BEFORE THE ENVIRONMENT COURT
Auckland Registry

ENV 2015 AKL 0000134

IN THE MATTER	of the Resource Management Act 1991
AND	of an appeal under Clause 14 of the First Schedule of the Act
BETWEEN	**TRUSTEES OF MOTITI ROHE MOANA TRUST**
	Appellant
AND	**BAY OF PLENTY REGIONAL COUNCIL**
	Respondent

STATEMENT OF EVIDENCE OF DR. NICHOLAS TONY SHEARS ON BEHALF OF MOTITI ROHE MOANA TRUST

25th October 2017

Counsel Acting
RB Enright
Barrister
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Introduction

1 My full name is Nicholas Tony Shears. I have the qualifications and expertise stated in my CV, which is **Attachment A**. My research history and publications are also listed in Attachment A. I am employed as a marine scientist by University of Auckland and have 15 years professional experience. My research focuses on the ecology of rocky reefs. I have carried out scientific research on rocky reefs throughout New Zealand, including surveys in the Bay of Plenty at Tuhua Island, Moutohora (Whale) Island, Whakaari/White Island and Volkner Rocks.

2 I have read and agree to comply with the Environment Court Expert Witness Code of Conduct. I have complied with the code in preparation of this evidence. I have not undertaken a site visit to the Motiti Rohe Moana Natural Environment Management Area. However, given my understanding of reef ecology in the wider Bay of Plenty and north-eastern New Zealand, I do not consider that a site visit is necessary in order to comment on the ecology of the reefs in the area. My research also involves the use of satellite imagery to map subtidal reef habitats and I have recently carried out a mapping project at Hahei, Coromandel Peninsula. I have examined available imagery of the Motiti Natural Environment Management Area (see **Attachment B**) and am certain the reef habitats in the area are analogous to those in other parts of north-eastern NZ.

Research

3 **Attachment B** is research prepared by me in relation to the ecology and impacts of fishing on shallow reefs in the Bay of Plenty. I consider that my research can reasonably be applied to the marine ecology of the MRMNE Management Area.

Outline of Issues

4 I have been asked to comment on:

(a) Is the ecology of shallow reefs in the Bay of Plenty consistent with that found in other parts of the Northeast Coast of New Zealand?

(b) Effects of human activities on habitat and biodiversity, experience at Leigh Marine reserve, Hauraki Gulf, and relevant Bay of Plenty experiences.

(c) Any other considerations related to potential thresholds for the impact of fishing techniques and methods.

5. My research also addresses:

(a) The ecological effects of fishing on shallow reefs

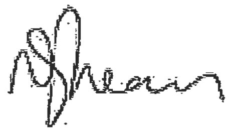
(b) The prevalence of urchin barrens in the Motiti Natural Environment Management Area

(c) The likely response of reef ecosystems to protection

Conclusions

6. The reef ecosystems in the Motiti Natural Environment Management Area and Bay of Plenty are typical of those found on the exposed coast of north-eastern New Zealand. The productivity and biodiversity of shallow reefs in the Motiti Natural Environment Management Area, particularly around Motiti Island, have been seriously impacted by overfishing. This is evidenced by the prevalence of urchin barrens around Motiti Island. Based on extensive research and monitoring in marine reserves in north-eastern New Zealand, it is clear that long-term protection of these reefs from fishing, in well-designed and enforced no-take areas, will promote the recovery of kelp forests and the associated indigenous biodiversity values on these reefs.

Dated this 25th day of October 2017



Dr N. Shears

Appendix A

Dr Nick Shears

Senior Lecturer

In: Marine Science » Faculty of Science

Biography

I carried out my PhD at the University of Auckland's Leigh Marine Laboratory, where I utilised the long-established Leigh Marine Reserve to experimentally investigate the ecological effects of fishing on kelp forest ecosystems. I then carried out a three year postdoctoral fellowship at the University of California Santa Barbara where I studied the effects of the Channel Islands Marine Reserve Network on kelp forest ecosystems.

In 2011 I was awarded a Rutherford Discovery Fellowship to support my research into the combined effects of terrestrial-derived sedimentation and climate change on rocky reef ecosystems.

