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 VINCENT CARLYLE KERR ON BEHALF OF NGĀTI MĀKINO HERITAGE TRUST

24th October 2017

Introduction

1. My name is Vincent Carlyle Kerr. I hold a Bachelor of Biological Science degree from the University of Oregon, USA and a National Diploma in Horticulture from the Royal Institute of Horticulture, Lincoln College. I am a member of the New Zealand Marine Sciences Association. I am the principal of Kerr and Associates and am engaged in environmental consulting with a focus on marine ecology work and marine protected area planning. I was a former marine technical officer for Northland Conservancy, Department of Conservation (DOC). I have also worked as a contractor and consultant in marine and freshwater ecology for DOC in Northland. I am the current chairman of the Northland based Mountains to Sea Conservation Trust which is amongst New Zealand's largest marine and freshwater environmental education providers. **Annexure A** is my CV.

Experience

2. I have been involved professionally with marine work in Northland. This work has included development of information systems, marine habitat mapping, coastal inventories, ecological descriptions and survey and monitoring. Since 2012 I have worked as a consultant in marine ecology and conservation and established a consultancy, Kerr & Associates.

3. I have been responsible for developing the marine protected area program for Northland with DOC and participated in marine protection working groups at national and regional level.

4. I have been a certified commercial diver and have logged approximately 1,000 scuba dives in Northland waters.

5. I am experienced in GIS operation and marine mapping methodologies.

6. I have also done extensive survey work in the Central Pacific with a focus on coral reef ecology and conservation initiatives.

7. I have carried out mapping work on the entire Northland east and west coasts, developing habitat mapping methodologies with side scan sonar, video surveys and aerial photo analysis.

Environment Court Expert Witness Code of Conduct

8. 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.

9. My role in presenting this evidence is to produce research prepared by me in relation to shallow reef ecology and the values associated with ecological processes. I have not undertaken a site visit to the Motiti Rohe Moana Natural Environment Management Area. However I do not consider that is necessary in order to produce my research on the values given my experience with representative ecological environment of the North East Coast of New Zealand. I consider this research is relevant to Otaiti (Astrolabe) reef.

10. I have had opportunity to review draft planning provisions prepared by Graeme Lawrence and associated maps prepared by Diane Lucas (landscape architect) as relevant background material.

Research

11. This work formed the base information for the GIS based marine habitat map of Northland's east coast. Field work for this project included analysis of aerial photos, and literature reviews relevant to the North East Coast of New Zealand and the Bay of Plenty. I have done a large number of scuba and snorkel dives along the North East Coast of New Zealand over a 30 year period.

12. I have been requested by the Motiti Rohe Moana Trust to provide a summary of 'lessons learned' from research on algal forests in northeast New Zealand and in particular my experience with North east coast shallow reefs. "Shallow reefs" refers to a depth range where algal forests dominate the biological community. In the Northland studies a standised range of 0-30m depth was adopted. Below 30m depth the reefs biological communities are dominated by filter feeding invertebrate communities. This major zonation occurs as a result of insufficient light penetrate the deeper zone to support macro algae species. Within this 'shallow reef' habitat there are further zones algal communities. Urchins typically

prefer the upper two-thirds of the 'Shallow reef'.[1] As a result of this habitat preference of urchins the end result of urchin barrens occurs only in the shallower part of overall shallow reef. In Northland this zone of preferred habitat of sea urchins is typically 1-15m in depth, but local variations and environmental condition exist.

13. Below is a list of the specifics of what the Motiti Rohe Moana Trust has asked to investigate:
    1. Describe what is known about the threat and extent of the urchin barren decline condition in shallow algal forests in Northland.
    2. Examine the relevance or similarity of shallow reef ecology and urchin barren studies to shallow rocky reefs in Bay of Plenty

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[1] Morrison, Jones, Consalvey, Burkenbusch (2012) provides relevant commentary on the definition of **biogenic habitat**:
"Fisheries research and management has traditionally been focussed on the fish populations, while the habitats and environments which underpin their production have been largely ignored. This situation is changing, with an increasing awareness that habitats are important and can be degraded through human activities, both marine and land-based. While the wider field of marine ecology has been researching such fish-habitat themes for a number of decades, the species worked on are often small, site-attached, and relatively short-lived; while fisheries species tend to be larger bodied, and operate over much larger spatial and temporal scales. Given this, quantitatively linking fisheries species to habitats is a challenge, and an active field of research. One type of habitat that appears to be especially important for many demersal species are those referred to as 'biogenic' habitats.

