**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 (the Act)
IN THE MATTER OF	appeals pursuant to Clause 14 of the First Schedule of the Act against decisions of the Northland Regional Council on the proposed Northland Regional Plan
BETWEEN	**Bay of Islands Maritime Park Incorporated** ENV-2019-AKL-117
	The Royal Forest & Bird Protection Society of New Zealand Incorporated ENV-2019-AKL-127
	Appellants
AND	**Northland Regional Council**
	Respondent

**STATEMENT OF EVIDENCE OF VINCE KERR
ON BEHALF OF TE URI O HIKIHIKI HAPU**

DATED 25th March 2021

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Qualifications and Experience

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 also hold teaching qualifications at High School and Tertiary level. I am a member of the New Zealand Marine Sciences Association. I have been a keen diver and observer of the natural world since childhood. My experience relevant to this evidence is as follows.

2. I am a principal of Kerr & Associates and engaged in environmental consulting with a focus on marine ecology monitoring, habitat mapping and marine protected area design and planning. I have worked as a 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. Relevant technical reports and publications that I have authored or contributed to, are identified below.

3. I am a co-founder of the Northland-based Mountains to Sea Conservation Trust, which is among New Zealand's largest marine and freshwater environmental education providers. I currently serve as a science advisor for the Trust and support a number of hapu and community conservation projects as part of the Trust's community engagement program.

4. Over the past twenty years I have led numerous marine habitat mapping projects, coastal inventories, ecological descriptions and have established a number of survey and monitoring programs around Northland. I have been an active diver and marine photographer here in Northland and throughout the central Pacific. My work in the Pacific has been focused on coral reef fish ecology and biodiversity surveys and exploration of remote reef systems in the Pacific.

5. Marine science investigations have been carried out at Mimiwhangata since the early 1970s. There are 34 technical reports and published research papers that specifically involve work at Mimiwhangata. Attachment 1 lists those investigations. My involvement with the science work at Mimiwhangata began in 1999 working as a contractor for the Department of Conservation. I have been involved in various capacities with all investigations and reports from 2002 onwards.

Code of Conduct

6. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014 and agree to comply with it. The contents of this statement are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this statement.

Scope of Evidence

7. I have been asked by Te Uri o Hikihiki to present evidence to the Court, in relation to the matters identified below. In addition, I have been asked by the hapu to give my account of how the partnership between the science investigations and the hapu has worked and benefited both the progress of the science and the understanding of the relevant ecological values.

8. This evidence is structured as follows:

    a. Summary of the history of science research and monitoring investigations
    b. Summary of the ecological implications from the various investigations
    c. The significant contribution from the mātauranga Māori of Te Uri o Hikhiki and leadership of the kaumātua
    d. Habitat mapping at Mimiwhangata and adjoining waters and associated investigations

e. Ecological importance of the deep reefs of Area C and vulnerability of these habitats
f. Decline of algal forests
g. Studies of crayfish abundance and ecology and what we learned about partial protection
h. A summary of fish abundance and the lack of recovery at Mimiwhangata
i. Additional biodiversity notes from Mimiwhangata investigations
j. Conclusion

Executive Summary

9. This evidence summarises research and monitoring investigations at Mimiwhangata carried out between 1973 and 2011. Mimiwhangata ranks amongst the most significant sites in New Zealand from a science perspective. Of particular significance is the long-term nature of the data sets for fish and crayfish and which stretch back into the 1980's. These studies have the added advantage of being paired with the same methods used at the full no-take Tawharanui Marine Park. The results have been published internationally and show that the full no-take reserve was effective in restoring key species exploited by fishing and reversed long-term trophic cascades resulting in algal forest decline. Partial protection where some fishing is allowed to continue did not lead to recovery in species or return of the algal forest. Detailed habitat mapping studies have been carried out in 1973 and 2005 and allowed for analysis of historic aerial imagery dating back to 1950. Results showed that there has been significant loss of the shallow algal forest since the seventies coinciding with increased fishing pressure. The various habitat mapping projects have also provided us with an accurate picture of the deep reef habitats offshore of Mimiwhangata allowing us to begin to appreciate the ecological connectivity between these deep and shallow habitats and their importance generally. Associated studies in other Northland sites support the understanding of the mechanisms at play with the

algal forest loss. They also provide us with an understanding of the process of recovery within full no-take reserves.

10. The proposals put forward by Te Uri o Hikihiki provide an opportunity to reverse the habitat and species declines that are an impact of localised long-term over-fishing. The protection areas and have been designed over a long process of comparing monitoring and research results and protected area design principles with their cultural knowledge and experience. The ecological studies and potential benefits identified in my opinion strongly support this proposal.

