National Science Challenges

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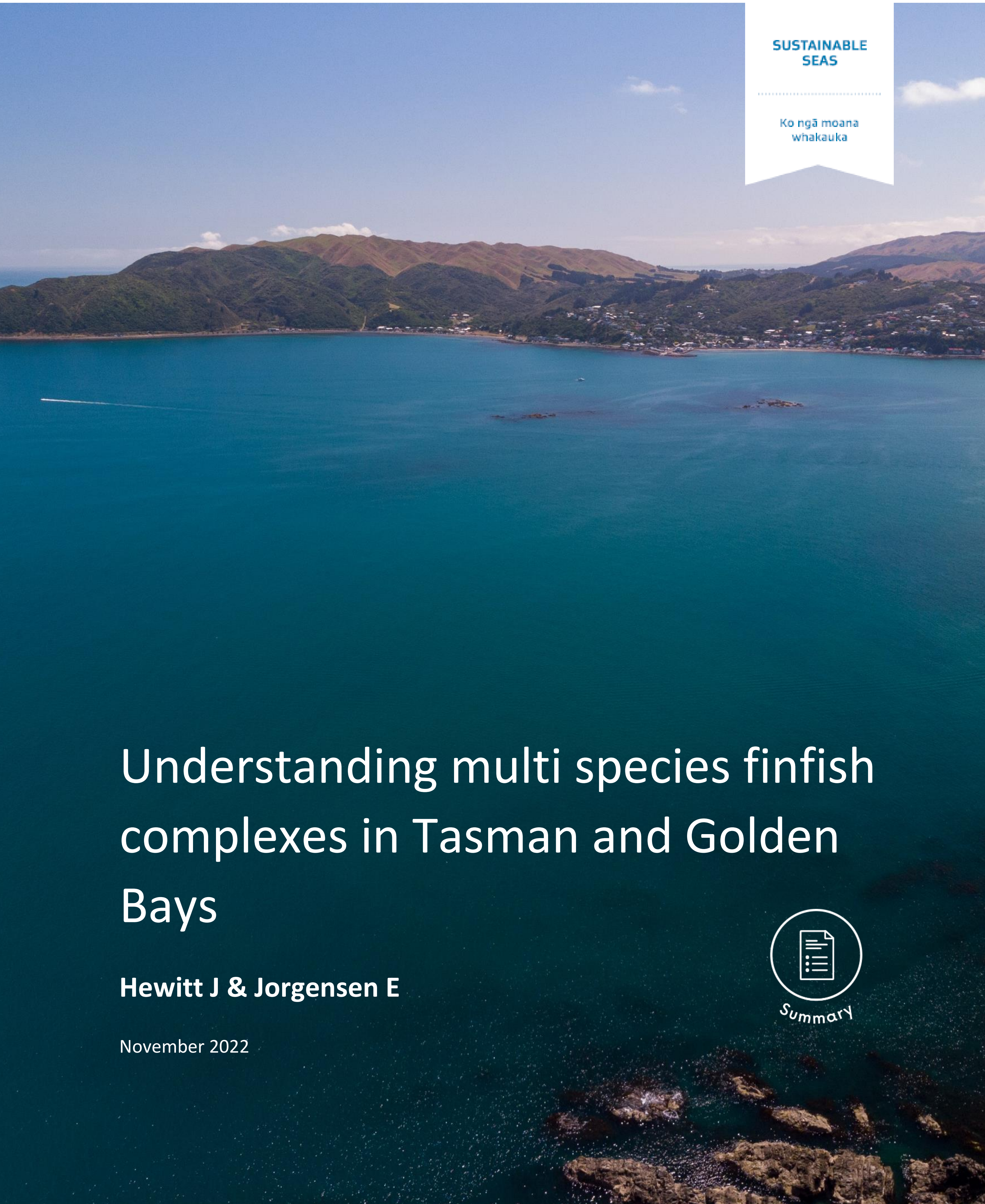

Understanding multi species finfish complexes in Tasman and Golden Bays

Summary

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November 2022

This is a summary of a report by the Sustainable Seas National Science Challenge project *Policy and legislation for EBM* (Project code 4.2)

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Date of publication

November 2022

For more information on this project, visit: sustainableseaschallenge.co.nz/our-research/policy-and-legislation-for-ebm

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About the Sustainable Seas National Science Challenge

Our vision is for Aotearoa New Zealand to have healthy marine ecosystems that provide value for all New Zealanders. We have 75 research projects that bring together around 250 scientists, social scientists, economists, and experts in mātauranga Māori and policy from across Aotearoa New Zealand. We are one of 11 National Science Challenges, funded by the Ministry of Business, Innovation & Employment.

www.sustainableseaschallenge.co.nz

Cover image: Hamish McCormick.