These biogenic habitats are formed by plants and animals, and occur from the inter-tidal out to the deep sea. Well known biogenic habitats include salt marshes, mangrove forests, seagrass meadows, kelp forests, bryozoan fields, and shellfish beds. For the purposes of this review, biogenic habitats are defined as a) those living species that form emergent three-dimensional structure, that separate areas in which they occur from surrounding lower vertical dimension seafloor habitats and b) non-living structure generated by living organisms, such as infaunal tubes and burrows. A sub-set of these habitats are biogenic "reefs", which are visually imposing, and are defined as "solid, massive structures which are created by accumulations of organisms, usually rising from the seabed, or at least clearly forming a substantial, discrete community or habitat which is very different from the surrounding seabed. The structure of the reef may be composed almost entirely of the reef building organism and its tubes or shells, or it may to some degree be composed of sediments, stones and shells bound together by the organisms.

The functions provided by these habitats are diverse, and can include the elevation of biodiversity, bentho-pelagic coupling, sediment baffling, protection from erosion, nutrient recycling, the provision of shelter and food for a wide range of other organisms, and even the creation of geological features over longer time scales. They also directly underpin fisheries production for a range of species, through: 1) the provision of shelter from predation, 2) the provision of associated prey species, and in some cases, 3) the provision of surfaces for reproductive purposes e.g. the laying of elasmobranch egg cases; as well as, 4) indirectly in the case of primary producers through trophic pathways." (Executive Summary, p1)

3. What are the ecological implications of the decline in algal reef health as seen in Northland studies?
4. What have we learned in Northland and elsewhere from various locally applied management actions involving localised controls on fishing?
5. Would the extent and persistence of urchin barrens be a suitable state of the environment indicator, and could this be measured and monitored in an ongoing system that was efficient?

Outline of Issues

14. Overfishing of sea urchin predators on shallow reefs can result in loss of kelp forests and consequential 'urchin barrens'. This process of ecological disruption is discussed below.

15. Effectiveness of the proposed rules framework for the Motiti Natural Environment Area (in the form of waahi tapu and waahi taonga areas where fishing techniques and methods are prohibited or restricted).

16. Performance measures and activity thresholds for application in the waahi taonga area.

Importance of Temperate Reef Ecological Assemblages

17. Recent research (discussed below) confirms that the recovery of crayfish and other reef fish (mainly snapper) can lead to a recovery of kelp forests in no-take marine reserves.

18. The application of Region-wide mapping of urchin barrens as a prominent feature of the coast indicates that shallow kelp forests are vulnerable to intensive fishing at large-spatial scales. The results of the attached report suggest greater understanding and recognition of the key biodiversity status and productivity of kelp forests is needed to better understand the ecosystem-level consequences of activities on rocky reefs.

19. Future management of coastal ecosystems must use a range of available tools to address these ecological challenges. We discuss various factors affecting the estimation of urchin barren extent and provide a set of initial thresholds for kelp

forest monitoring which could be used to inform management decisions impacting fishing techniques and methods within the Motiti Natural Environment Management Area.

Background

20. The north east coast region is unique in several aspects relating to marine habitats. Firstly, Northland has an extensive coastline and a very large area of shallow rocky reefs. Many of the Northland reef systems have an ecological sequence with large areas of offshore 'deep reefs' (rocky reef structures occurring at depths greater than 30m), not dissimilar to that of the Motiti Natural Environment area (MNEA). Secondly, Northland has had more marine habitat mapping projects completed than any other region.

21. In my experience and expressed in the attached report (**Annexure B**) we have brought all this information together in a GIS based project to question the state of health of shallow rocky reefs in particular in the Northland region. This regional scale analysis is relevant to MNEA, particularly the extent of the habitat type known as 'urchin barrens', where large numbers of sea urchins have lead to the loss of kelp forests. I consider the estimated extent of urchin barren areas are having dramatic effects on the coastal ecological assemblies, productivity, biodiversity of the marine environment, especially reef resident and reef specialist species.