Ecological Investigations and Research at Mimiwhangata[1]

11. In the early 1970s Mimiwhangata was owned by NZ Breweries, which commissioned a series of studies (1,2&3) to document the environmental values of the area including the waters of Mimiwhangata. As part of that study the marine ecology team of the late Dr. Bill Ballantine (Auckland University), Dr. Roger Grace (independent scientist) and Wade Doak (marine explorer and author) were brought together. In 1972 and 1973 they completed extensive survey work over the area we now know as the Marine Park. As part of this work, they completed an ecological report and the first subtidal marine habitat map in New Zealand (3). They developed principles and methods for this mapping that form the basis of what we still use today. The Mimiwhangata habitat map was added to by Dr. Grace with a further area covered at adjoining Paparahi Point in 1981 (7). In both habitat maps the kina grazed zone where the shallow *Ecklonia radiata* forest was degraded covered significant areas. This indicates that as far back as the 1970s, overfishing was affecting the ecology of the shallow reefs, although the link between overfishing and the decline of the algal forests was not fully understood at the time.

[1] Note the numbers in parenthesis following references to research and monitoring reports refer to the numbered list of Mimiwhangata research reports in Attachment 1.

12. In 1976 Dr. Grace set up a monitoring program for the area which focused on species that were thought to be affected by fishing pressure. Permanent transects were established to track abundance of reef fish, crayfish, mussels, tuatua, rock oysters, and scallops. Monitoring reports were completed regularly up until 1986. These reports showed that generally reef fish abundance levels were static over the period with abundance levels generally low and large individuals generally missing from the populations. Mussels, tuatua, rock oysters and scallops were in decline. The Marine Park was fully established in 1984 with the removal of all commercial fishing from the Park. By 1987 Dr. Grace had growing concerns that kina barrens were increasing and there was no apparent recovery of crayfish or fish from what he then described as an overfished state. At this time, the ecological significance of the increasing kina grazed zone was not fully understood. Based on these first periods of monitoring, in 1987 Dr. Grace made the case that the current partial protection approach should be carefully monitored to ascertain if recovery of habitat, reef fish and crayfish was occurring under the Marine Park management rules. Unfortunately, for various reasons monitoring ceased in 1986.

13. The various reports of the first era of investigation paint an accurate picture of the special nature of the Mimiwhangata coastal habitats and the adjoining deep reefs. They describe the wide range of habitats and exposures occurring there, the small offshore islands and the effects of the offshore subtropical currents sweeping around the peninsula and islands extending seaward into deeper waters. They document the presence of a variety of sub-tropical fish species and invertebrates, commenting that the special nature of Mimiwhangata's habitat support a diversity of reef fish species comparable to the some of the best locations in Northland. In the early 1970s, Dr. Grace and Wade Doak explored with scuba dives out to the edge of what we now refer to as the deep reef at Mimiwhangata (4). Their dives went to approximately 47m depth and 1 km offshore, which is approximately the existing boundary of the Marine Park. On these dives they observed a rich and diverse filter feeding community with large areas of pink

Gorgonians *Primoides sp.* and the rarely seen *Occulina virgosa*, often referred to as ivory coral, and Antipatharian black coral. They noted the richness of this sponge and Gorgonian dominated habitat and commented that it could well extend further to the east into deeper waters. They also noted that these deeper reef habitats could play a very important role in the ecology of the Mimiwhangata marine area and that they were biologically rich.

The second era of Mimiwhangata science investigation 1999-2011

14. In the period between 1986 and 1999 Mimiwhangata came into government ownership, with DOC having management responsibility for the land and the Ministry of Fisheries having responsibility for compliance with the regulations applying to the Marine Park. In this period of 13 years there was no program of marine monitoring and the compliance effort was limited to signage and DOC officers reminding visitors of the regulations.