The Sustainable Seas National Science Challenge:

The Sustainable Seas National Science Challenge (the Challenge) seeks to improve decision-making and the health of our seas through ecosystem-based management (EBM).

The Challenge objective is: “To enhance utilisation of our marine resources within environmental and biological constraints” and its mission is: “To transform Aotearoa New Zealand’s ability to enhance our marine economy, and to improve decision-making and the health of our seas through ecosystem-based management (EBM)”. EBM is a holistic and inclusive approach to managing marine environments and competing uses for them, demands on them, and the ways New Zealanders value them (Hewitt et al. 2018).

Sustainable Seas Project 4.2; ‘Options for policy and legislative change to enable EBM across scale’:

This project seeks to provide a robust research base to support policy makers, iwi, and stakeholders to navigate the legislative, policy and practice constraints surrounding EBM and any changes required to enable it. The research will provide tools to enhance EBM, in terms of context, models and options to support integrated decision-making processes and frameworks.

Our focus addresses institutional fragmentation and jurisdictional complexity as well as managing the effects of activities, especially cumulative effects, across different scales (e.g. temporal, geographical, social-ecological, and organisational).

The project includes three iterative and interrelated aims, which will be addressed by collaborative and interdisciplinary research teams, providing input and feedback to each other throughout the project.

> *Aim 1*: To identify and analyse a range of legal and policy options to enable both progressive and transformative change, and the practice, policy, and legislative implications involved in transition to EBM.
>
> *Aim 2*: To understand and articulate the risk of different management options and scales in an EBM context; and create adaptive management options appropriate to fluid spatial and temporal scales.
>
> *Aim 3*: To identify what opportunities exist for EBM implementation and determine what needs to change to support successful implementation of EBM in Aotearoa New Zealand

This case study:

Methodology and Outputs:

As co-development partners with Sustainable Seas project 4.2, Fisheries New Zealand (FNZ) was approached to be involved in a potential case study to develop research supporting *Aim 2* . Following several meetings with FNZ, managing multi-species finfish complexes to support integrated multi-stock management (one of 5 focus areas within FNZ’s draft Inshore Finfish Fisheries Management Plan[1]) was highlighted as a suitable case study subject that would contribute towards objectives of both organisations (see below).

[1] https://www.mpi.govt.nz/dmsdocument/38045-National-Inshore-Finfish-Fisheries-Plan-Draft

A number of methods were suggested to FNZ for exploring and seeking to understand the socio-ecological relationships for the case study, including Network models, Agent-based simulation models and System models / causal loop diagram models. Subsequently, systems diagrams (a qualitative method) was selected by FNZ as the tool to be used, and internal FNZ dialogue settled on a case study focused on the Tasman and Golden bays mixed trawl fishery.

Initially, the research plan was to develop a system diagram and then use part of this to inform an exploratory agent-based model. However, during the development of the system diagram the limitations of 'layering' the system diagram described for any single species into a series of multi-tier diagrams to provide multi-species insight, became apparent. The Challenge research team therefore suggested the coupling of a multi-variate analysis with the system diagram. This was added to the work programme to enable insight to the commonalities and differences between species-specific system dynamics within a multi-species complex, which would then help inform the agent-based model.

The project, undertaken in collaboration with FNZ, focused on a multi-species finfish complex in the Tasman and Golden bays snapper fishery, a part of Fisheries Management Area 7 (FMA7). It contributes towards objectives of both the Challenge ("to *understand risks associated with mismatches of management and species behaviours"*) and FNZ (to understand "*How can a collaborative modelling tool (socio-ecological model) be used to improve analysis and advice to inform multi-species fisheries management?").*

To help inform the research, FNZ invited the Department of Conservation, Nelson City Council and Tasman District Council along with Forest and Bird and individuals who had extensive local knowledge and expertise in fisheries management and/or the marine environment to contribute. Collectively, the group provided knowledge and experience of customary, commercial and recreational fishing, marine environment and species conservation, local government policy and the broader community (societal) values. We explored the inter-connectedness between species that were identified as part of a multi-complex, chosen because they are often caught together with snapper. This totalled six species: snapper; tarakihi; john dory; red gurnard; rig; and flatfish (in general).