22. Our study and data included analysis of different types of activity management including two marine reserve and a partial protection area. Tawharanui was set up as a Marine Park in in the 1980's, but was effectively a marine reserve with a full 'no-take' due to rules in place, and subsequently obtained full marine reserve status. The Cape Rodney to Okakari Marine Reserve was established in the 1970's. A third relevant site is an area that has had partial protection in place since the 1980's. Mimiwhangata Marine Park has all commercial fishing and some method restrictions on recreational fishers.

23. I understand that MRMT proposes a cultural and biodiversity based marine spatial plan with associated rules that is intended to have ecological benefits through preventing or restricting fishing techniques and methods within identified areas (waahi tapu and waahi taonga areas).

North East Coast Bioregional View Of Similarities

24. I consider that ecological conditions associated with shallow reefs in Northland are likely to have substantial similarities with the Bay of Plenty region; accordingly my research is relevant to the ecological conditions likely to apply to the Motiti Natural Environment Management Area. This view is supported by extensive work supporting the creation of a regional classification system for coastal New Zealand. This classification system appears in its most updated form in the Government's Marine Protected Areas Policy and Implementation Plan (DOC & MPI, 2008) (Map 1 below). Northland's east coast shares the same regional classification, 'Northeast Bioregion', with Hauraki Gulf, Coromandel, and Bay of Plenty.

25. This bioregional level classification is a large body of data that shows that these three regions share similar currents, water temperatures and flora and fauna groups. Detailed studies testing the validity of the bioregional classification and specifically similarities between the shallow reefs across the bioregion have been carried out and also support the concept and application of the current classification (Shears et al. 2008; Shears & Babcock, 2007, Shears & Babcock, 2004).

26. In Northland and Bay of Plenty our coasts are regularly swept with warm subtropical currents which bring with them an extra dimension of larvae from subtropical origins. As a result the northeast bioregion has by far the highest fish diversity associated with its shallow reefs. These habitats have been documented in a comprehensive Northland rocky reef fish diversity study (Brook, 2002).

27. I do note that sub-regional ecological responses may occur at a local level in relation to specific influences of micro-habitat orientation to current, swell, light, biological availability and other physical and environmental parameters.

Ecological Significance Of Shallow Rocky Reefs And The Urchin Barren Dynamic

28. The shallow rocky reef ecosystem is very important for biodiversity value of flora and fauna. Shallow rocky reef systems in ecological terms are generally accepted

to be one of the most significant habitats of the exposed coast marine environment.

29. There is no current regime of monitoring that looks specifically at the health of algal forests which are the foundation of productivity and structure for this habitat. [2] The evidence I have prepared on the health of rocky reefs comes from habitat mapping projects which have been arranged to support marine protected area planning and spatial frameworks.

30. A big picture review of the ecology of the North East Coast, in particular my experience with Northland's reefs and coastal environments, is consistent with the attached NIWA Report (Morrison, 2005) and the wider review of Biogenic Habitats, 2014 by the same author. This review highlights the fact that many commercially important fish species spend part of their life cycle on shallow rocky reefs. Also highlighted in the NIWA report is the high diversity levels of invertebrates and algal species have a critical habitat relationship which is intrinsic in nature.

31. The sea urchin, *Evechinus chloroticus*, known as kina in New Zealand, is widespread in the Northeast Bioregion. In addition to being a traditional food species, it plays a key role as a primary grazer of kelp. Early studies in north east New Zealand documented kina's role as a habitat creator through grazing of kelp (Choat, 1982), (Grace 1983), however at that time it was thought that barren areas on the reef caused by urchin grazing was a 'natural' characteristic of our reefs.

32. In subsequent decades, the dynamics between kelp forests, sea urchins and exploitation of sea urchin predators (mainly snapper and crayfish) has been investigated in New Zealand (Shears et al. 2004; Shears and Babcock, 2002). The Mimiwhangata habitat mapping report (Kerr & Grace 2005) illustrated dramatic decline of the kelp forests over wide areas, starting sometime in the 1960s or 1970s.