15. In 1999 I was tasked to plan and implement an investigation into the effectiveness of the Marine Park arrangement at Mimiwhangata. This program of work was carried out in the years between 1999 and 2011. The initial objectives of the project were identified as follows:

    a. Engage with the hapu and seek their support and guidance for the investigation and shaping of future options
    b. Review what was learned from the previous monitoring program and what methods should be carried forward
    c. Identify key monitoring and research questions, objectives and updated survey and research methods to support the investigation

16. In the planning stage of the second investigation an expert group was established consisting of myself, Dr. Grace, Dr.Babcock, Dr Ballantine and Dr Shears from the Leigh laboratory of Auckland University (the Expert Group). Some Auckland University scientists

were at that time doing leading work on the effectiveness of full no-take reserves and the recovery of exploited fish species, crayfish and algal forests. The Auckland University scientists were particularly interested in the value of the long-term studies of a partial protection at Mimiwhangata, which was paired with the full no-take area of Tāwharanui Marine Park. At that time there was a paucity of evidence in the international literature and in New Zealand on the effectiveness of the various forms of partial protection in restoring or protecting biodiversity, habitats or fisheries. The collective advice from the Expert Group to DOC regarding Mimwhangata in 2000 was:

a. While the work at Mimiwhangata stretching back to the 1970s offered one of New Zealand’s best long-term monitoring data sets, it lacked a clear baseline in which to compare results to. In the 1970s a decline in algal habitats and reef fish abundance was already suspected. Also, there were no adequate reference areas without fishing impacts represented in the monitoring. This conclusion was formed and supported by research work on recovery of algal forest and reef fish ecology being studied at the Leigh Marine Reserve.

b. The extensive historical knowledge of Mimiwhangata held by the local hapu, Te Uri o Hikihiki, would be invaluable to guide us in understanding what could be considered a natural baseline for this area and this would be of great benefit to the study of ecology there.

c. The early-period permanent transects established for reef fish and crayfish should be preserved on the basis of their high value as a long-term data set and usefulness to indicate change over time. Alongside this, set up a monitoring system utilizing baited underwater video (BUV) and randomized underwater diver (scuba) census (UVC) transects. This system would be randomized and include reference areas to the northwest and southeast of the

Marine Park. A similar UVC transect should be set-up for crayfish. This combined monitoring design would allow for current statistical methods of analysis to be applied as well as providing a basis for linking the new investigation to other similar investigations in northeast New Zealand and the long-term data set at both the partial protection area of Mimiwhangata and the no-take then Marine Park at Tāwharanui.

d. The 1973 habitat map at Mimiwhangata needed to be updated adding adjacent areas on all sides of the Marine Park including the deep reefs outwards to depths of 100m.

17. In 2001, a second period of investigation began. The findings can be summarised under three broad themes:
    a. reef fish
    b. crayfish; and
    c. habitat mapping.

18. Over this period of investigation, the scientists (including myself) received various contributions of historic ecological knowledge from the kaumātua of Te Uri o Hikihiki.

19. I have read the evidence of Dr. Shears dated 19 March 2021 that provides the science overview of the ecological significance of the area, being the shallow coastal area of Mimiwhangata and the deep reef areas off Mimiwhangata extending to Cape Brett paragraphs (18-24). The evidence of Dr. Shears captures the key findings of the Expert Group over this second stage of investigation. I agree with the evidence of Dr. Shears as reflecting the ecological findings from the second period of investigation. I also agree with the conclusions that Dr. Shears has drawn in his evidence at [(25-28). Additionally, in paragraphs (29-38) Dr. Shears summarises the current knowledge of the impacts of fishing on these habitats especially in the shallow areas resulting in the loss of keystone predators which regulate kina grazing,

leading to catastrophic decline of our shallow algal forests at Mimiwhangata and more generally on Northland’s east coast. I agree with Dr. Shears conclusions in paragraphs (29-38).

Mātauranga and leadership from Te Uri o Hikihiki

20. Early in the second period of the investigations, a strong working relationship was growing between Dr. Grace, myself and the kaumātua of Te Uri o Hikihiki. This relationship was based on the sharing of knowledge. Over time, Dr Grace and myself became increasingly aware of the significance and extent of their knowledge of the area and its value. It helped that the two leading kaumātua, the late Houpeke Piripi and Puke Haika, were life-long divers and fishers and were from families which were likewise in the true sense “people of the sea”. Houpeke was a renowned historian in a traditional sense and Puke was hugely experienced as a diver and had a keen interest in traditional knowledge. These kaumātua were wanting to assert their traditional authority in the form of restoring ‘life’ back to Mimiwhangata.

21. Every year we would have several meetings where Dr. Grace and I would share descriptions of what we were doing and seeing and then Houpeke and Puke would relate their experience and knowledge where relevant to our research. This body of traditional knowledge and observations was often recounted in detailed direct observations going back several generations, which pre-dates industrialised fishing in this area and extends to pre-European times. I will recount some of these observations and descriptions as I go through the ecological information below.