I have a joint position between the Leigh Marine Laboratory and the Department of Statistics and am particularly interested in using marine reserves as experimental tools to better understand marine ecosystems and the effects that humans have on them.

See my publications on Google Scholar.

Research | Current

My main research interests lie in rocky reef ecology and marine conservation. I aim to address fundamental questions in modern ecology that have clear applications to management of marine ecosystems.

Current research areas include:

- Long-term change in sea surface temperature around the New Zealand coast (in collaboration with Dr Melissa Bowen, School of Environment)
- Using hydrothermal vents to examine the effects of ocean acidification on reef ecosystems (in collaboration with Drs Craig Radford and Mary Sewell)
- Blooms of benthic dinoflagellates (*Ostreopsis*) on shallow reefs (in collaboration with Dr Luisa Mangialajo, University of Nice)
- Investigating long-term changes in marine reserves (Department of Conservation, eCoast Ltd) and on rocky reefs in the Hauraki Gulf (Auckland Council)

Teaching | Current

- BIOSCI 209 S1 2012 City
- MARINE 302 S2 2012 City

Postgraduate supervision

Current students:

- Caitlin Blain - Drivers of variation in kelp (*Ecklonia radiata*) forest productivity - PhD Marine Science
- Oliver Evans - Refining video techniqes for marine reserve monitoring - MSc, Jointly supervised by Dr Richard Taylor
- Christine Hansen - Resilience and recovery of kelp forests across a sedimentation gradient - PhD Marine Science

- Jared Kibele – Using satellite imagery to map rocky reef habitats - PhD Marine Science
- Blake Seers – Predicting the effects of climate change on sedimentation in the coastal environment - PhD Statistics
- Arie Spyksma - Direct and indirect effects of predators on the behaviour and morphology of sea urchins - PhD Marine Science - Jointly supervised by Dr Richard Taylor

Past students:

- Kate James – Invasive kelp Undaria pinnatifida in the Hauraki Gulf (PhD 2016)
- Evan Brown - Indirect effects of marine reserves on reef fish assemblages (MSc 2015)
- Josh Richardson - Using unbaited cameras to monitor reef fish in marine reserves (MSc 2015) Jointly supervised by Dr Richard Taylor
- Pam Kane - Lobster catchbility (MSc 2014) Jointly supervised by Dr Ian Tuck
- Kirsten Rodgers – The effects of multiple anthropogenic stressors on the ecological function and resilience of kelp forest ecosystems (PhD Marine Science 2015)
- Benn Hanns - Morphology of the kelp *Ecklonia radiata* (MSc 2014)
- Sarah Roth - Blooms of the green algae *Microdictyon umbillicatum* (MSc 2014)
- Edwin Ainley - Effects of deposited sediments on macroalgal assemblages (MSc Marine Science 2013)
- Alessandra Bisquera - Sediment effects on intertidal rocky reef assemblages in the Hauraki Gulf (MSc - Statistics 2012)
- Blake Seers – Investigation into the current state and trends of Auckland's coastal water quality (MSc Statistics, 2011)
- Richard Hughes - Sedimentation and the ecology of shallow macroalgal habitats in the Hauraki Gulf (MSc Marine Science, 2011)

Potential research topics (MSc or PhD):

- Impacts of toxic dinoflagellates (*Ostreopsis* sp.) on rocky reef ecosystems
- Exploring the use of environmental health indicators on rocky reefs
- Direct and indirect effects of marine reserves on intertidal reef communities
- Sea urchin-kelp dynamics across an environmental stress gradient
- Habitat and resource-use of spiny lobster (*Jasus edwardsii*) in marine reserves

Selected publications and creative works (Research Outputs)

