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Disturbance influences the invasion of a seagrass into an existing meadow

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ABSTRACT

Future impacts from climate change and human activities may increase the likelihood of invasions of native marine species into existing habitats as a result of range shifts. To provide an understanding of the invasion of a native seagrass species (*Syringodium isoetifolium*) into a tropical multi-species meadow, detailed field assessments were conducted over a six year period. After establishing in a discrete patch, the extent and standing crop of *S. isoetifolium* increased 800 and 7000 fold, respectively, between 1988 and 2003 (~300–260,000 m^2 and <1 kg DW to 7596 ± 555 kg DW). The expansion of *S. isoetifolium* was confined to subtidal areas and appears primarily from clonal growth. The observed expansion of this species into a new locality was found to be clearly influenced by cumulative impacts and chronic small-scale physical disturbances. This study has immediate relevance to managing impacts which influence the spread of invasive species.

1. Introduction

Predicating species responses to environmental change requires knowledge not just of their physiology and their interactions with other existing species, but also of new interactions with species that are invading due to range shifts (He et al., 2013; Rahel and Olden, 2008). Given the increasing likelihood of species geographic range shifts due to environmental change (McCarty, 2001) the capacity to understand the consequences of these shifts in terms of the resultant species interactions is of wide reaching importance.

An invasive species can affect ecosystem structure, functioning and resultant provision of ecosystem services through changes such as habitat availability, associated biota, and biogeochemical cycling (Pejchar and Mooney, 2009; Vicente et al., 2013). As a result of such changes, biological invasions in many ecosystems have resulted in major biodiversity loss (Bax et al., 2003; Butchart et al., 2010) and are generally considered a threat to the integrity of natural communities and to the preservation of endangered species (Walker and Kendrick, 1998; Lodge, 1993; Carlton and Geller, 1993; Ribera and Boudouresque, 1995; Vitousek et al., 1997). Not all species invasions result in biodiversity loss as new species interactions induced by an invasion can have positive effects upon that system. In natural communities, species have been found to affect each other through both negative and positive interactions (He et al., 2013).

Invasive plants are recognised as species or strains that rapidly increase their spatial distribution by expanding into existing plant communities (Kercher and Zedler, 2004). Although some invasions simply result from natural or human induced dispersal mechanisms, providing an invader species the opportunity to rapidly out-compete existing species, a range of biological and physical factors can drive such processes (Bax et al., 2003; He et al., 2013; Williams, 2007). For example, physical disturbance can provide an opportunity for an invasive species to have a competitive advantage (Williams, 2007) which may depend upon the life history traits of the invasive species and the interactions of that species with native species (He et al., 2013).

Tropical seagrass meadows are characterised by high disturbance regimes which can occur at a range of scales and are thought to be of importance in driving species composition and interactions (Carruthers et al., 2002; Rasheed, 2000). Such disturbance can be ecophysiological (e.g. light limitation, elevated nutrients) or physical (e.g. grazing, bioturbation, waves) (Larkum et al., 2006). Physical disturbance is common and has multiple forcing factors including both natural and human related (Williams, 1988; Preen et al., 1995; Creed and Amado Filho, 1999; Kenworthy et al., 2002). Physical disturbances may cause seagrass loss (Orth et al., 2006a; Waycott et al., 2009) or through subsequent recovery

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