Habitat mapping at Mimiwhangata

22. Three habitat maps have been completed with varying coverage of Mimiwhangata. These studies involve analysis of aerial imagery, various forms of sonar data and ground truthing surveys using ROV or drop cameras and sediment sampling and in some case scuba dives. Figure 1 below shows the spatial relationship

between the two fine-scale mapping studies (1973 and 2005) and additionally the 1981 Paparahi Point map. All of these methods and the mapping processes unveil a lot of information about the characteristics of the areas involved. The maps have shown themselves to be a valuable tool for planning and designing marine protected areas, assessing ecological significance, describing marine communities and identifying spatial areas of habitats to be used as proxies for ecological communities.

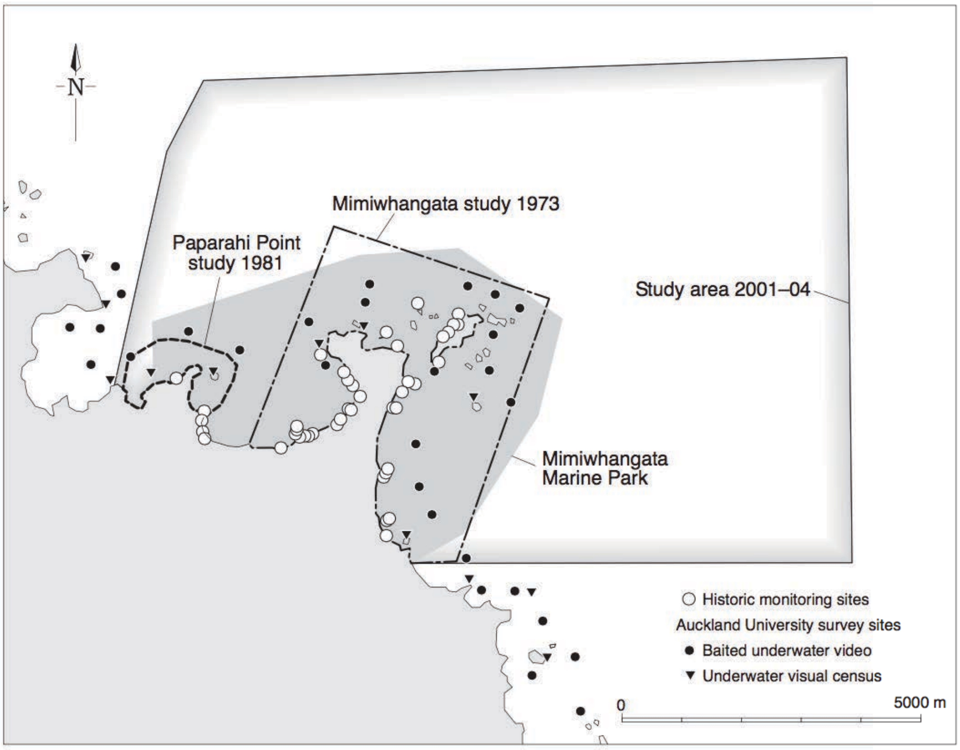

Figure 1 Survey sites at Mimiwhangata established in 1976 by Dr. Grace and the three areas where habitat mapping was completed.

23. The mapping designed around Mimiwhangata in 2005 was completed at a relatively fine scale with most of the map drawn at 1:500 scale. This supported accurate mapping of kina barrens and a more refined habitat classification. The 2005 map further defines and reinforces the descriptions of the special and significant aspects of the area alluded to in the 1973 report (4). The 2005 habitat map is attached as Attachment 3. The ecological

descriptions in the 1973 report were confirmed and extended to a larger spatial area and deep reefs.

24. Mimiwhangata has a very complex coastline creating a great diversity of habitats characterised by varying topography of the sea floor substrates and exposure. The peninsula and the outer islands project eastwards out into oceanic waters and the subtropical currents in warmer months. All these characteristics result in increased shelter, feeding opportunities, and upwellings that result higher plankton productivity and availability to planktivorous fish species. These elements of diversity attract more predators. Importantly, around Mimiwhangata there is a lot of ‘edge’ between reef both deep and shallow and a wide diversity of soft sediment habitats. These edges are known to be very productive. Many species find advantages in foraging for food in both areas and seek shelter and protection from the reef structures.[2] The significance of this complex diversity of habitat at Mimiwhangata cannot be understated and is only really equaled in the Bay of Islands with its diverse array of islands. Mimiwhangata however also combines a strong oceanic influence and proximity to deep habitats, similar to biodiversity hotspots Cape Brett and the Karikari Peninsula. Mimiwhangata also shares another significant feature with both the Karikari Peninsula and Cape Brett in that it has excellent connectivity with a large area of offshore deep reef. Some areas within the system have complex vertical structures and topography. These high relief areas of deep reef support the highest productivity and diversity of filter feeding communities due to greater current and upwelling effects. All this complexity translates to the areas becoming fish and biodiversity hot spots. I will make further comment on the deep reefs of the proposed Area C in paragraphs (30-35) below.