- Bowen, M., Markham, J., Sutton, P., Zhang, X., Wu, Q., Shears, N. T., & Fernandez, D. (2017). Interannual Variability of Sea Surface Temperature in the Southwest Pacific and the Role of Ocean Dynamics. *Journal of Climate, 30* (18), 7481-7492. 10.1175/JCLI-D-16-0852.1
- Other University of Auckland co-authors: Melissa Bowen
- Teck, S. J., Lorda, J., Shears, N. T., Bell, T. W., Cornejo-Donoso, J., Caselle, J. E., ... Gaines, S. D. (2017). Disentangling the effects of fishing and environmental forcing on demographic variation in an exploited species. *Biological Conservation, 209*, 488-498. 10.1016/j.biocon.2017.03.014
- Bonaviri, C., Graham, M., Gianguzza, P., & Shears, N. T. (2017). Warmer temperatures reduce the influence of an important keystone predator. *The Journal of animal ecology, 86* (3), 490-500. 10.1111/1365-2656.12634
- Spyksma, A. J. P., Taylor, R. B., & Shears, N. T. (2017). Predation cues rather than resource availability promote cryptic behaviour in a habitat-forming sea urchin. *Oecologia, 183* (3), 821-829. 10.1007/s00442-017-3809-4
- Other University of Auckland co-authors: Richard Taylor
- Krumhansl, K. A., Okamoto, D. K., Rassweiler, A., Novak, M., Bolton, J. J., Cavanaugh, K. C., ... Ling, S. D. (2016). Global patterns of kelp forest change over the past half-century. *Proceedings of the National Academy of Sciences, 113* (48), 13785-13790. 10.1073/pnas.1606102113
- URL: http://hdl.handle.net/2292/32229
- James, K., & Shears, N. T. (2016). Population ecology of the invasive kelp Undaria pinnatifida towards the upper extreme of its temperature range. *Marine Biology, 163* (11).10.1007/s00227-016-2993-9
- URL: http://hdl.handle.net/2292/31250
- Kibele, J., & Shears, N. T. (2016). Nonparametric Empirical Depth Regression for Bathymetric Mapping in Coastal Waters. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 9* (11), 5130-5138. 10.1109/JSTARS.2016.2598152

Rodgers, K. L., & Shears, N. T. (2016). Modelling kelp forest primary production using in situ photosynthesis, biomass and light measurements. *Marine Ecology Progress Series, 553*, 67-79. 10.3354/meps11801

Appendix B – Statement on ecological impact of fishing on shallow reefs and likely response of reef ecosystems to marine reserve protection.

Prepared by: Dr Nick Shears, University of Auckland

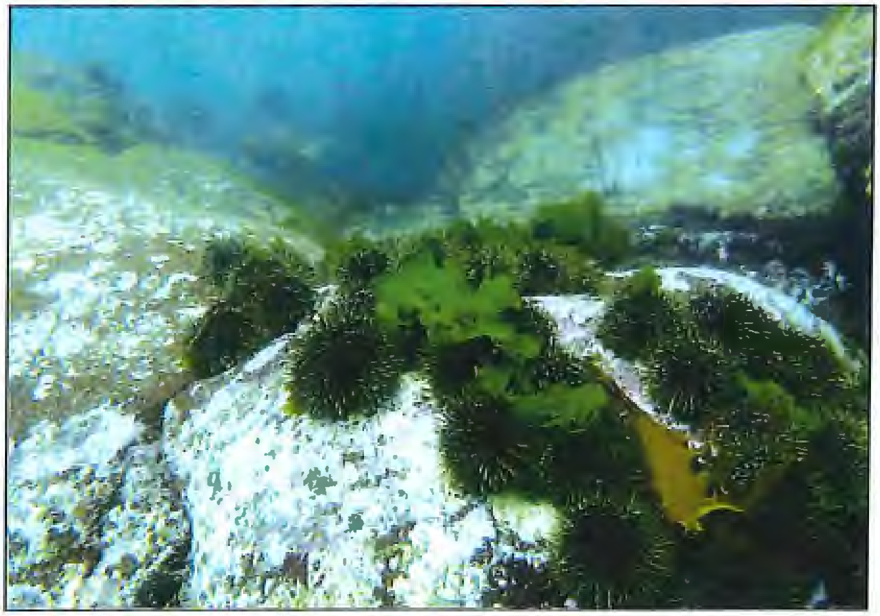
Ecological impact of fishing on shallow reefs in northeastern NZ

The ecological impact of fishing on shallow reefs in northeastern has been well established (Babcock 2013; Schiel 2013). The most obvious and well described ecological impact of fishing is the proliferation of sea urchins that has occurred in many parts of northeastern New Zealand following large-scale declines in sea urchin predators (mainly snapper and crayfish) due to fishing. The increase in herbivorous sea urchins leads to the deforestation of kelps forests and formation of "urchin barrens" habitat in shallow waters (Fig. 1).

