Marine Pollution Bulletin 134 (2018) 166–176

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Seagrass ecosystem trajectory depends on the relative timescales of resistance, recovery and disturbance

Katherine R. O'Brien[a,*], Michelle Waycott[b,c], Paul Maxwell[a,d], Gary A. Kendrick[e,f], James W. Udy[d,g], Angus J.P. Ferguson[h], Kieryn Kilminster[f,i], Peter Scanes[h], Len J. McKenzie[j], Kathryn McMahon[k,l], Matthew P. Adams[a], Jimena Samper-Villarreal[m,n], Catherine Collier[j], Mitchell Lyons[o], Peter J. Mumby[m], Lynda Radke[p], Marjolijn J.A. Christianen[q], William C. Dennison[r]

[a] School of Chemical Engineering, The University of Queensland, St Lucia 4072, Queensland, Australia
[b] School of Biological Sciences, The University of Adelaide, Adelaide, SA 5005, Australia
[c] State Herbarium of South Australia, Botanic Gardens and State Herbarium, Department of Environment and Natural Resources, GPO Box 1047, Adelaide, SA, Australia
[d] Healthy Land and Water, PO Box 13204, George St, Brisbane 4003, Queensland, Australia
[e] The Oceans Institute (M470), The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia
[f] School of Biological Sciences, The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia
[g] School of Earth, Environmental and Biological Sciences, Queensland University of Technology, P.O. Box 2434, Brisbane, Queensland 4001, Australia
[h] NSW Office of Environment and Heritage, PO Box A290, Sydney South, NSW 1232, Australia
[i] Department of Water and Environmental Regulation, Locked Bag 33, Cloisters Square, Perth, WA 6842, Australia
[j] Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Cairns, Queensland 4870, Australia
[k] School of Sciences, Edith Cowan University, WA, 6027, Australia
[l] Centre for Marine Ecosystems Research, Edith Cowan University, WA, 6027, Australia
[m] Marine Spatial Ecology Lab, The University of Queensland, St Lucia, Queensland 4072, Australia
[n] Centro de Investigación en Ciencias del Mar y Limnología, Universidad de Costa Rica, San Pedro, 11501-2060, San José, Costa Rica
[o] Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, 2052 NSW, Australia
[p] Coastal, Marine and Climate Change Group, Geoscience Australia, GPO Box 378, Canberra, ACT 2601, Australia
[q] Groningen Institute of Evolutionary Life Sciences (GELIFES), University of Groningen, P.O. Box 11103, 9700, CC, Groningen, Netherlands
[r] University of Maryland Center for Environmental Science, Cambridge, MD 21613, USA

ARTICLE INFO

Keywords:
Seagrass
Trajectory
Resistance
Recovery
Resilience
Colonizing
Persistent
Opportunistic

ABSTRACT

Seagrass ecosystems are inherently dynamic, responding to environmental change across a range of scales. Habitat requirements of seagrass are well defined, but less is known about their ability to resist disturbance. Specific means of recovery after loss are particularly difficult to quantify. Here we assess the resistance and recovery capacity of 12 seagrass genera. We document four classic trajectories of degradation and recovery for seagrass ecosystems, illustrated with examples from around the world. Recovery can be rapid once conditions improve, but seagrass absence at landscape scales may persist for many decades, perpetuated by feedbacks and/or lack of seed or plant propagules to initiate recovery. It can be difficult to distinguish between slow recovery, recalcitrant degradation, and the need for a window of opportunity to trigger recovery. We propose a framework synthesizing how the spatial and temporal scales of both disturbance and seagrass response affect ecosystem trajectory and hence resilience.

1. Introduction

Found at the interface between the land and the sea, seagrasses act as ecosystem engineers by stabilizing sediment, taking up nutrients, storing carbon and providing habitat for fish and other marine fauna (Bos et al., 2007; Jones et al., 1994; Mcleod et al., 2011). The feedbacks and interactions between seagrass and various biotic and abiotic factors can buffer against stressors, and generate many valuable ecosystem services (Duarte, 2002; Orth et al., 2006a). Seagrass presence can improve conditions for seagrass growth, for example through sediment stabilization, nutrient uptake and sheltering mesograzers (Maxwell et al., 2016). Ironically these feedbacks can also act as a barrier to

* Corresponding author.
E-mail address: k.obrien@uq.edu.au (K.R. O'Brien).

http://dx.doi.org/10.1016/j.marpolbul.2017.09.006
Received 31 March 2017; Received in revised form 30 June 2017; Accepted 6 September 2017
Available online 19 September 2017
0025-326X/