

FIRST REPORT ON SWIMMING TRACE FOSSILS OF FISH FROM THE UPPER PERMIAN AND LOWER TRIASSIC OF THE DOLOMITES (ITALY)

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Abstract: In the Upper Permian continental to marginal-marine succession of the Southern Alps (Dolomites, north Italy), the ichnological record consists of diverse vertebrate footprints and non-diverse invertebrate trace fossils, mainly occurring in the “Bletterbach ichnoassociation” of the Val Gardena Sandstone Formation. After the Permian-Triassic Boundary event, vertebrate ichnoassociations are scarce until the Middle Triassic (Anisian), whereas the uppermost Permian–Lower Triassic Werfen Formation preserves a rich invertebrate trace-fossil record. To date, fish body and trace fossils (*Undichna*) are very rare in the pre- and post-extinction deposits of the Dolomites; only *Undichna gosiutensis* Gibert, 2001 was identified in the “Voltago Conglomerate” (Middle Anisian), whereas some unidentified fossil fish casts were found in the Permian Val Gardena Sandstone and some fish remains in the overlying Werfen Formation.

Recently, for the first time, fish trails have been discovered in the Val Gardena Sandstone (Lopingian) and in the Werfen Formation (Campil member, Early Triassic, Smithian). Val Gardena Sandstone yielded *Undichna* cf. *quina* Trewin, 2000 and *U. bina* Anderson, 1976 and these represent the oldest fish trails found in the Southern Alps so far. Conversely, the specimens found in the Werfen Formation can be assigned to *Undichna* cf. *britannica* Higgs, 1988. They represent the oldest Mesozoic record of fish trace fossils in northern Italy and one of the few records of *Undichna* from marine environments. These trace fossils are consistent with the fossil association found in the two formations and reflect fish swimming activity in different environments: in very shallow, calm, brackish distal-floodplain to marginal-marine environments in the Late Permian, in association with abundant and diverse tetrapod tracks, and non-diverse invertebrate trace fossils, and in inter- to subtidal calm, shallow, marine environments in the Early Triassic, together with abundant, but not diverse invertebrate trace fossils.

Key words: Trace fossils, *Undichna*, Permian, Triassic, northern Italy.

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INTRODUCTION

Trace fossils, being rarely transported, represent an *in situ* record of ancient biogenic activities, and in shallow marine settings, can provide an important insight into benthic life (e.g., Seilacher, 1967; Leonardi, 1987; Buatois and Mángano 2011). This work deals with the recent discovery of *Undichna* fish trails in the Upper Permian and Lower Triassic deposits of the Southern Alps of Italy (Fig. 1). They

represent the first record of fish trace fossils in the stratigraphical units below and above the Permian-Triassic Boundary (PTB). Undetermined fish casts are known from Upper Permian strata (Conti *et al.*, 1975) and other fossil remains, referred to *Archaeolepidotus leonardi* and *Paralepidotus? moroderi*, were determined by Accordi (1955, 1956). According to this author, they were found in the Lower