33. As part of our methodology for the Mimiwhangata habitat mapping exercise, local kaumatua were interviewed and stated with confidence that the current condition

[2] I understand that Dr Kepa Morgan will provide evidence on the mauri-model developed by him that may assist with measurement of reef health and biodiversity.

of extensive urchin barren areas was not known prior to about 1960-1970 and was not mentioned in their tribal knowledge handed down from elders.

34. In northern New Zealand it was found that large snapper and crayfish are the main predators of urchins (Shears & Babcock, 2002). In their absence, population density of urchins can raise to ten fold of normal densities resulting in the urchins removing large areas of the kelp forest. These areas often become a stable state of drastically reduced productivity and diversity.

35. There is a large body of research based around the Leigh marine reserve where after thirty years of full protection the urchin barren areas which were extensive in the 1970's reverted to kelp forests, in parallel with the predator species re-establishing in the marine reserve.

36. Diversity loss gives rise to further concerns around reefs' reduced ability to fulfil their natural role of fixing carbon and thus reduce greenhouse gas and potentially serious reduction in the reef systems' resilience to rapidly changing environmental conditions brought on by global warming.

37. Recognition of the importance of shallow rocky reefs and the threat of diversity and productivity loss due to overfishing and urchin barren establishment in New Zealand has unfortunately not yet lead to a point where it features in any monitoring programs regionally.

38. To highlight the potential effects of the rules on urchin kelp relationships in Figure xx below you can see a glaring example from the Bay of Islands of the extent of urchin barrens in an area badly affected. There would have been naturally continuous heavy kelp forest cover across the entire reef (seen as dark brown). What we see is a thin edge of specialised shallow water seaweeds, species of *Carpophyllum* less palatable to urchins, and a remnant of the *Ecklonia radiata* (large brown kelp), seen here below about 10m depth only covering a small area of the bottom of the reef near where it drops off on to an edge with a sandy bottom habitat. This barren condition represents a major loss of productivity, habitat and diversity. In contrast the fully restored reefs under full protection have a consistent coverage of macro algae species and high productivity and

biodiversity values. I have provided a more detailed explanation in my appended report.

Partial Protection From Activities

39. Our research has provided an opportunity to measure algal forest health recovery responses in a partially protected area, measuring urchin barren extent.

40. There is a good history of monitoring and research at Mimiwhangata Marine Park. It was established as a marine park, with fisheries regulations which restricted commercial activities and provided special recreational fishing provisions in the form of a regulation allowing fishing only with non weighted lines.

41. Based on long term monitoring studies for reef fish and crayfish, researchers have tracked the effectiveness of this partial protection management approach over several decades. Results are conclusive and dramatic for both reef fish (Denny & Babcock, 2004) and crayfish (Shears et al., 2006). It can be concluded that there has been no recovery of key predators over the history of the partially protected marine park. Urchin barren areas are extensive and have not recovered.

Discussion

42. In my opinion it has become apparent that this decadal trend parallels intensive fishing practices. This decline trend is likely exacerbated by a spatially disproportionate recreational fishing effort focused on ‘accessible’ shallow reefs. Fisheries research carried out by NIWA (Harthill et al., 2013) indicates that the recreational catch of snapper in northern New Zealand is significant compared to the commercial catch, but is spatially concentrated on shallow coastal reef areas.

43. At a more regional and localised level, John Booth (2017) prepared a report for the Bay of Islands Fish Forever group which uses the MPI recreational fishing data to compare and comment on localised recreational fishing and its’ now serious impacts on shallow rocky reefs at the local scale. Dr Booth relevantly notes that:

