National Science Challenges | SUSTAINABLE SEAS | Ko ngā moana whakauka

How do we decide on robust locally generated Coastal Marine Area (CMA) targets that incorporate climate change?

For regional council planners and scientists

Robustness of locally generated targets rely on a process bringing diverse groups together. Three major groups of people are involved in generating local targets: iwi and hapū of the area; regional and district council staff; and the community, including community groups working in the area of interest. Targets can be generated by any of these three groups but to make effective progress, all three groups need to be involved in the process. Councils should set a requirement for a robust overall process to include:

- Co-production with iwi/hapū, which includes setting timelines, defining targets, use of mātauranga to underpin target selection, selecting actions to meet targets and determining tohu for monitoring progress. Some of this may be defined in iwi management plans.

🔗 Sustainable Seas products that can help include *Te Kete Kaitiakitanga (in particular the section E Toru Ngā Mea)* and *Empowering Māori knowledge in marine decision-making*.

- Collaboration with district council staff
- Early engagement between the co-producers (regional council and iwi/hapū) and district council staff and the community. Discuss values, define targets and desired outcomes, including discussion of world views.

🔗 Sustainable Seas products that can help include the *Participatory processes ingredients tool*, guides 2 and 4 in the *Quick guides: Navigating risk and uncertainty in marine management series*, and *Roadmaps to EBM: How likely is it that the action we want will benefit others?*

- Workshops or other engagement with the community on past and present uses, collate existing information and ascertain who to engage with to get local information. Information requirements include present state (ability to meet present and past uses), ecological health and characteristics of the stressors that are present.

🔗 Sustainable Seas products that can help include the *Participatory processes ingredients tool*, *Enabling a broad knowledge base for marine management decisions*, *Assessing present health* and *Characteristics of stressors that control their effect on ecological health* (see below).

- Technical assessments of what outcomes can be achieved with what actions, under what time frame and at what cost, against a background of climate change (see *Climate change considerations* below) and holistic management. Risks of the actions to other outcomes and the uncertainty involved must be displayed.

🔗 Sustainable Seas products that can help include the *Recovery decision tree*, the *Risk assessment method decision tree*, *Roadmaps to EBM: Local groups are interested in recovering the health of an area: how do we go about helping them move forward?* and *How do we assess the present ecological integrity of a management unit?*, and *Enabling a broad knowledge base for marine management decisions*, *Addressing cumulative effects in marine management decisions* and *Addressing risk and uncertainty in decision-making*.

- Collaborative workshops to present technical assessments, reevaluate targets, determine the actions to achieve them (including who is going to undertake the actions and the timelines for these) and the indicators to monitor progress.
- Documentation throughout the process including documentation of all disagreements, actions taken as a result of these and why some outcomes were targeted and others weren't.

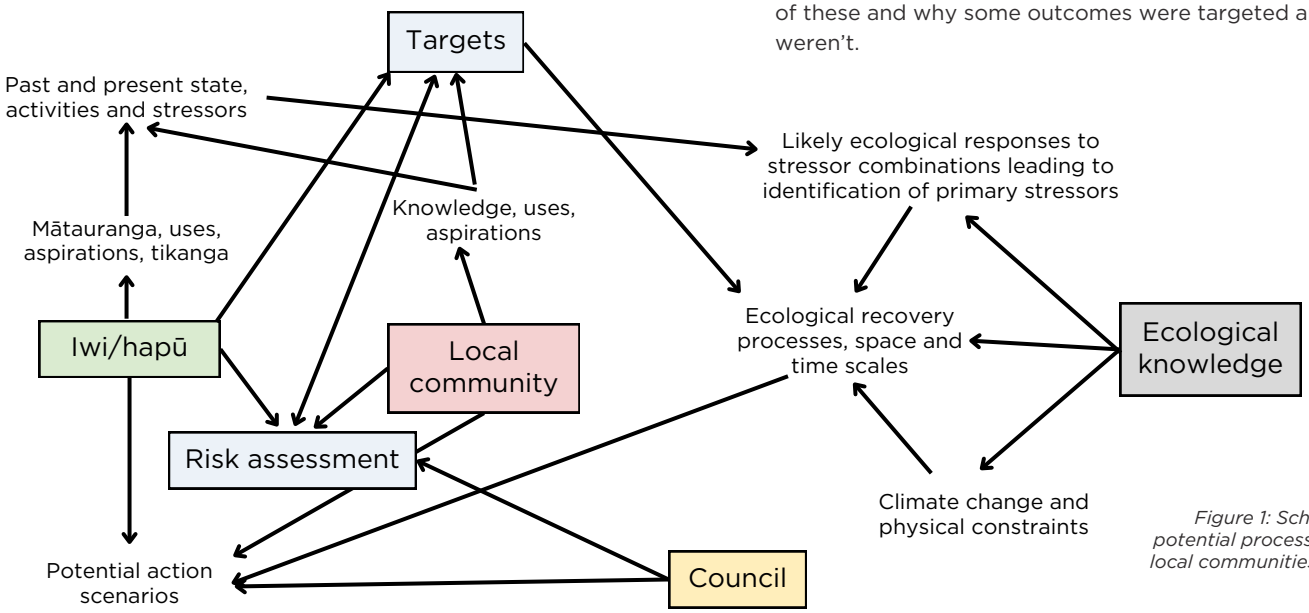

Figure 1: Schematic of the potential process involving iwi local communities, council and scientists

Characteristics of stressors that control their effect on ecological health

There are some critical characteristics of stressors that can be used to determine how important they are in driving decreasing ecological health. Understanding the types and magnitudes of stressors in an area is useful for understanding the role they play in affecting the use of an area and the ability to set realistic targets.

