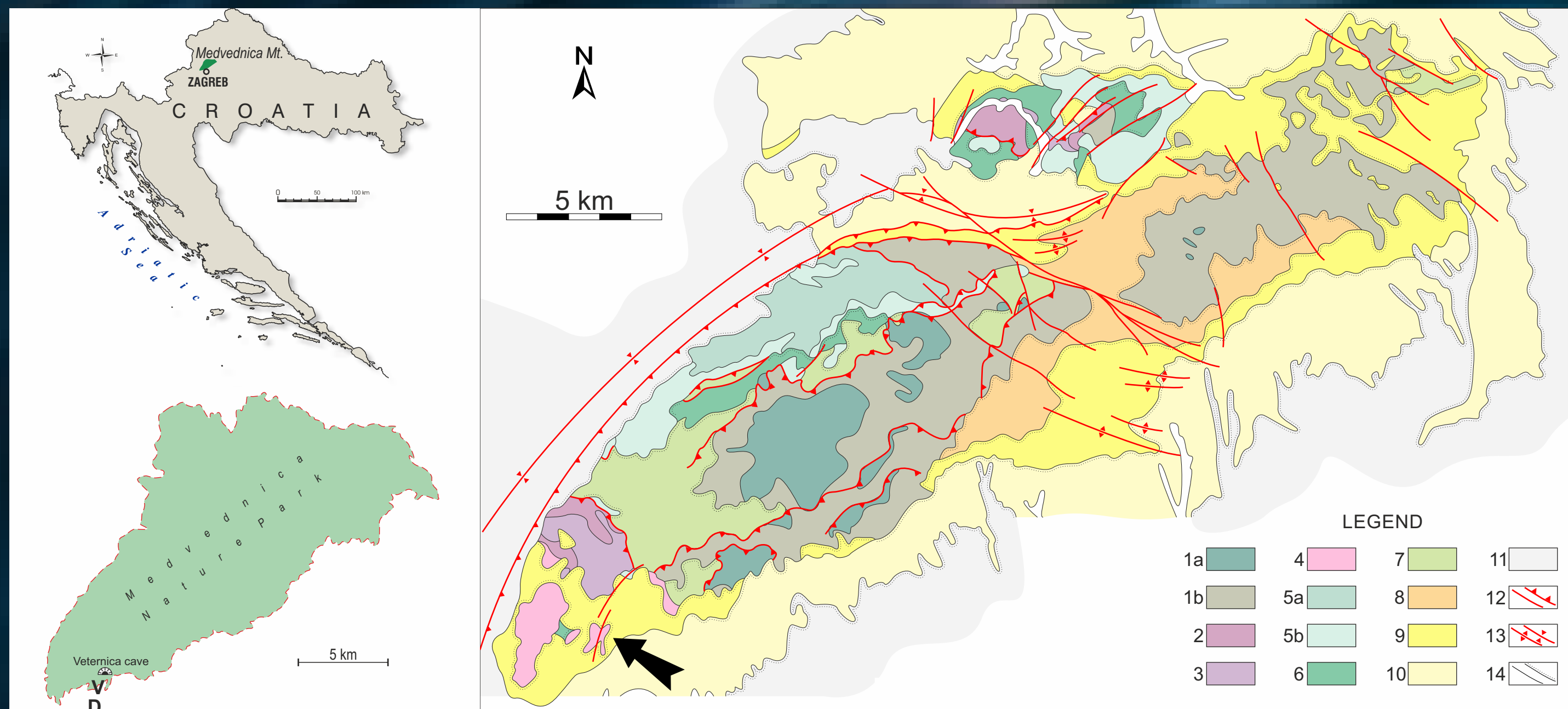


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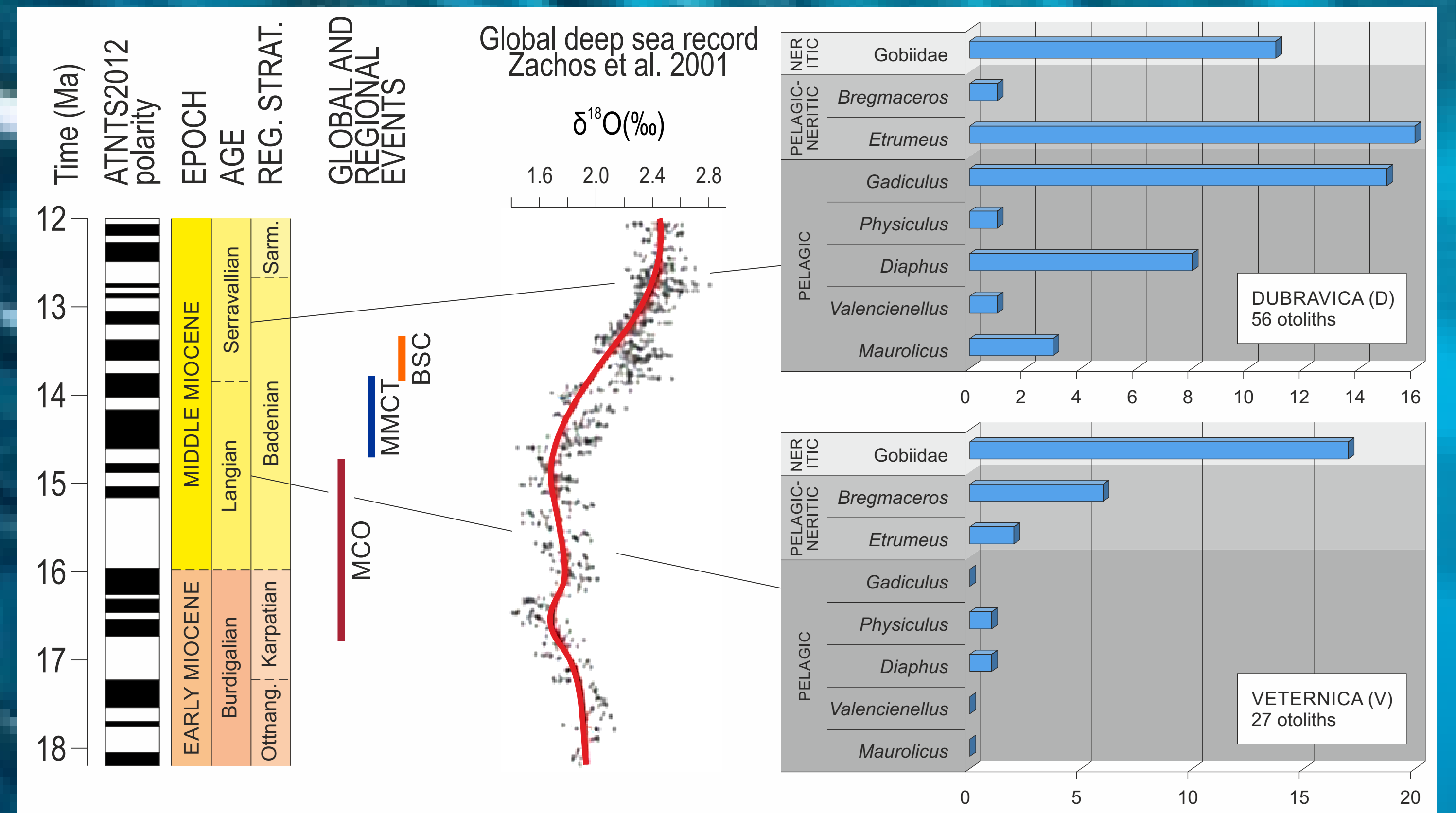
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Legend: 1a,b – Silurian to Upper Triassic metamorphic rocks; 2-4 – Triassic clastic and carbonate sedimentary rocks; 5a,b – Mesozoic ophiolites; 6 – Aptian to Cenomanian marine sedimentary rocks; 7 – Uppermost Cretaceous to Paleocene transgressive succession; 8 – Early Miocene fluvial and lacustrine deposits; 9 – Middle Miocene marine to brackish sedimentary rocks; 10 – Late Miocene brackish and marsh deposits; 11 – Pliocene clastic deposits; 12 – faults; 13 – fold axes; 14 – normal and transgressive boundaries

Figure 2. Global and regional Early and Middle Miocene events (from Mandić et al., 2019) and diversity and abundance of fish otoliths collected at the localities Dubravica and Veternica, at SW part of the Medvednica Mt.



## RESULTS

Diverse small otoliths of shallow-water gobiid fishes, together with neritic-pelagic clupeiform *Etrumeus* and codlets of the genus *Bregmaceros* dominate at Veternica locality, while pelagic genera of cods, lanternfishes and silvery lightfishes (*Gadiculus*, *Physiculus*, *Diaphus*, *Valencienellus* and *Maurollicus*) dominate at Dubravica locality (Husain, 2018) (Figures 2-4). Associated fauna at Veternica locality comprises solitary corals, numerous gadilid and some dentalid scaphopods, small oysters, foraminifera, ostracods, decapod crustaceans and echinoids. This fossil assemblage points to the temporarily increased input of fresh water into the basin, therefore a shelf environment with a nearby river-mouth is presumed for this locality (Šeparović, 2019). Otoliths and the associated fauna at Dubravica locality (foraminifera, ostracods, sponge spicules, diverse scaphopods, bivalves, gastropods, crustaceans) represent a mixture of shallow-marine and pelagic taxa, probably deposited on the upper continental slope.

