I TE KŌTI TAIAO Ō AOTEAROA
IN THE ENVIRONMENT COURT
OF NEW ZEALAND

ENV-2019-AKL-117
ENV-2019-AKL-127

UNDER the Resource Management Act 1991

IN THE MATTER of appeals under Clause 14 of Schedule 1 of the Act

BETWEEN **BAY OF ISLANDS MARITIME PARK INCORPORATED**
(ENV-2019-AKL-000117)

AND **ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND INCORPORATED**
(ENV-2019-AKL-000127)

Appellants

AND **NORTHLAND REGIONAL COUNCIL**
Respondent

REBUTTAL STATEMENT OF SIMON THRUSH ON BEHALF OF TE URI O HIKIHIKI HAPU AND MANUHIRI KAITIAKI CHARITABLE TRUST

MARINE ECOLOGY

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INTRODUCTION

1. My name is Simon Thrush. I am a Professor at the University of Auckland and Director of the University's Institute of Marine Science. I have approximately 30 years' experience in marine ecology and its application in environmental management. My qualifications are set out in Appendix A.
2. I am providing this evidence on behalf of Te Uri o Hikihiki and Manuhiri Kaitiaki Charitable Trust.

CODE OF CONDUCT

3. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and that I agree to comply with it. I have complied with it in preparing this evidence and I agree to comply with it in presenting evidence at this hearing. The evidence that I give is within my area of expertise except where I state that my evidence is given in reliance on another person's evidence. I have considered all material facts that are known to me that might alter or detract from the opinions that I express in this evidence.

SCOPE OF STATEMENT

4. I provide this evidence in respect of prohibition or control of activities which disturb the seafloor, including fishing techniques/methods that impact on biodiversity, which includes carbon cycling and links to climate change.
5. In response to the evidence of Mr West[1] which in my expert opinion falsely indicates little biodiversity value of the soft-sediment seafloor habitats or the importance of biodiversity to the decision-making process, I offer the following ecological definition of biodiversity.
6. Biodiversity encompasses variability across all levels of biological organisation from genes to ecosystems. Biodiversity encompasses components of both structure (e.g., how many species are found in a particular area) and function (e.g., how the system works to store carbon or recycle nutrients). In seafloor ecosystems the connectivity between specific habitats (e.g., reefs and sediments) is an important consideration in assessing ecosystem function. Particularly in situations where we have inadequate

[1] Statement of Evidence of Simon West dated 21 May 2021.

sampling of seafloor biodiversity, encompassing a diverse range of habitats is a useful management approach to enhance and maintain biodiversity.

7. I have not conducted any field research on the shelf of Northland's east coast. However, I have worked extensively in the Hauraki Gulf and in coastal ecosystems around New Zealand and in other parts of the world. I believe my experience and research findings are applicable to this case. Here I will make some general comments on the nature of marine ecosystems in relation to physical disturbance of the seafloor and then link this to the carbon cycle and the importance of the precautionary principle especially when limited local data or credible I have impact assessments available.

8. Associated Professor Shears, Dr Stirnemann, Dr Morrison, Mr Kerr and Ms Froude have all provided evidence on the ecological values of the region and the impacts of fishing on seafloor ecology. The Joint Witness Statement that resulted from the ecology expert conference (9 & 10 June 2021) provides a high degree of consensus that the region has high biodiversity values and these are being impacted by fishing activity. I wish to focus attention on the role of seafloor protection of the soft-sediment habitats and the potential to enhance carbon storage. This is a critical future issue as we seek to holistically manage our carbon budgets and mitigate the adverse effects of climate change.

9. My statement in largely in response to comments found in Mr Wests statement regarding the ecological values of soft sediments and will address the following matters:

   a) The marine environment and seafloor physical disturbance associated with fishing.

   b) The important of marine sediments in the carbon cycle and effects of bottom trawling on carbon dioxide emissions.

   c) The relevance of international research to New Zealand's marine ecosystems.

   d) The role of marine protected areas.

10. In preparing my evidence I have reviewed the evidence provided to the Court by: Dr Mark Morrison, Mr Vince Kerr, Associate Professor Nick Shears, Mr Simon West, Dr Rebecca Stirnemann, Ms Victoria Froude and the Agreed Statement of Facts – Fisheries Issues Topic 14 – Marine Protected Areas Ecology Expert Conference Joint Witness Statement.

EXECUTIVE SUMMARY

11. Soft-sediment habitats make a substantive contribution to marine biodiversity and are critical to many ecosystem functions that deliver important ecosystem services.