Tarakihi, Hāpuku and traditional habitat knowledge

[2] Langlois, T.J., Anderson, M.J., Babcock, R.C., 2005. Reef-associated predators influence adjacent soft-sediment communities. Ecology 86, 1508–1519.

25. During the habitat mapping process at Mimiwhangata two significant descriptions of habitats emerged from the kaumātua. The first was a description of an important traditional tarakihi, *Nemadactylus macropterus*, fishing ground.

26. In 2006 while out on a boat offshore north of Mimiwhangata, the kaumātua recalled how they navigated to this ground via triangulation with land features. They regularly fished on this ground and normally easily caught fish at the right time of year. In the years prior to that boat trip, this fishing ground had disappeared. Following this trip, I mapped the triangulation on the habitat map. The ground was located at a prominent edge and corner of one portion of the deep reef, which is the sort of habitat I would expect a 'fishing ground' to be for this species.

Hāpuku at Mimiwhangata

27. Another traditional fishing ground of great significance to the hapu was a hāpuku, *Polyprion oxygeneios*, ground about 1.5km off the coast of Rimariki Island. The kaumātua recounted how they would several times a year at just the right time and weather pattern row out to this ground. At a specific location they would anchor and fish. They again used triangulation of landmarks to navigate to this spot. At this specific location they would regularly catch large hāpuku. When I asked what was large they described a fish that would have been in excess of 50kg. When I mapped this area over the habitat map it was in the middle of the high relief deep reef at 45-50 depth, where we would expect a biodiversity hotspot to be and a perfect habitat for hāpuku.

28. This hāpuku ground also was in the vicinity of the exploratory deep dives that Dr. Grace and Wade Doak completed in the 1970s, which led to their description of the 'remarkably rich deep reef' at Mimiwhangata. We can only ponder how the hapu had such accurate information of these offshore habitats. When I showed them the habitat map and the imagery we had collected they were

interested and amused, but were in no way surprised that they had identified these special areas out of many square miles of ocean.

29. Hāpuku were once an important predator in these 50m reefs. Now even in the shallow reefs they are locally extinct and play no part of their ecological role in these waters of less than 100m. The role of overfishing in this story is significant.

Figure 2 This photo was taken by Dr. Grace when hāpuku could still be seen in diving depths at the Poor Knights Islands.

Figure 3 Images of diverse and productive filter feeding invertebrate communities captured on the high relief deep reefs at 50m depth, approximately 1.5 km off Rimiriki Island. (right) an example of a health

community of pink gorgonian fan corals with a large cup sponge in the background and a white Zoanthid species, the understory of this community is a complex mixture of encrusting sponge species; Bryozoans and many other encrusting invertebrate forming a complete cover of the reef and 3-dimensional structure which is home to a large community of reef dwelling invertebrates and fish that feed on this resource. (left) a complex filter feeding community with a large cup sponge in the background and an *Antipatharia* black coral (seen as white) in the foreground. The black coral is protected in all NZ waters by the Wildlife Act.

30. The 2009 Northland map (30) and the data supplied by the Ocean's 2020 survey project for the first time allowed us to see the spatial extent of the offshore deep reefs along Northland's entire east coast. The map in Attachment 4 shows the offshore deep reefs, as well as an indication of the surface topography made by using a type of 3D contour map derived from the Ocean's 2020 multi-beam data.

31. In my opinion, this series of deep reefs is highly significant regionally and also nationally. This conclusion is based on the many survey projects I have participated in in Northland, which have involved sonar and video data collection, as well as a working familiarity with the literature in New Zealand on this subject. I will summarise some key considerations:

    a. The deep reefs in the Area C Protection area extend between the shallow reefs of Mimiwhangata to Cape Brett including depth zones from the edge of the shallow kelp covered reefs at 30m depth to over 100m depths.

    b. There are diverse and ecologically valuable invertebrate filter feeding communities that form the basis of many food chains and support coastal marine species in many ways during different parts of their life cycle.