The information and system diagram also informed a small-scale agent-based model (ABM) which explored its utility to help manage the same multi-species complex.

This paper summarises the case study process and "road-testing" of the system diagram and multi-variate analysis to inform management of multi-species finfish complexes for fisheries.. There are two additional companion papers also available which together provide an overarching view of the case study. Links, and the full project report, are:

1. A companion paper summarising the components the participants included in the system diagram.
2. A companion paper summarising the development and use of agent-based model component of the research, and
3. The full report Project 4.2: Options for policy and legislative change to enable EBM across scales – Exploring the use of a system diagram and multi-variate analysis to understand multi-species complexes in fisheries May 2022

System Diagrams:

System Dynamics is the discipline that informs the system diagram. A system diagram is generally used to help *elicit causal assumptions* from people involved in a system. More rigorous System Dynamics modelling would be a way of *quantitatively testing those causal assumptions*.

As noted, the research forms part of the journey to better understanding tools and processes to 'road test' the application of a system diagram and supporting multi-variate analysis (MVA), to manage a multi-species finfish complex.

The system diagram is a conceptual diagram articulating cause and effect across and within a wide range of factors. This visual articulation of the structure of influences and relationships known to participants helps to identify cause-effect feedback loops of influence. From these loops, potential changes over time can be inferred. One of the critical elements of the system diagram approach is the identification of feedback loops of influence. There are two types of feedback loops: reinforcing feedback loops – which occur when one influence eventually encourages more of itself, thus 'reinforcing' on itself; and balancing feedback loops – which occur when one influence cancels or 'balances' itself out, resulting in low likelihood of runaway effects.

The system diagram does not seek to provide quantitatively rigorous insights and it is stressed that any inferences from the system diagram are conceptual only. However, the diagrams provide a mechanism for exploring inter-connected influences and pathways of influence across a wide range of inter-connected factors, albeit at a high level. This is informed by, and intended to complement, the current in depth knowledge that exist in many of these subject matter areas. The diagrams can also inform future more detailed and quantitative modelling.

Process Insights:

Both the process to *use* these tools (participatory and workshop based) and the *tools themselves*, were found to have likely benefit in the management of multi-species complexes. A summary of these insights is provided below. As noted throughout these insights, many of the benefits would be directly transferable to other management scenarios where multiple jurisdictions and actors are required to participate and interact to understand complex relationships:

- This 'road test' of the system diagram process and tool coupled with MVA, has demonstrated that this approach can positively contribute to the management of multi-species complexes. They can also strongly contribute to management that may require the input of multiple agencies across both land and ocean.
- The system diagram may be a useful tool to communicate the complexity of the inter-connected world to a variety of other stakeholders and agencies. The system diagram also presents an opportunity to inform part of the shared understanding that is often required across, between and even sometimes within agencies on differing yet interconnected issues.
- While useful, system diagrams do require one to 'tune in' to a certain way of thinking. This may be different to the predominant way most people think, and also highlights that this tool can supplement the existing ways that people think.
- The observations in this research are consistent with experiences in both: the pilot application of system diagrams in the Challenge; and a different Challenge case study in the Hawke's Bay. In particular, that the process helps:
    - participants better understand the perspectives of other participants;
    - participants to identify and consider factors that are not usually considered;
    - the group work together well; and
    - develop a holistic view of the issue which would support workable solutions/interventions.
- The system diagram is generic enough to be applicable across a range of other areas, not only geographic areas, but fish species also. The complexity demonstrated within this system diagram may be useful to other agencies, outside FNZ, regardless of whether FNZ were to be involved with the policy issue.
- The use of MVA in the project suggests a method for transparently highlighting commonalities between species. This can both: help inform *which* species to manage within a multi-species complex; or, if species have already been determined in a complex, help highlight which

characteristics of those species may need further investigation to develop appropriate management actions.

- While only used here to assess overlaps in species biology and habitat requirements, MVA could equally be used to commonalities in response to environmental change, human activities and management actions as well as appropriate fishers' activities.
  The process of MVA is also useful in identifying information gaps that need to be filled, in relation to species and/or management actions.

Figure ES1: Overview of the system diagram developed in this research