Estuaries and Coasts
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Structural and Functional Composition of Benthic Nematode Assemblages During a Natural Recovery Process of *Zostera noltii* Seagrass Beds

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Abstract In 2008, the stable seagrass beds of the Mira estuary (SW Portugal) disappeared completely; however, during 2009, they have begun to present early symptoms of natural recovery, characterised by a strongly heterogeneous distribution. This study was designed to investigate the spatial and temporal variability patterns of species composition, densities and trophic composition of the benthic nematode assemblages in this early recovery process, at two sampling sites with three stations each and at five sampling occasions. Because of the erratic and highly patchy seagrass recovery and the high environmental similarity of the two sampling sites, we expected within-site variability in nematode assemblages to exceed between-site variability. However, contrary to that expectation, whilst nematode genus composition was broadly similar between sites, nematode densities differed significantly between sites, and this between-site variability exceeded within-site variability. This may be linked to differences in the *Zostera* recovery patterns between both sites. In addition, no clear temporal patterns of nematode density, trophic composition and diversity were evident. Nematode assemblages generally resembled those of other estuarine muddy intertidal areas, which have a high tolerance of stress conditions.

Keywords Biodiversity · Free-living nematodes · Seagrass recovery · Spatial and temporal distributions

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Introduction

Seagrass beds comprise some of the most heterogeneous landscape structures of shallow-water estuarine/marine ecosystems in the world. They have important ecological roles and provide high-value ecosystem services (Costanza et al. 1997). Many studies have reported that seagrass beds harbour higher productivity, biomass, abundance and diversity of benthos compared to unvegetated sediments (Boström and Bonsdorff 1997; Edgar et al. 1994; Hemminga and Duarte 2000; Hirst and Attrill 2008; Webster et al. 1998). Their high sensitivity to environmental deterioration and widespread geographical distribution also make seagrasses useful 'miner's canaries' of coastal deterioration (Marbà et al. 2006; Orth et al. 2006).

There have been numerous reports of seagrass decline worldwide, indicating that seagrass habitats are undergoing a global crisis with important consequences for coastal biodiversity, environmental status and even economy (Boström et al. 2006; Hughes et al. 2009). Unprecedented decline of *Zostera noltii* Hornem. meadows has also been reported in Portuguese estuaries during the last decade (Cunha et al. 2013). In 2008, the *Z. noltii* beds of the Mira estuary disappeared completely (Cunha et al. 2013). The causes of the seagrass loss have not yet been determined, but changes in sedimentation dynamics may be an important driver of seagrass habitat loss (Fourqurean and Rutten 2004).

During 2009, the *Z. noltii* bed of the Mira estuary began to show early symptoms of natural recovery, characterised by

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