National Science Challenges
SUSTAINABLE SEAS
Ko ngā moana whakauka

Local groups are interested in recovering the health of an area: how do we go about helping them move forward?

For regional councils, scientists and planners

Recovering the health of an area is not simple if multiple activities have contributed to declining health. You can make it easier to do by first considering which stressors are preventing recovery, and then by considering whether the area is sufficiently connected to other healthy places to allow them to provide colonists, for example seeds, larvae, juveniles or adults.

To help local groups move forward in helping recover the health of an area, answer the following questions.

1. Which stressors are preventing recovery, and can they be removed?

Stressor removal, relative importance, and likelihood of success

This decision-making guidance uses the characteristics of stressors to determine which stressor may control any recovery process, given the local information on stressors in place. The guidance can be paired with local information on habitat requirements, how much the habitat has changed, and how long the stressor will stay in the system — to give in-place predictions on which stressor(s) to target and whether stressor legacies are likely to prevent recovery.

Which stressors to reduce?

The obvious stressors to reduce are those that are most likely either to continue to degrade the health of the environment or to prevent any natural recovery to an improved state. We can estimate which these are using basic principles.

Largest gain

Removing any stressor that impacts on more than one point of the ecosystem network (SP5 Low et al 2023), especially if it is accumulating (the stressor leaves behind an environmental legacy such as mud content from terrestrial sediment, SP2 Low et al 2023). This stressor should be targeted even if the levels are only moderate at present (SP5 without SP2) or low (SP5 with SP2).

- This should be followed by removing or reducing any high magnitude of stressors that cover a large area (SP6 Low et al 2023).

Moderate gain

Removing any stressor that may be low to moderate intensity but are accumulating (SP2 Low et al 2023) and cover a large area (SP6 Low et al 2023).

- This should be followed by removing or reducing moderate magnitude of stressors that cover a large area (SP6 Low et al 2023).

Lowest gain

There is least to be gained with the removal of stressors that generate unimodal responses when they are occurring only at low levels (SP3) and not accumulating (SP2 Low et al 2023).

What would be the best locations for recovery actions?

To help prioritise natural recovery potential, see the table *Predicting recovery times if a stressor(s) is removed.*

Academic publication

Jasmine M. L. Low, Rebecca V. Gladstone-Gallagher, Judi E. Hewitt, Conrad A. Pilditch, Joanne I. Ellis, and Simon F. Thrush (2023) **Using Ecosystem Response Footprints to Guide Environmental Management Priorities**, Ecosystem Health and Sustainability, 9:0115

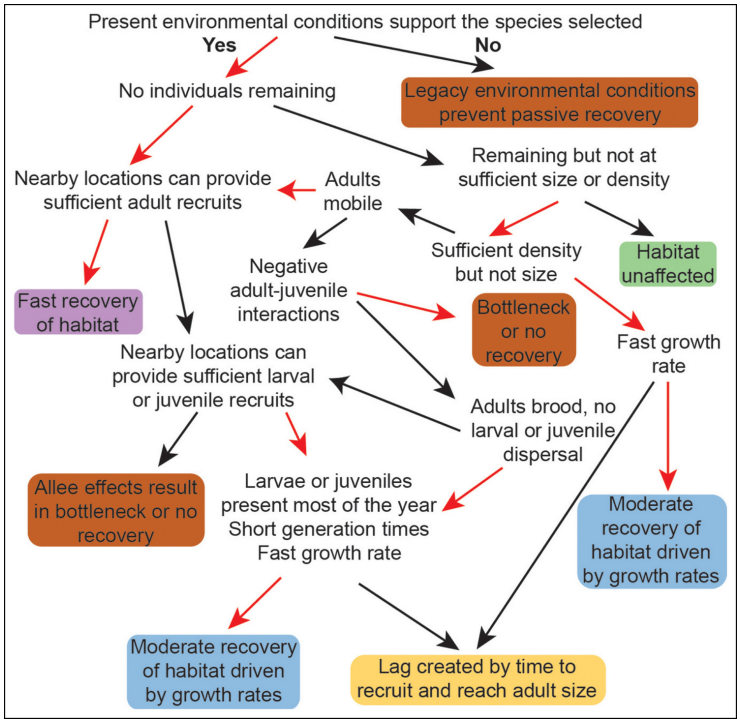
2. How long would natural recovery take, or would actions to speed recovery be necessary?