This summary discusses the characteristics in order of relative importance with examples to aid discussion between scientists, managers and lay people. A range of values that can be taken by each stressor characteristic is given in terms of "high" (bad) and "low" (good). The characteristics are based on principles from an internationally peer reviewed publication (Gladstone-Gallagher et al 2024).

S1. The number of stressors. Multiple stressors are now the default in many coastal systems (due to emerging contaminants and climate change). Multiple stressors increase the frequency and intensity of non-linear ecological surprises. *High = 3 or more stressors present. Low = no (or one) stressor present.*

S2. The levels of stressors that are ongoing and accumulating. Accumulating stressors cause problems because low levels accumulate over time into higher levels, and legacies are created that remain even when the activity is stopped. *High = Stressors are at moderate-to-high levels and accumulate rapidly. Low = stressors are at low levels and only accumulate slowly.*

S3. The levels of stressors that generate unimodal responses. Increases in some stressors, such as temperature, nutrients and sediment mud content, can have an initial positive effect but then switch to a negative effect. *High = high levels of such stressors can result in cumulative stressor effects that can be greater than the individual effects of different stressors (ie synergistic responses). Low = low levels of such stressors can mitigate the negative effects of other stressors.*

S4. The levels of stressors that generate responses other than unimodal. Some stressors (eg toxic contaminants and microplastics) even at low levels have negative effects. *High = Two or more stressors at moderate-to-high levels Synergistic effects (the effect of the two stressors is greater than the effect of either of them added together) will occur. Low = none/one at low levels.*

S5. The number of ecological components impacted directly and indirectly. Stressors impact networks of interacting ecological components. The number of components impacted is likely to determine the severity of ecological responses. As the magnitude and numbers of stressors increase, so does the number of components directly affected. This, in turn, increases the likelihood of indirect effects. However, a single stressor can also impact multiple ecological components (for example, suspended sediment affects pipi, cockles and algae growing in the sediment) and create indirect effects (for example, fewer pipi reduces their capability to armour the seafloor — increasing resuspension of sediment — while fewer algae growing in the sediment reduces food for many species of macrofauna). *High = many direct and indirect effects. Low = none/one direct and indirect effect.*

S6. Size of the impacted area (relative to the ecosystem of interest or managed area. The spatial extent of the impact determines how far colonists have to travel and thus recovery rate. Larger areas are also likely to impact more habitat types decreasing the regional biodiversity in the managed area and increasing the probability of spillover impacts to other areas due to nutrient, food and recruitment source-sink dynamics and expansion of scavenger/predator habitat. *High = large impacted areas relative to management area. Low = small impacted area relative to management area.*

Climate change considerations

Climate change results in change to numerous stressors, a summary of the majority of these is presented in Lundquist et al 2023 in relation to effects on the seafood sector: temperature; wind and waves; ocean acidification; oxygen; stratification; coastal erosion; productivity and detrital flux; and circulation patterns. Also important for more coastal areas are: sea level rise resulting in the loss of intertidal areas and coastal wetlands (see Rullens et al 2022); rainfall and changes in salinity and flushing in estuaries; and suspended sediment (as a result of changes in terrestrial erosion and resuspension within estuaries and coastal zones). All these stressors are often already present in marine environments, both naturally and as a result of human activities.

The effects of climate change on the potential to achieve desired outcomes can be assessed by considering whether climate change will result in the following:

1. additional new stressors (therefore adding new cumulative effects)
2. increased intensity of present stressors
3. alter where people live and how they use the land
4. changes to ecological or physical connectivity
5. changes to the underlying distribution of key species or production of key services

Points 1 to 3 should be able to be used to help define points 4 and 5, and all should be integrated into the technical assessment.

References

Lundquist C, Cummings V, Hansen L & Mielbrecht E (2023). State of knowledge: Climate change and New Zealand's Seafood Sector. Synthesis report to support technical report prepared for Fisheries New Zealand, project ZBD201409. 12 p.

Rullens V, Mangan S, Stephenson F, Clark DE, Bulmer RH, Berthelsen A, Crawshaw J, Gladstone-Gallagher R, Thomas S, Ellis J & Pilditch C (2022) Understanding the consequences of sea level rise: the ecological implications of losing intertidal habitat. New Zealand Journal of Marine and Freshwater Research 56: 1-18.