The invasive bivalve *Ruditapes philippinarum* (Adams and Reeve), collected in the Venice lagoon (Italy), one of the study sites in Queirós *et al.* (in prep.).

Are all invasions alike?

Context dependence of invasion impacts on biodiversity and ecosystem functioning

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Invasive ecosystem engineers are high-impact species because they regulate resource availability to other species and contribute disproportionately to ecosystem functioning. With the potential to modify local species diversity patterns and the physical attributes of invaded systems, these species can cause significant change to the ecological context under which biodiversity and ecosystem functioning links are established. Under global environmental change, it is crucial that invasion processes begin to be perceived under a more integrated ecosystem perspective, in which contrasting ecological scenarios are taken into account.

Biodiversity influence on ecosystem functioning rates has long been recognized to be strongly dependent on biotic and abiotic characteristics of ecosystems (i.e. ecological context (Cardinale *et al.*, 2000; Emmerson *et al.*, 2001; Biles *et al.*, 2003; Duffy *et al.*, 2007; Rossi *et al.*, 2008)). Invasive ecosystem engineers play a key role in the determination of ecological context because they can trigger significant changes in community composition while modifying ecosystem physical properties (Vitousek, 1990; Cuddington & Hastings, 2004). Nevertheless, invasion success rates and the impacts on invaded systems are, on their own, context-dependent, reflecting variation in the availability of resources, presence of enemies to the introduced species and the physical environment of the new system (i.e. niche opportunities, Shea & Chesson, 2002). Potential feedback loops between ecosystem engineer invasions and invaded system characteristics urge the need for large-scale studies where the effects of invasive species are observed under contrasting invaded-ecosystem scenarios. The importance of these studies for the understanding of global patterns of biodiversity and ecosystem functioning relationships are of uttermost importance under a global climate change scenario.

In a recent study across four coastal lagoons in southern Europe (Queirós *et al.*, in prep.), we found evidence for significant positive effects of an invasive ecosystem engineer, the bioturbating filter-feeding bivalve *Ruditapes philippinarum*, on community bioturbation rates. However, the effects of bioturbation on sediment mixing (an ecosystem function) were dependent on location. The consequences for local species diversity (analysed as species richness) were consistent across three of the four study areas, but the strength of this relationship increased in relation to the contribution of temperature regime to the establishment of anoxic conditions in the sediment. These findings strongly suggest that the influence of invasion on biodiversity and ecosystem functioning relationships is context-dependent, an aspect of invasion ecology which has often been neglected, with most studies focusing on single-location effects of invasive species.

Under a global climate change scenario, it is urgent that we fill this gap in our understanding of invasion processes and their consequences on native diversity and

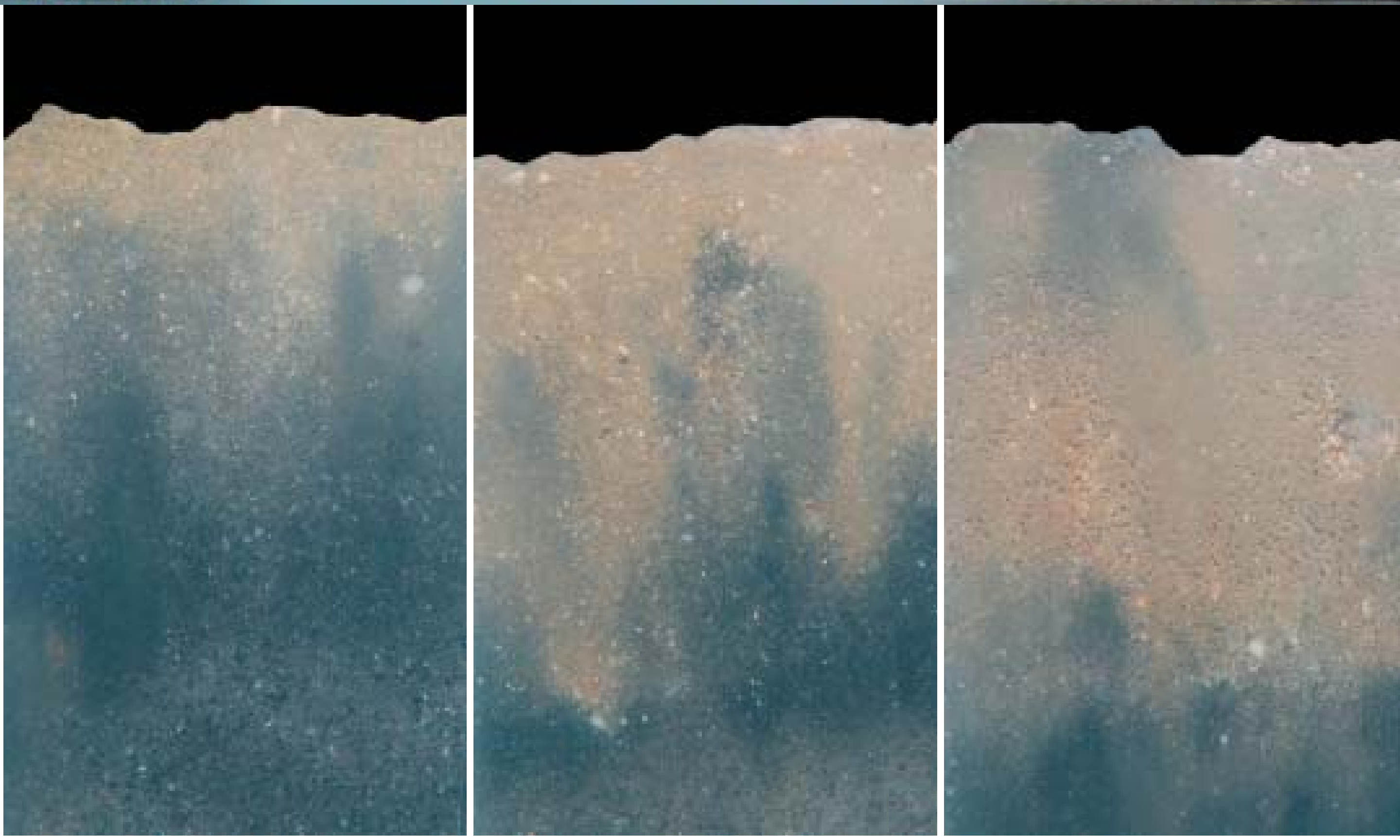

Figure 2. A sequence of sediment profile images retrieved from the Ria Formosa (Portugal), one of the study sites in Queirós *et al.* (in prep.). *Left to right:* increasing community bioturbation potential produces deeper sediment mixing, with the depth of the oxic layer varying from 4.1 to 11.5cm. Observed species richness increased in the same fashion, from five to eight species.

functioning. Impacts strongly depend on invasive species' trade-offs between competitive ability and abiotic stress tolerance (Kneitel & Chase, 2004; Krassoi *et al.*, 2008). With changing climatic conditions, and the additional possibility for changes in invasive species climatic niches (Broennimann & Guisan, 2008), our ability to predict and prevent ecological invasion will require larger datasets, where invasion impacts can be related to a gradient of environmental scenarios. Invasion ecology must no longer be based on single location studies. A more integrated ecosystem approach is now an immediate need.

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