To help work out how long natural recovery would take or whether you need to intervene to speed recovery, see *Predicting recovery times if a stressor(s) is removed,* below.

Predicting recovery times if a stressor(s) is removed

This matrix is derived from a series of questions about species traits (mobility of different life stages, reproduction traits, juvenile-adult interactions and interactions with other species), distance to nearby patches of the species or habitat, and surrounding landscape patterns in community composition and biodiversity. Note that 'no environmental legacies' is equivalent to 'no accumulating stressors' (SP2 Low et al 2023).

Length of time that recovery may take can be estimated using the figure to the right from Hewitt et al 2021.



Figures: J Hewitt, R Gladstone-Gallagher & S Thrush (2022) Disturbance–recovery dynamics inform seafloor management for recovery, Frontiers in Ecology and the Environment, 20:10

Table 2. Example of prioritizing sites for passive recovery of a habitat-forming species, characterized by immobile adults and mobile juveniles (with the ability to travel up to 10 km)

	Stressor rank	× Degradation rank	× Species dispersion rank	= Site calculations*
rank = 1 (passive recovery possible)	At sites 1 to 3 & 10, primary stressor(s) removable and no environmental legacies	At sites 1, 4, and 7, the species has been maintained although reduced, no further prioritization required	At sites 2 & 6, juveniles already on site, recovery time driven by growth rates At sites 3 & 5, adults available on site, recovery time driven by frequency and duration of reproduction and growth rates	Site 1 = 1 × 1 = 1 Site 2 = 1 × 0.8 × 1 = 0.8 Site 4 = 0.8 × 1 = 0.8 Site 7 = 0.4 × 1 = 0.4 Site 3 = 1 × 0.4 × 1 = 0.4 Site 6 = 0.6 × 0.6 × 1 = 0.36 Site 5 = 0.8 × 0.2 × 1 = 0.16 Site 8 = 0.2 × 0.1 × 0.5 = 0.01 Site 10 = 1 × 0.1 × 0 = 0 Site 9 = 0.2 × 0 = 0 Site 11 = 0
1 > rank > 0 (passive recovery possible)	At sites 4 to 9, primary stressors reduceable: *4 & 5 > 6 > 7 > 8 & 9* *Sites 4 & 5 rank = 0.8* *Site 6 rank = 0.6* *Site 7 rank = 0.4* *Sites 8 & 9 rank = 0.2*	At sites 2 & 6, the species is sufficient in density but not size; site 2 has larger average size *Site 2 rank = 0.8* *Site 6 rank = 0.6* At sites 3 & 5, the species is sufficient in size but not density, no negative adult–juvenile interactions; density at site 3 is higher than site 5 *Site 3 rank = 0.4* *Site 5 rank = 0.2* At sites 8 & 10, no individuals remain, assign lowest rank (rank = 0.1)	At site 8, juveniles located 11 km away with a current flowing toward the site *Site 8 rank = 0.5*	
rank = 0 (passive recovery not possible)	At site 11, environmental conditions are now outside the range required for restoration objectives *Site 11 rank = 0*	At site 9, the species exhibits negative adult–juvenile interactions and is sufficient in size but not density *Site 9 rank = 0*	At site 10, juveniles are located 30 km away across a current *Site 10 rank = 0*	

Notes: *Sites are prioritized based on their scores, sorted in descending order (from top to bottom). Of the 11 sites, the three lowest-ranked sites (sites 9, 10, and 11) do not qualify for passive recovery.