
Image: Cawthron Institute

Summary

# Modelling factors that influence community initiatives to restore marine environments

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**Societies increasingly agree that we need to transition to more nature-positive actions. Marine restoration is an important action because it allows us to:**

- **rebuild ecosystem health, viability, and resilience**
- **build social networks that benefit people**
- **develop our blue economy.**

**This document reports on a project to model the network of social, ecological, and economic factors connected to community-based initiatives to restore the marine environment. For more information on restoration, please read our guidance document on *Restoring marine ecosystems through better management and financing*.**

## The project aimed to map the influential factors for community restoration

The project aimed to explore the actors or processes that enable or inhibit community-based restoration of marine ecosystems. Communities can take multiple pathways to enhance restoration opportunity and secure the resources necessary to implement action. To date, most analysis of these pathways has focussed on the social, economic, and ecological aspects in isolation. This approach occurs because different disciplines tend to emphasise their own understandings. However, successful restoration (ie re-establishing self-sustaining populations, communities, and habitats) requires linking these different components.

## Researchers adopted a multi-disciplinary, multi-step approach

Our approach was to allow experts from ecology, social science (including law and governance), and restorative economies to determine the components (drivers, outcomes, and intermediatory points) and relationships that they saw affecting community-based restoration projects. We then asked them to consider links between their own components and other disciplines' components.

We formalised these relationships using a Bayes Net (BN) model that allowed us to use different scenarios to determine what components and links are most likely to lead to benefits for those involved in restorative economies. We focussed on three benefits.

- **Social capital** encapsulates the enhancement of community relationships that help society function and work towards shared goals.
- **Revenue generation** is an important factor for potential investors and likely to increase project survival over the long term.
- **Provisioning services** reflect the ecological benefits of improving ecosystem structure and function, as well as improving human wellbeing — the latter was chosen as an example of the effect of goals that receive multi-dimensional benefits.


Image: Jenny Hillman

## Restoration can be active or passive

Restoring marine ecosystems can be either active (eg re-establishing shellfish or seagrass) or passive (eg creating a marine protected area or rāhui). In both cases, understanding the ecology of what you're trying to restore is critical but so is finding support, navigating government processes or permits, and setting realistic aims and outcomes.

We used three levels of ecological starting conditions — poor, okay, and good — for each scenario that we ran. These levels impact the goals and expectations of the restoration project set by restorers and investors. 'Good' retains the ecological functions that will aid natural recovery.

We used five different community-based actions.

1. Passive restoration, including passive only protection of an area from an activity
2. Reduce stressors only
3. Passive restoration and reduce stressors
4. Active restoration, with removal of stressors
5. Active restoration, without removal of stressors.

### Bayes Net models offer a simpler way to model complex things

Bayes Net models have been widely used in environmental interdisciplinary and transdisciplinary research because of their ability to include qualitative and quantitative data. Bayes Net models are useful when trying to balance the interests of industry, community, and nature. Bayes Net models provide a simple way to model complex relationships, express uncertainty, and allow for stakeholder participation. They have been used in several Challenge projects.

- Communicating risk and uncertainty
- Modelling restorative economies
- Participatory tools
- Measuring ecosystem services and assessing impacts


Image: Brady Doak

## The Bayes Net model for community initiatives for marine restoration

We constructed and parametrised the Bayes Net model following the Marcot et al. (2006) framework, using Netica, Norsys software (version 5.0.17). The initial conceptual model structure was based on literature and expert knowledge. Nodes were selected that would best capture the dynamics of a social-ecological system of community-based restoration actions within a 10-year timeframe (Figure 1). The model timeframe was constrained to reduce uncertainties around political cycles, climate change, ecological recovery processes, and stressor timescales.

Social processes and entities are represented by seventeen nodes that reflect the interactions between law and policy, social norms, and potential entities involved in restoration efforts.

Economic processes and outcomes are represented by six nodes, which generally reflect the movement of available funding for restoration through various actions and the economic processes that may slow or boost restoration action, for example, business practices.

Ecological nodes are split into two categories: six that reflect an ecosystem's ability to recover and the location's starting ecological condition and five that reflect location-specific stressor characteristics that can affect ecosystem recovery.

The remaining seven nodes are the benefits. In some cases, these feed back into motivations to generate higher levels of funding.

## The model shows interacting factors at play

Ecological starting conditions were important. In part, this was because 'poor' conditions were seen to require removal of stressors and active enhancement. In turn, this work requires collaboration with local and central government and a high level of local commitment over at least the 10-year period, which in turn can best be supported by financial investment.

Social capital was maximised under poor and okay conditions, when social aspects such as reconnection, responsibility, and knowledge generation become important, despite the lack of good outcomes for ecosystem resilience.

A focus on restoration revenue when ecological conditions were poor or okay reduced the chances of achieving other ecological outcomes, for example, increased biodiversity. Regardless of the ecological conditions or restoration methods, high levels of restoration revenue, could only be achieved if carbon and blue service accreditation was available.