12. Fishing that physically disturbs soft-sediment habits has a negative effect on biodiversity and ecosystem function.

13. Physical disturbance to soft-sediment habitats resuspends fine sediments and associated organic matter. Elevating suspended sediment concentration that have negative effects on suspension feeding animals (e.g., sponges and bivalves) and enhances the conversion of organic matter back to carbon dioxide.

14. The decreased potential for carbon storage on the continental shelf is important in mitigating the accumulation of carbon dioxide.

15. While these processes are not fully understood or quantified there is sufficient scientific evidence to raise concern and act to avoid risk.

16. Given the magnitude of disturbance to the seafloor of the territorial sea, effective management, protection and restoration of functionally important seafloor biodiversity cannot be addressed in a piecemeal fashion. This has been recognised both nationally and internationally with a move to more integrative ecosystem-based management.

17. Marine protected areas avoid risks to biodiversity and ecosystem function, they also can provide suitable locations for research that is not confounded by human impacts.

18. While specific ecological effects of climate change are difficult to predict, the ecosystem consequences will be dependent on the capacity of the ecosystem to absorb change and this is influenced by multiple stressors and legacy effects. Marine Protected Area have the potential to mitigate these risks.

19. Inaction on the basis of uncertainty enables poor environmental practices to continue and fails to put the burden of proof where it should lie.

MARINE ENVIRONMENT AND SEAFLOOR PHYSICAL DISTURBANCE ASSOCIATED WITH FISHING

20. Coastal marine ecosystems are squeezed between the land and the open ocean. They encompass our estuaries, harbours, and the adjacent continental shelf.

21. Ecosystems are the product of interactions between physical, chemical and biological processes and do not have fixed spatial scales. Ecosystems always have leaky boundaries. This means that when defining a place for scientific or management purposes we need to be aware of influences across these human defined boundaries. In marine ecosystems these connections between ecosystems are profoundly important in understanding our coasts and in managing the impacts we have on them.

22. New Zealand has an extensive marine estate and a significant proportion of our biodiversity is found in the sea. We are signatories to international agreements and have national policies that seek to enhance or at least maintain biodiversity. This must include consideration of marine biodiversity in environmental management and conservation.

23. In seafloor ecosystems there is generally a strong and positive relationship between habitat diversity and species richness and both have strong and positive links to ecosystem function. Ecosystem function is simply how the ecosystem works and what it produces by way of goods and services.

24. Biodiversity has intrinsic value, but it is also linked to a range of ecosystem functions (e.g., carbon sequestration, habitat provision, nutrient cycling) that underpin important ecosystem services (e.g., climate regulation, food production, productivity, limiting eutrophication).

25. A healthy and functioning ecosystem also underpins the quality of experience for many people who directly or indirectly interact with the marine environment.

26. Many impacts on marine biodiversity do not occur in isolation, cumulative effects of repeated disturbance or multiple stressors mean that managing individual activities while effectively blind to others is likely to lead to ineffectual actions and environmental surprises.

27. The proposed areas for marine biodiversity protection encompass extensive areas of deep-water reef and soft- sediment habitats. Here I refer to the areas identified in Attachment 1 of the Ecology Expert Conference Joint Witness Statement. The deep reefs encompassed in Te Au o Morunga Protection Area C support communities of sedentary animals that mainly feed by suspension feeding and are thus prone to impacts from suspended sediments. The adjacent offshore sediments have been classified as muddy, meaning they can be easily resuspended and dispersed. Typically, the resident suspension feeding animals are classified as delicate and fragile in terms of their biological traits that link to physical damage, but sensitive species can also exist in soft-sediment habitats. Evidence on the extent of commercial fishing (Agreed Statement of Facts – Fisheries Issues) highlights that most of the direct impacts from commercial fishing are occurring in these offshore soft-sediment habitats.

28. Physical disturbance to the seafloor by bottom trawl and dredge fisheries is recognised internationally as the major agent of direct human impact on biodiversity in marine ecosystems (Dayton et al. 1995, Thrush et al. 2001, Thrush and Dayton 2002, 2010, Thrush et al. 2015). This has led to multiple calls from the research community for protection, most recently https://www.interacademies.org/news/world-academies-call-protection-marine-environments . Bottom trawling and dredging involves dragging nets, wires, bobbins, trawl doors and metal cages across the seafloor. The ecological effects of these different types of gear passing across the seafloor will be affected by various factors, including sediment type and the nature of the seafloor community as well as the towing vessel, sea conditions and proficiency of the skipper. In all instances it will be physically invasive.

29. This physical disturbance can result in species becoming functionally extinct, this means that species or groups of species fail to contribute to ecosystem functions. Note that, it is not merely the presence of these organisms that is important, their size, density and spatial arrangement on the seafloor are important with regard to their ability to provide functions and ecosystem services.