## DISCUSSION

Badenian (Langhian to Serravalian) age of these deposits (Figure 2) is determined on the basis of the accompanying foraminifera, while the associated nanoplankton is scarce, poorly preserved and points to the wide stratigraphic range (NN4 to NN6 Zones). Fish fauna shows similarity with the Badenian assemblage from the borehole LOM-1 situated in Lomnice/Tišnov denudational relict (Carpathian Foredeep, Czech Republic; Holcová et al. 2015), and, partly, Badenian to Sarmatian ichthyofauna from the vicinity of Belgrade (Schwarzshans et al. 2015). This research highly improves the knowledge on the Badenian teleost fauna from northwestern Croatia, regarding the only two taxa (*Chrysophrys* sp. and Acanthuridae gen. et sp. indet.) previously determined from fossil teeth found in this area (Kochansky 1944; Tripalo et al. 2016).



Figure 3. Selected otoliths from the localities Veternica (lower picture) and Dubravica (upper). They belong to fishes from neritic (both localities: a,b – Gobiidae), transitional (d – *Bregmaceros* from Dubravica and *Etrumeus* from Veternica) and pelagic (c – *Maurollicus* from Dubravica, e,f – *Diaphus* from both localities) environments. Further collecting and taxonomical study is in course.

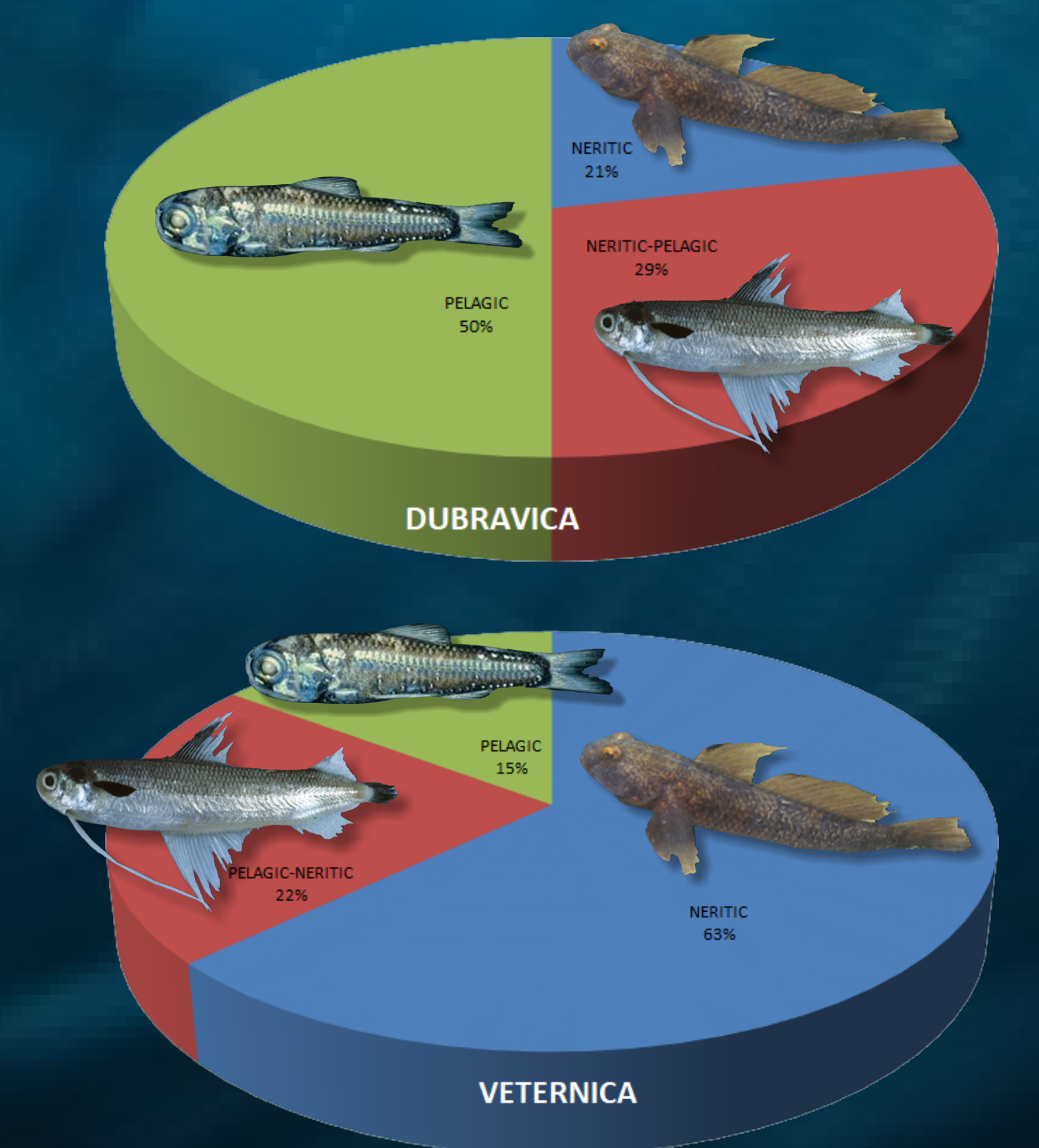


Figure 4. Relative abundances of neritic, neritic-pelagic and pelagic fishes at research localities, calculated from the number of collected otoliths

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