> “The loss of shallow-reef kelp in the Bay of Islands has been intensive and extensive (up to 90% or more in places), and is likely to have led to a multitude of cascading consequences, most of them not yet even recognised let alone understood. The kelp community plays pivotal ecological roles (e.g., Tegner & Dayton 2000; Schiel, 2003; Leleu et al. 2012; Hesse et al. 2016): kelps are highly productive, fixing carbon, and fuelling the ecosystem; and they provide habitat for all manner of animals and plants. Shallow kelp forests provide areas for fish spawning and larval settlement, and shelter for juveniles, by reducing exposure to water movement and predation. Red rock lobster postlarvae often settle out of the plankton among shallow-reef kelp, and juvenile snapper are strongly associated with it.
>
> Whereas the reason for the emergence of sea-urchin/kina barrens in northeastern New Zealand was for a time contested, there now appears to be consensus that these barrens are a direct result of the overharvesting of keystone predators (predators whose impact on the ecosystem is disproportionately large relative to their abundance) such as snapper and red rock lobsters - the ones capable of preying on kina (Andrew & MacDiarmid 1991, Shears & Babcock 2002, Ayling & Babcock 2003, Schiel 2013, Ballantine 2014) and other sea urchins. In Schiel’s (2013) cascading, ‘trophic-effect model’ for northeast Northland, reductions in the proportions of large individuals of these predatory species have led to burgeoning sea urchin (kina in particular) populations and to the widespread loss of shallow-reef kelp. Resulting sea-urchin barrens such as these are a world-wide phenomenon and one surprisingly difficult to reverse (Ling et al. 2014).” ([5.3] Discussion & Conclusion, p58)

44. Establishment and persistence of urchin barrens also appear to be context dependent and as a result variable (Shears et al., 2008), suggesting that environmental factors can also limit urchin grazing and formation of urchin barrens.

45. The ecological impact of fishing has not been (in my experience) a consideration in fisheries management decisions or ‘models’ to date. Despite the significance of the rocky reef habitat to many fish species and the coastal environment, the loss of shallow algal forests and greater ecological consequences have not been monitored in any comprehensive manner. It is therefore relevant to any management regime introduced to control fishing techniques and methods as part of the MNEA.

46. I consider that there is a clear need for an ability to apply restrictions on fishing techniques and methods such as those sought by the Motiti Rohe Moana Trust. These are likely, over time, to support and restore natural control of kelp forest

grazing by restoring a functional ecological balance and trophic interactions between predator, prey, grazer.

Potential Thresholds for Algal Forest Health

47. In both marine ecological research and fisheries management there is currently a great interest in the move to ecosystem based management. The development of a method focused on algal forest health is an ideal ecological monitoring approach and will complement more holistic ecosystem management approaches.

48. I have not been involved in developing the rules framework for the Motiti Natural Environment Area. Hence I can only comment at the level of principle and not on specific wording proposed. I consider that the proposal to ban fishing techniques and methods completely within identified areas (known as waahi tapu) is likely to result in benefits to indigenous biodiversity and the habitat of valued fish and flora species such as snapper, hapuku and crayfish. However, as Dr Roger Grace notes in his draft evidence, the benefits will be related to the size and quality of habitat of "no-take" areas. In principle, I also consider that restricting fishing techniques and methods within identified areas (known as waahi taonga) until transect studies confirm sustainable populations of key species of flora or fauna (for example, *Eklonia* (rimurimu or brown kelp) are restored is likely to result in benefits to indigenous biodiversity and the habitat of valued fish and flora species. Benefits will be related to the level of management control imposed and other variables such as size and quality of habitat.

49. I therefore support, in principle, the proposal that areas within the Motiti Natural Environment Area cannot be fished until brown kelp is restored to a healthy state within those areas. The trigger we offer below level 2 is arguably a threshold where negative impacts on the reef system are substantial and from what we know headed towards further decline and a shift to a more stable unproductive state. The level 2 extent of persistent urchin barren could be considered for this management approach to indicate the threshold level of a healthy reef. Levels between Level 1 and 2 could trigger a warning that an unhealthy state may develop. Levels below Level 1 could be considered to be at a natural and very

healthy condition parallel to what we see in a restored algal forests in our long term marine reserves.

50. I would like to offer here some initial guidelines for thresholds which could be measured in a low cost monitoring system with the provision of the following working assumptions:
    50.1. For a given management area, a basic marine habitat map is completed outlining the extent of rocky reefs;
    50.2. A system of representative monitoring sites are established where the reef's biological zonation is mapped;
    50.3. At each site a shallow reef depth zone is established representing preferred urchin habitat zone (shown in white in figure 3 below). Typically this would range from the 1 m to 10-15m depth levels or the depth of the reef edge if it is less than this figure. Wave exposure and water clarity affect this depth zonation.