30. Disturbance to the seafloor needs to be considered at multiple scales. At the scale of the areas identified in this case, we need to consider the role of buffer zones and refugia from disturbance in maintaining or enhancing biodiversity. In situations, where high diversity patches on the seafloor become increasingly isolated by disturbance, the ability of these high diversity patches to play a role in rescuing disturbed patches decreases. When changes in the frequency and extent of disturbance outstrip the recovery potential of resident organisms, the selective loss of species contributes to habitat loss and fragmentation across the seafloor. This phenomenon highlights the importance of managing cumulative impacts on the seafloor to maintain or enhance biodiversity.

31. Apart from physical disturbance that can kill or damage organisms, fishing gear also resuspends fine sediments in the wake of the trawl or dredge gear. These plumes of sediment can drift over the seafloor and suspension feeder dominated communities are very likely to be highly sensitive to this impact. This is an important reason for considering in marine management and spatial planning buffer zones around reef habitats and in soft-sediment habitats dominated by suspension feeders.

32. Increasingly, the potential impacts on ecosystem functions has been brought into focus by our concerns with managing our natural environments to mitigate the effects of climate change and enhance the resilience of natural ecosystems. I want to focus on two basic questions that link habitat protection and climate change: (i) what role is there for marine ecosystems in helping to reduce the rate of increase in atmospheric carbon dioxide concentrations and (ii) how to enhance the resilience of marine ecosystems, their ecosystem services and cultural values in the face of the threat of climate change impacts on marine ecosystems.

THE IMPORTANCE OF MARINE SEDIMENTS IN THE CARBON CYCLE AND EFFECTS OF BOTTOM TRAWLING ON CARBON DIOXIDE EMISSIONS

33. Climate change has drawn a strong focus on atmospheric carbon dioxide concentrations. Our oceans have played a major role in absorbing carbon dioxide. This involves the solution of carbon dioxide in seawater and conversion of carbon dioxide into organic matter. Continental margin ecosystems collectively receive and store vast amounts of organic carbon derived from primary productivity both on land and in the ocean and play a central role in the global carbon cycle (Bianchi et al. 2018). The productivity of coasts and continental shelfs (covering ~9% of the global marine area) means they make a disproportionate contribution to carbon sequestration and cycling. For example, an analysis of the carbon budget for eastern North America indicates about 20 % of the carbon is buried in marine sediments (Najjar et al. 2018). Without question we have much to learn about these processes, but we do know enough to identify this as an important contribution to marine ecosystem services. As we seek to manage carbon budgets, we should explicitly include all habitats (tidal wetlands, estuaries, shelf waters, and the linkages between them) if we are to define the value of protecting stocks of stored carbon in marine sediments.

34. The ecological processes that underpin these carbon budgets start with carbon dioxide converted to organic matter via photosynthesis. Carbon can then move through marine food webs and be exported to different places by the mobility of plants and animals. All organisms respire- this involves the combustion of organic matter and the release of carbon dioxide where it can be recycled in healthy ecosystems. Plant production on the seafloor involves seaweeds (such as kelp), seagrass and mangroves but also the microphytobenthos that live at the sediment-water interface. Microphytobenthos are the dominant primary producers in many estuarine and coastal ecosystems and in clear water exist across the continental shelf. The other important primary producers are phytoplankton that live in the water column and contribute to the rain of organic matter that lands on the seafloor. Plant and the animal-produced organic matter all contribute to the concentration of organic matter on the seafloor. Here organic matter is consumed or stored in the sediment. Organisms that burrow into the sediment (e.g., burrowing crustaceans and polychaete worms) affect the transport of water, organic matter and chemicals (such as oxygen and nutrients). These processes influence the potential storage capacity of the seafloor and the subduction of carbon deeper into the sediment. These are all globally current and significant areas of research (Snelgrove et al. 2017).

35. As fisheries disturb marine sediments, they resuspend the organic matter resulting in elevated consumption and recycling and the removal of seafloor biodiversity. This reduces the ecosystem functions that influence burial and consumption of organic matter. Fishing grounds commonly have lower concentrations of organic matter due to winnowing and oxygenation (Martín et al. 2014, Pusceddua et al. 2014, Oberle et al. 2016).

36. There is recognition in the science community that although we have much to learn about shelf sediments, they are an important carbon store that we need to consider in our management actions. A recent study from the UK explored the economic value of the damage of human activities and climate change on marine habitats and estimated damage costs up to US$12.5 billion from carbon release linked to disturbance of coastal and shelf sea sediment carbon stores(Luisetti et al. 2019, Luisetti et al. 2020).

THE RELEVANCE OF INTERNATIONAL RESEARCH TO NEW ZEALAND’S MARINE ECOSYSTEMS.