c. The reefs have complex edges and large areas of soft bottom habitats associated that incorporate a great range of substrates and depths and therefore a corresponding diversity of benthic communities and the ecological functions they support.

d. In my experience of surveying and mapping these reefs, I point to their importance of representing a transition in a north south gradient between deep reefs to the south with more silt and influence of the fine sediment inputs of the Hauraki Gulf to the ‘cleaner reefs’ extending to the North, which have progressively less silt as you go northwards. I believe there is an important transition between Mimiwhangata and Cape Brett, which favors reef invertebrate filter feeding communities and increasing diversity of soft bottom invertebrate communities in association with more sandy and shelly substrates as you travel north up the coast.

e. The connectivity of these deep reefs with the two coastal areas of Mimiwhangata and Cape Brett is I believe significant, as they are both examples of our best coastal sites in terms of fish and habitat diversity and productivity associated with the sub-tropical currents running down the coast and large areas of complex reef.

f. Ecologically these deep reefs would stand out for their biodiversity value and would be ideal representative areas of these habitats to support marine protection and support restoration of adjacent degraded shallow areas. There are currently no examples of this habitat represented in the marine protected area network in Northland.

g. There is a clear threat from any bottom disturbance on these deep rock reefs from the 30m to 150-200m depths. Along Northland’s coast these reefs vary greatly in topography. Flatter reef areas and patch reefs of low relief have probably been most affected by bottom fishing gear, whereas the high relief areas of the reefs may be identified by fishers and not fished due to the expense of losing gear. However, high relief areas can be the most desirable for surface and mid-depth bulk fishing methods as they are often biodiversity hot-spots attracting fish of many species, especially predators. The deep reef filter feeding communities are especially vulnerable to any physical disturbance. Many of the larger species are very slow-growing, very delicate and easily removed from the system.

32. An important New Zealand study of the risk to soft bottom communities from fishing impacts was done in 1998,[3] and remains a clear statement on this subject. In this study in the Hauraki Gulf, 18 study sites were chosen along a gradient of fishing pressure. This summary is from the abstract:

    a. *Samples along a putative gradient of fishing pressure were collected from 18 sites in the Hauraki Gulf, New Zealand. After accounting for the effects of location and sediment characteristics, 15–20% of the variability in the macrofauna community composition sampled in the cores and grab/suction dredge samples was attributed to fishing. With decreasing fishing pressure we observed increases in the density of echinoderms, long-lived surface dwellers, total number of species and individuals, and the Shannon-Weiner diversity index. Our data provide evidence of broad-scale changes in benthic communities that can be directly related to fishing. As these changes were identifiable over broad spatial scales they are likely to have important*

[3] Thrush, S.F., Hewitt, J.E., Cummings, V.J., Dayton, P.K., Cryer, M., Turner, S.J., Funnell, G.A., Budd, R.G., Milburn, C.J., Wilkinson, M.R., 1998. Disturbance of the marine benthic habitat by commercial fishing: Impacts at the scale of the fishery. Ecological Applications 8, 866-879.

ramifications for ecosystem management and the development of sustainable fisheries.

33. In 2000 a research project led by Dr. Martin Cryer, then with NIWA, surveyed a large area of soft bottom habitat in the Far North off Spirits Bay. [4] In this study an unprecedented array of deep reef filter feeding communities was sampled. The findings revealed numerous new species of international significance and led to this area having a ban on bottom trawling and scallop dredging. This is a rare undisturbed 'shelf' soft bottom area which has such high biodiversity and scientific interest that it was viewed as warranting total protection from any bottom disturbance indefinitely. This rare investigation of a pristine 'shelf' site should shed considerable light on the wisdom of using these fishing methods in a reef/soft bottom complex like that off the coast of Mimiwhangata and Cape Brett or at the very least point to the scientific requirement to have a no-fished reference site against which fishing impacts can be evaluated rigorously.

34. In 2002 in a review paper by Dr. Cryer published in Ecological Applications,[5] large areas of seabed in the depth range of 200-600m were studied. Sixty-six research trawls were spread along an area of 220 km of seabed along a line of fishing pressure gradients. The study found that up to 40% of the invertebrate variation could be attributed statistically to fishing activity. In the discussion section of this paper Dr. Cryer reviewed a large list of ecosystem processes linked potentially to bottom disturbance via bottom trawling. Some 18 years ago when this paper was written Dr. Cryer drew attention to large scale ocean processes threats which may be associated with bottom trawling. In this excerpt Dr.

