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BIODIVERSITY RESEARCH

Spatial patterns of seagrass dispersal and settlement

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ABSTRACT

Aim The movement of propagules among plant populations affects their ability to replenish and recover after a disturbance. Quantitative data on recovery strategies, including the effectiveness of population connectivity, are often lacking at broad spatial and temporal scales. We use numerical modelling to predict seagrass propagule dispersal and settlement to provide an approach for circumstances where direct, or even indirect, measures of population dynamics are difficult to establish.

Location Great Barrier Reef, Australia.

Methods We used the finite-element *Second-generation Louvain-la-Neuve Ice-ocean Model* (SLIM) to resolve the hydrodynamics of the central Great Barrier Reef and to simulate the dispersal of seagrass. We predicted dispersal and settlement patterns by releasing 10.6 million passive particles representing seagrass propagules at known sites of seagrass presence. We considered two fractions when modelling seagrass dispersal: floating and suspended propagules. Both fractions were modelled using 34 simulations run for a maximum of 8 weeks during the peak seagrass reproductive period, capturing variability in winds, tides and currents.

Results The 'virtual' seagrass propagules moved on average between 30 and 60 km, but distances of over 900 km also occurred. Most particle movement was to the north-west. The season (month) of release and source locations of the particles correlated with their dispersal distance, particularly for particles released offshore, with the complex coastal topography impeding movements close to the coast. The replenishment and recovery potential of the northernmost meadows was influenced by southern meadows. Protected north-facing bays were less likely to receive particles.

Main conclusions Our approach advances the conservation and management of marine biodiversity by predicting a key component of ecosystem resilience at a spatial scale that informs marine planning. We show a complex interaction among time, wind, water movement and topography that can guide a management response to improving replenishment and recovery after disturbance events.

Keywords
dispersal, Great Barrier Reef, hydrodynamics, recovery, resilience, seagrass.

INTRODUCTION

Safeguarding biodiversity and the delivery of marine ecosystem services requires the maintenance of ecological processes that underpin their functioning and resilience (Roberts *et al.*, 2003; Magris *et al.*, 2014). The multiple factors that contribute to resilience and their interactions are complex (Kilminster *et al.*, 2015; Unsworth *et al.*, 2015). An important component of marine ecosystem resilience is the capacity to recover from loss or degradation. Recovery is supported by the dispersal of larvae, adults or propagules via the convective forces of ocean waves and currents (Bereuman

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