37. In my evidence I have combined the results of my own research with that of many international studies. This highlights that in the presence of physical disturbance, irrespective of seafloor sediment type, we see a decoupling of the carbon cycle and organism-sediment relationships. In New Zealand there is very limited research on seafloor ecology and ecosystem function and thus we have to rely on international research. It is an important role for science to look for generality and this is a normal scientific practice to consider the relevance of overseas process-based research to understand our ecology and our environmental effects.

38. In seafloor ecology we commonly deal with complex-system dynamics and in coastal ecosystems with multifaceted and multidimensional problems. We exploit multiple lines of evidence to identify mechanisms of change and the potential for successful environmental solutions. In the face of this uncertainty a precautionary approach to environmental decision is wise. Much of the evidence presented to the court by other witnesses highlights the lack of ecological information available for this part our coast and continental shelf. This does not mean adverse effects are not happening or that this section of our marine environment is not delivering important ecosystem services. It does mean we need to take a precautionary approach to wise environmental decision making.

39. The Precautionary Principle is recognised in the RMA jurisdiction and identified in NZCPS policy 3. Given the degradation of our coastal ecosystems, the application of this principle is not a matter of maintaining the status quo, rather it is about positive management interventions to enhance a balance between multiple resource uses and values.

THE ROLE OF MARINE PROTECTED AREAS

40. Marine Protected Areas offer a simple way to manage socio-economic pressures and maintain sedimentary carbon storage. They offer opportunities to understand these processes better and develop effective incentive mechanisms to preserve these valuable coastal and marine ecosystems. This is a chicken and egg problem; we need both the capacity to do the research and the much-needed protected areas to generate the robust evidence.

41. Seafloor ecosystems deliver multiple ecosystems services well beyond food production and include carbon cycling and sequestration. These services support many human values and often it is the undervalued and unseen organisms of the soft-sediment habitats that play critical roles. To make an analogy to our urban environments many of these ecosystem services are only valued once they have failed. The ecological evidence is that once lost the recovery of services can be slow and expensive. Thus, in a world of climate change and biodiversity loss, marine protected areas offer us some hope and insurance in the face of future changes.

Professor Simon Thrush

22 June 2021

Appendix A: Qualifications & Experience

1.1. My name is Simon Francis Thrush. I am employed as a Professor and Director of the Institute of Marine Science and the George Mason Centre for the Natural Environment by The University of Auckland.

1.2. I hold the degrees of Bachelor of Science with First Class Honours in Zoology from the University of Otago and a PhD in Biological Sciences from the University of East Anglia, England.

1.3. I am a Fellow of the Royal Society of New Zealand.

1.4. I am a recipient of the New Zealand Marine Sciences Lifetime Achievement Award for outstanding service to marine science.

1.5. I have worked as a marine ecologist, researching, teaching and advising on coastal and estuarine seafloor communities and how they are affected by human activity, since 1985. My particular area of expertise includes seafloor ecology and natural and human-induced disturbance, as well as the ecological and environmental processes associated with ecological recovery from disturbance. I have extensive experience in monitoring and mapping the seafloor and in researching and advising on how environmental change will affect a range of ecosystem functions and services.

1.6. From 1986-2014, I worked as a marine ecologist at the National Institute of Water and Atmospheric Research, in Hamilton. As part of my work at NIWA, I led the initial research conducted in New Zealand on the impacts of trawl and dredge fishing on seafloor ecology, this was funded by Department of Conservation. Subsequently I led a large research project focused on the impacts of fishing funded by the Foundation for Research Science and Technology (FRST). I have also played a lead role in researching the ecological effects of sediment inputs to estuarine and coastal ecosystems. This work has been funded by FRST, and Ministry of Business Innovation and Employment (MBIE) and Auckland Council.

1.7. Currently my research is focused on Ecosystem-based management, cumulative impacts, tipping points and marine ecosystem services, all of which are directly relevant to managing seafloor disturbance. As well as involved in research projects in New Zealand I am involved in research into fishing impacts on seafloor biodiversity in Spain and oxygen dynamics in coastal seascapes in Finland.

1.8. Over the last thirty years, I have been involved in working with regional councils, Ministry for Primary Industries (**MPI**), Department of Conservation (**DOC**) and Ministry for the Environment (**MfE**) on a wide range of issues related to the management of coastal and marine ecosystems. This includes advice on the impacts of fishing, sediment runoff, urban contaminants and ecological monitoring. I have also provided comment and input to various national and regional policies and plans, including the New Zealand Coastal Policy Statement 2010 (**NZCPS**).

1.9. I have authored over 250 publications in peer-reviewed scientific journals and books, and over 85 consultancy reports.

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