Thresholds Marine Use Activity

51. Based on the monitoring of the shallow portion of the reef classified as sea urchin preferred habitat, the following thresholds could be considered to trigger management arrangements:

    51.1. Level 1: 5-10% urchin barren extent signals concern that impacts of urchin barrens are becoming significant. If this level persists or expands and is supported by low reef fish diversity counts and low counts of large snapper and crayfish restrictions of fishing could be considered.

    51.2. Level 2 : >10% urchin barren extent which is persistent or expanding and supported by poor monitoring results for reef fish diversity, large snapper and crayfish counts. This level triggers consideration of long term no fishing protection to restore ecological balance and productivity of the reef. Decisions to remove the no-fishing restriction could be considered only after recovery of kelp forest had reached a level better than the Level 1 trigger and where sufficient representative areas in the management area remain as a network of fully protected areas to meet basic marine protection goals.

51.3. Fishing controls considered should include areas mapped as reef edge habitats of adjacent soft bottom habitats and extend offshore to a minimum distance of 2 km where possible. This design guideline is informed by studies of crayfish (Kelly, 2001 & MacDiarmid & Kelly, 2003) and snapper home range (Parsons et al. 2003) and use of reef edge soft bottom habitats (Langlois, 2005 & 2006).

51.4. As noted earlier, there are variables in the urchin barren effect in terms of 'other environmental factors' which affect urchin behaviour or population density. They are things like disease, storms, wave exposure, sedimentation and topography. In short at times and at certain places these factors effectively limit urchin populations and grazing so that even in the absence of urchin predators there are few or no urchin barrens, but there is a depleted fish community and potentially other ecological imbalances etc. The urchin barren is not a perfect indicator for all stretches of coast. Ideally what we can learn from this indicator is applied with other forms of monitoring and knowledge to design protection at large scales.

Recommendations

52. I have made specific recommendation in my report to the Motiti Rohe Moana Trust and reiterate them below.

52.1. We have identified a specific biodiversity threat to shallow rocky reefs, which is not being taken into account by the current fisheries management framework. This leads us to a conclusion that there is a valid reason to adopt other means to support biodiversity conservation and restoration by pursuing localised management controls on areas where fishing activities result in significant reduction in biodiversity (or other) identified values of shallow reefs.

52.2. Support further investigations into the special nature of habitats and biodiversity in the shallow coastal zone where localised heavy fishing pressure can have specific ecological impacts. Fish, algal communities, benthic invertebrate communities, and deep reef encrusting invertebrate communities are all good candidates for future investigations.

52.3. Establish a set of representative rocky reef study areas where long-term changes can be documented and understood.

52.4. Develop a research programme that reviews the spatial implications of various forms of activities and fishing and specific impacts on shallow rocky reefs. The specific impacts of fishing intensity at the local or reef scale must be quantified for its ecological impact role to be understood.

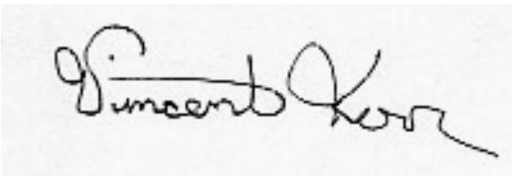
52.5. Support ongoing study of the restoration of kelp forests in New Zealand marine reserves and other fully protected areas. Studies of marine reserves have demonstrated that marine reserves (or equivalent areas where a “no-take” regime is in place) can reverse the urchin barren condition back to a restored kelp forest and offer an essential ‘control area’.

52.6. Create a research project that examines the climate change implications of loss of kelp forests.

52.7. Develop a model for documenting the ecological goods and services value of shallow rocky reefs and the ecological, economic and cultural losses associated with the loss of kelp forests versus the positive value of their restoration (Van den Belt & Cole 2014).

52.8. Develop local and regional goals or design objectives for the extent and arrangement of a network of fully protected areas that would insure against further decline of shallow reefs and support restoration of kelp forests at a regional scale.

DATED at Whangarei this 24th day of October 2017.



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Vince Kerr