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[4] Cryer, M, O'Shea, S., Gordon, D., Kelly, M., Drury, J., Morrison, M., Hill, A., Saunders, H., Shankar, U., Wilkinson, M., & Foster, G. (2000). Distribution and structure of benthic invertebrate communities between North Cape and Cape Reinga. Final Research Report for Ministry of Fisheries Research Project ENV9805 Objectives 1 & 2.

[5] Cryer, M., Hartill, B., O'Shea, S., 2002. Modification of marine benthos by trawling: toward a generalization for the deep ocean? *Ecological Applications,* 12(6), 2002, pp. 1824–1839

Cryer was summarising concerns raised by international colleagues:

a. *… switching off the "biological pump" (sequestration of atmospheric CO2 in deep-sea sediments) would have far more dire consequences than the loss of tens, hundreds, or even thousands of rare species (on which most conservation attention is focused). Thus, understanding and managing impacts on deep-sea benthos may be important for safeguarding ocean processes as well as sustainable fisheries.*

35. This above reference to large scale ecological processes impacted by fishing and bottom disturbance foreshadows a major study recently published in *Nature.*[6] This study reviews current knowledge on the impact of bottom disturbance on the ocean floor's role of sequestering carbon that falls to the seabed from the ocean's biological productivity. This organic carbon builds up on the ocean floor and is essentially trapped in layers of silt on the seafloor. Bulk fishing methods like bottom-trawling stir up this material enabling breakdown of the organic component releasing CO_2 into the water column which is released into the atmosphere. The global figure for the CO_2 released by this fishing impact is estimated at 1 gigaton of carbon/yr. To put this number in perspective, this number is similar to the CO_2 released each year by global commercial air travel. The study proposes that 30% of the areas currently fished with bottom disturbance methods should immediately be designated full no-take reserves. Their modeling shows that beyond the immediacy of climate change mitigation, there could be substantial fisheries benefits derived form this level of protection.

[6] Sala, E., Mayorga, J., Bradley, D., Cabral, R. B., Atwood, T. B., Auber, A., Cheung, W., Costello, C., Ferretti, F., Friedlander A M, Gaines S D, Garilao C, Goodell W, Halpern B S, Hinson A, Kaschner K, Kesner-Reyes K, Leprieur F, McGowan J, Morgan L E, Mouillot D, Palacios-Abrantes J, Possingham H P, Rechberger K D, Worm B and Lubchenco J., 2021. Protecting the global ocean for biodiversity, food and climate *Nature* 1–6. Published online 17 March, 2021.

36. Decline of algal forests

37. The 2005 habitat mapping study of Mimiwhangata (25) accurately mapped the shallow habitats at scales of 1:500 or better. Spatial extent of potential shallow reef *Ecklonia radiata* habitat was calculated at 975 hectares with kina barrens making up 24.9% of that area. It is important to note that the shallow part of the *Ecklonia radiata* forest where this loss is occurring is the most productive zone of the forest due to the higher light levels driving photosynthesis of the algae. The accurate mapping was made possible by the use of aerial photography completed by Dr. Grace and myself. These images had to be carried out in ideal conditions to allow a view of the underwater features and habitat boundaries. An example of one of the oblique angle photos taken in this study is shown in Figure 4 below.

Figure 4 This image taken by Dr. Grace in 2003 was shot flying over the southeast corner of Rimariki Island looking southwest towards the shore of the Mimiwhangata headland. The lighter grayish looking patches are kina barrens.

Time series analysis of aerial imagery

38. As part of the 2005 study we were able to source good imagery from 1950. This allowed us to test the trophic change assumption that kina barrens at scale are not a natural condition. Figure 5 below shows a comparison of 1950 to 2003 of a shallow reef at Pa Point situated on the southwest end of Mimiwhangata Bay. In the 1950 image the dark solid cover on the reef represents a dense algal forest cover with no signs of kina barrens present. In the 2003 imagery you can see the bare rock appearance of the reef that is predominantly kina barren.

39. As we were doing this work on several occasions we asked the kaumātua Houpeke Piripi and Puke Haika if they recalled extensive kina barrens being present in the early days of their diving (which predates the 1970s). We also asked if there were any examples of descriptions of kina barrens in the historical accounts of their ancestors. The answer to these questions was consistently no, kina barrens were not present prior to the 1960-70s.

40. This account is entirely consistent with our findings of time series analysis in 2005. More recent time series studies have been completed in the Bay of Islands[7], in the Maitai Bay Rahui[8] and at the Leigh Marine Reserve[9]. At these three locations the same trend of decline from a full forest cover to extensive kina barren progresses from the 1970s onwards.