The extent and depth distribution of urchin barrens varies predictably with wave exposure in northeastern New Zealand (Grace 1983; Shears & Babcock 2004). On wave-sheltered reefs urchin barrens are typically limited in extent and may only occur in shallow water (<5 m), whereas at exposed open coast locations sea urchin barrens can occur from ~3 to 20 m depth (Shears & Babcock 2004). Surveys at open coast locations throughout northeastern New Zealand, including sites at Tuhua Is in the Bay of Plenty, found that urchin barrens typically cover 20-40% of the reef <10 m depth (Shears *et al.* 2008a).

The shift from kelp forests to urchin barrens on shallow reefs results in large-scale declines in primary productivity (Babcock *et al.* 1999), and declines in available food and habitat for a range of fish and invertebrate species.

Fig. 1. Urchin barrens habitat at Whakaari/White Island, Bay of Plenty, New Zealand (Photo: N. Shears, 13/11/2015)



Ecology of reefs in the Bay of Plenty

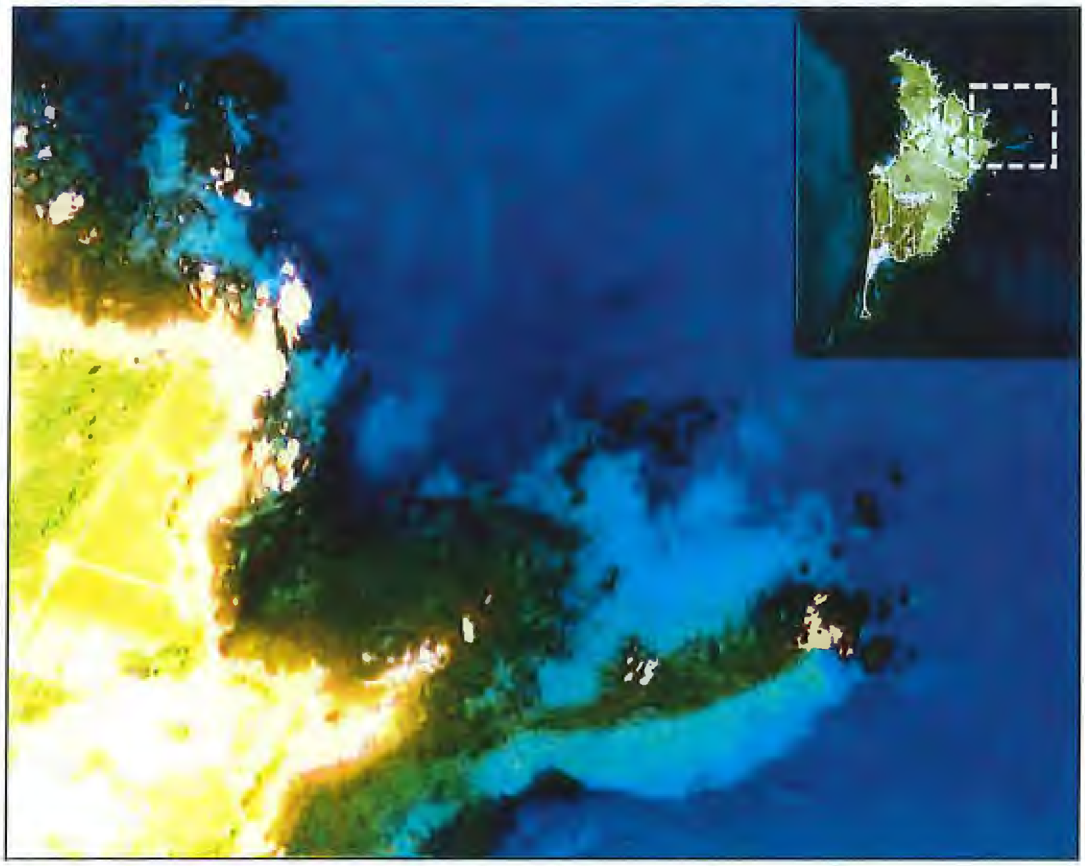
Shallow reef communities in the Bay of Plenty are typical of those found in other parts of the Northeastern bioregion (Shears *et al.* 2008b). Specifically, the offshore islands in the Bay of Plenty such as Tuhua have a variety of reef habitats, and seaweed and invertebrate assemblages, that are typical of other offshore islands along the northeast NZ coast (e.g. Mokohinau Is, Poor Knights Is). The reef fish assemblages have also been found in the Bay of Plenty typical of northeastern New Zealand (Cole et al. 2012). The similarities in species assemblages are due to the similar environmental conditions (wave exposure, temperature etc) and influence of the East Auckland Current.