Maximum increases in provisioning services reflected ecological condition and the types of restoration action, occurring with *good* ecological conditions and *active* or *active and reduce stressor* actions.

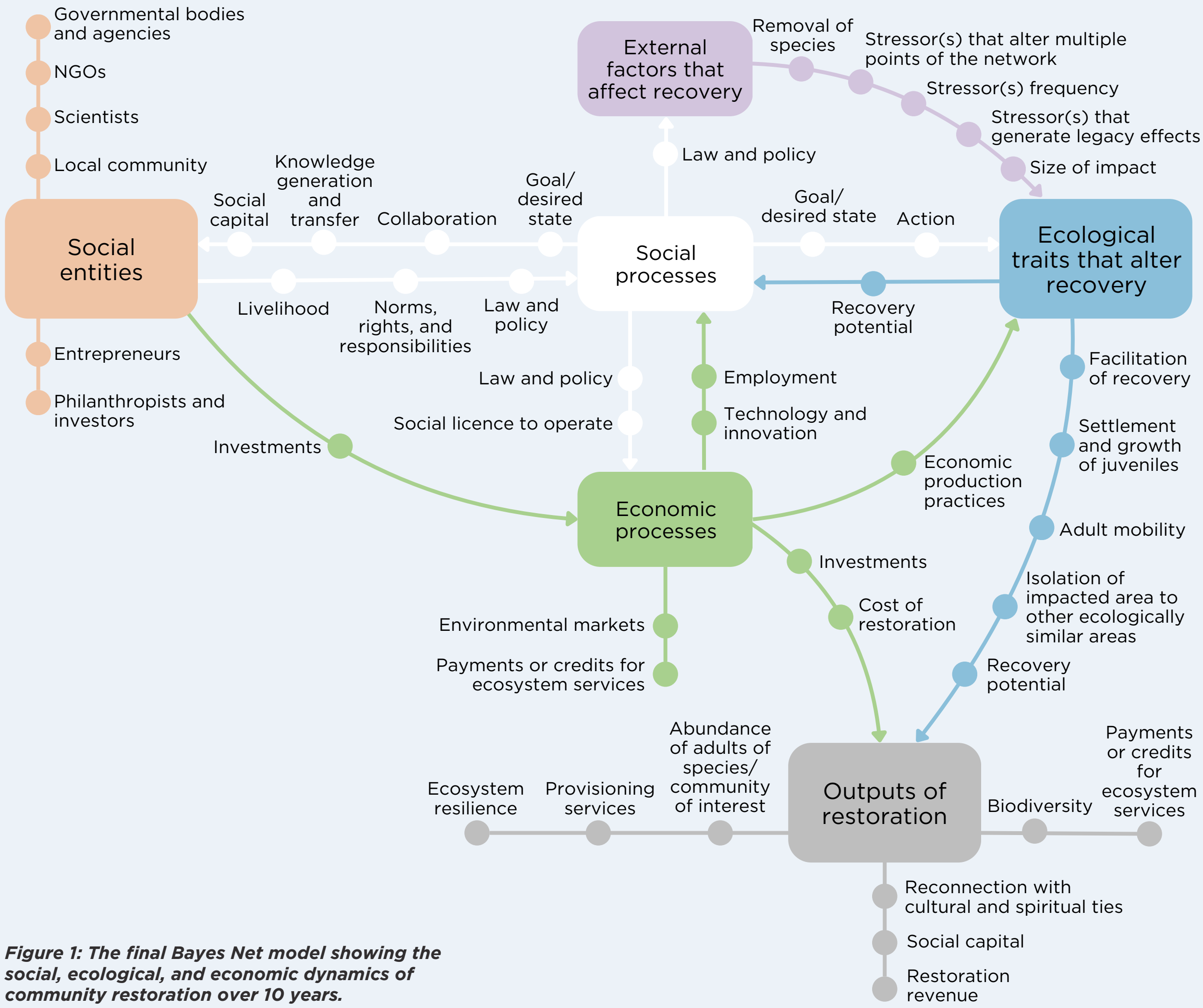


***Figure 1: The final Bayes Net model showing the social, ecological, and economic dynamics of community restoration over 10 years.***

## The model can help guide community-based restoration efforts

The model is a useful way to open dialogue on what steps or processes (social, ecological, or economic) people need to consider when wanting to do community-based restoration.

Our results highlight that ecosystem recovery after community-based restoration is driven by various social and ecological dependencies, including the:

- potential for ecosystem recovery
- goals set
- desired outcomes.

Maximising one set of desired outcomes can result in poorer outcomes for others. For example, while funding can limit the type of restoration possible, focusing on maximising revenue likely results in poorer ecological outcomes.


Academic publication

Marcot BG, Steventon JD, Sutherland GD & McCann RK (2006). ***Guidelines for developing and updating Bayesian belief networks applied to ecological modeling and conservation***. Canadian Journal of Forest Research 36: 12.