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Ecosystem service metrics for restorative marine economies in Aotearoa New Zealand

To support restorative economy (RE) endeavours, we need ways to measure the ecosystem services (ES) provided by marine ecosystems. These will provide metrics to quantify the many benefits provided by marine ecosystems. Natural capital and ES need to be quantified before restoration efforts begin, and over time following restoration, to measure (i) whether the investment has been successful, and (ii) that the benefits are lasting.

What metrics are currently available?

Current metrics of ES in marine ecosystems that may be possible to quantify include measures of natural capital or biomass of ES-delivering species.

Examples:

- Water regulation ES performed by shellfish beds may be quantified based on estimated filtration rates and shellfish bed area.

- Allometric models have been developed for quantifying carbon storage in New Zealand mangrove forests.

A variety of habitat maps and spatial tools have been applied throughout coastal areas of Aotearoa New Zealand that could support the ES quantification requirements of RE endeavours. Combining these with ES or natural capital metrics will provide next steps. For example this ES map showing denitrification potential of Whitford Estuary, sustainableseaschallenge.co.nz/map-denitrification-whitford

What is needed to support RE development?

Metrics of a broader set of ES including socio-cultural values need to be progressed and amalgamated. In many cases appropriate tools exist for quantifying some types of ES, but place- and ecosystem-specific research and additional spatial data may be required. In particular, there is a need to understand the role of spatial variation in, and the effect of temporal variability in specific types of natural capital on, maintaining ES across a landscape over time.