The typical zonation pattern on shallow reefs in northeastern New Zealand is evident at offshore locations in the Bay of Plenty (Fig. 2; Choat & Schiel 1982; Shears & Babcock 2004). Shallow depths (<3-5 m) are dominated by large seaweeds (fucoids). *Ecklonia radiata* is the dominant kelp along the entire northeast coast and typically forms large monospecific stands at depths below ~10 m at offshore island locations along the northeastern coast (Shears & Babcock 2004). The intermediate depths are often made up of a mix of habitats but this is where sea urchins can proliferate and where urchin barrens form. At Tuhua in the Bay of Plenty urchin barrens cover ~30% of the shallow reef at fished sites, which is typical for offshore islands along the northeastern coast (Shears *et al.* 2008a). Personal observations made at Moutohora (Whale) Island and Whakaari/White Island suggest that these patterns are typical for the offshore reefs in the Bay of Plenty.

My research group has recently developed new methods for mapping subtidal reef habitats in northeastern New Zealand with multispectral satellite imagery (Kibele & Shears 2016; Kibele 2017). Examination of available satellite imagery covering the MRMNE Management Area demonstrates that urchin barrens habitat occur around much of Motiti Island (Fig. 2). Urchin barrens are particularly extensive on the northern and eastern coasts which is consistent with high wave exposure and greater extent of the subtidal reef. The quality of the imagery available would make mapping these habitats relatively straight forward with satellite imagery and limited ground-truthing necessary. This would provide a valuable and cost-effective method for monitoring changes in these habitats in the future.

Urchin barrens also appear to be common in shallow water around the other smaller islands (e.g. Motunau Is) in the MRMNE Management Area but it is difficult to accurately assess this with the available satellite imagery. The submerged reefs, pinnacles and rock stacks in the area typically have limited availability of shallow reef so may not be expected to have substantial areas of urchin barrens.

Fig. 2. Multispectral satellite imagery showing extensive sea urchin barrens habitat (light coloured reef) on the northeastern point of Motiti Is. The shallow band of large brown seaweeds is also evident around the coastal margin and deeper kelp forest (dark area) beneath the urchin barrens. (Imagery courtesy of DigitalGlobe; Image date: 8/12/2015).



Recovery of biodiversity and ecosystem services in marine protected areas

There is now strong evidence from three marine reserves on the exposed northeastern coast of New Zealand that no-take protection leads to recovery from the ecological impacts of fishing. Research from the Leigh and Tawharanui Marine reserves (Babcock *et al.* 1999; Shears & Babcock 2002, 2003), and more recently the Te Whanganui a hei (Hahei) Marine Reserve (Kibele & Shears 2017), has shown that given time urchin barrens decline and kelp forests recover in marine reserves, following the recovery of predator (snapper and crayfish) populations. In each of these reserves urchin barrens now cover <5% of shallow reefs compared to ~20% of shallow reefs on the surrounding fished coasts (Kibele & Shears 2016; Kibele 2017). This results in substantial increases in productivity of the shallow reefs in reserves compared to adjacent fished areas (Babcock *et al.* 1999; Rodgers & Shears 2016). However, these conservation outcomes are only achieved if marine reserves are effective at protecting previously fished predatory species such as snapper and crayfish. This requires reserves to be large enough, no-take, and adequately enforced (Edgar et al. 2014).

References

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