Key requirements for ES metrics that can guide RE

- Knowledge of habitat/ecosystem/species
  - » Local/traditional
  - » Scientific/ecological
- Knowledge of place (history, current and future stressors)
- Spatial extent of ES delivering species/habitats
- Habitat quality (degraded, recovering, healthy)
  - » Ability to measure and monitor ecosystem health
  - » Health indicators (eg macroalgal cover, species densities, and Traits Based Indices)
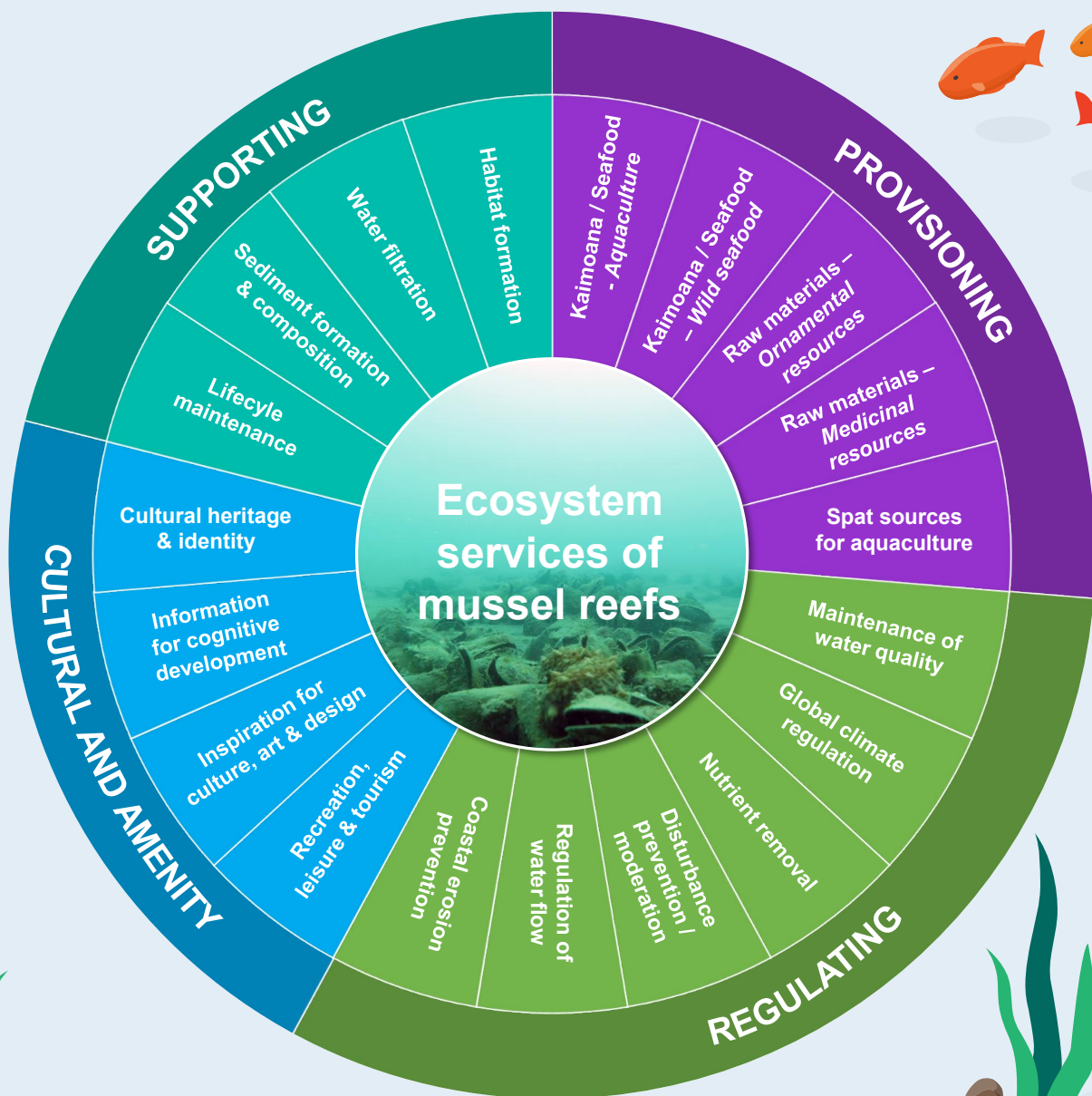 - » Measures of ES providing natural capital
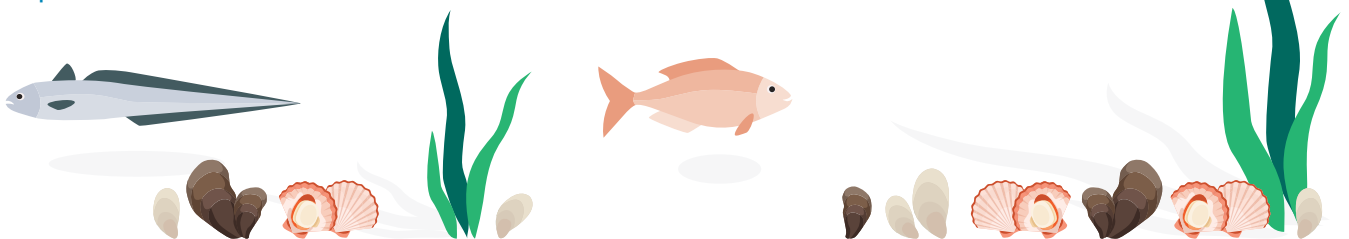
ES metrics will be required at the scoping, development, and monitoring phases of RE projects. Any metrics used will need to be robust enough to stand the test of time, and potential changes in ecosystem pressures and financial structures.

Developing RE in Aotearoa New Zealand will require the support of further ES-specific research and spatial analysis of existing marine ecosystems, but this will vary depending on the type of restoration and the place. The figure below details the types of ES that may be provided by seabed mussel restoration initiatives that are being trialled in multiple parts of the country. Developing metrics for quantifying these types of ES is one of the key research needs.

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Ecosystem services of mussel reefs

SUPPORTING
- Habitat formation
- Water filtration
- Sediment formation & composition
- Lifecyle maintenance

PROVISIONING
- Kaimoana / Seafood - Aquaculture
- Kaimoana / Seafood – Wild seafood
- Raw materials – Ornamental resources
- Raw materials – Medicinal resources
- Spat sources for aquaculture

REGULATING
- Maintenance of water quality
- Global climate regulation
- Nutrient removal
- Disturbance prevention / moderation
- Regulation of water flow
- Coastal erosion prevention

CULTURAL AND AMENITY
- Cultural heritage & identity
- Information for cognitive development
- Inspiration for culture, art & design
- Recreation, leisure & tourism

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