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[7] Booth, J. D., 2015. Flagging kelp: potent symbol of loss of mauri in the Bay of Islands. An essay prepared for Fish Forever, Bay of Islands Maritime Park Inc.

[8] Kerr, V.C., Rutene, W., Bone, O., 2020. Marine habitats of Maitai Bay and the exposed coast of the Karikari Peninsula. A report prepared for Te Whānau Moana/Te Rorohuri, Maitai Bay, Karikari Peninsula, Northland and the Mountains to Sea Conservation Trust.

[9] Leleu, K., Remy-Zephir, B., 2012. *Mapping habitats in a marine reserve showed how a 30- year trophic cascade altered ecosystem structure.* Biological Conservation, 155, 193–201

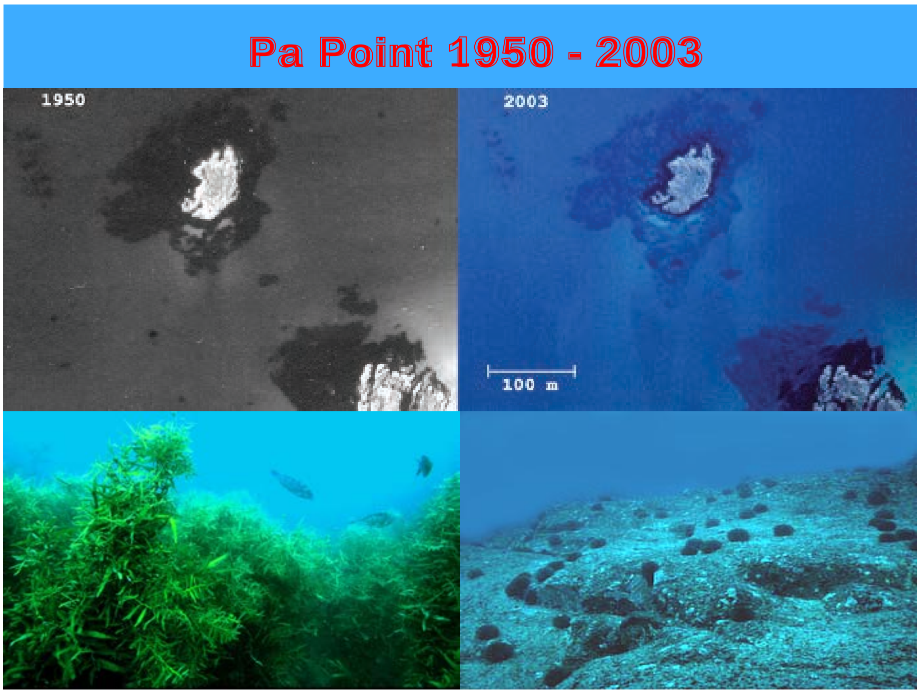

Figure 5 This time series imagery comparison between 1950 and 2003 shows a completely dense cover of kelp in 1950 contrasting with extensive kina barrens in 2003. The lower images show typical images of a healthy kelp forest and a mature kina barren. The kelp in the lower left image is the species *Carpophyllum flexulosum* that replaces or mixes with the common kelp species *Ecklonia radiata* where there is relatively low wave exposure, which is the case in this location at Pa Point. (Images Grace and Kerr)

41. In 2017 Dr. Grace and myself produced a GIS-based meta study of the extent of algal forest decline for Northland's east coast, (34) [10] which used mapping data of kina barrens from six locations stretching from Tāwharanui in the south to Doubtless Bay in the north and including Mimiwhangata. This estimate along with a review of the ecological implications of this decline and relationship with recreational fishing concentrating on shallow reef areas was prepared as a background technical report for the Motiti Rohe Moana Trust. The report also summarised the trends and conclusion from the international literature on the threat of

[10] Kerr, V.C., Grace, R.V., 2017. Estimated extent of urchin barrens on shallow reefs of Northland's east coast. A report prepared for Motiti Rohe Moana Trust. Kerr & Associates, Whangarei.

overfishing and trophic cascade effect leading to algal forest decline. (See Attachment 5).

42. Based largely on this Northland work I provided ecological evidence for Motiti Rohe Moana Trust appeal in the Environment Court. In this evidence, I outlined in detail the ecological threat and loss associated with localised overfishing and commented on the management proposals by Motiti Rohe Moana Trust. I also proposed specific monitoring methodology and recovery thresholds which could form part of a management regime to track and evaluate the recovery of algal forests expected under medium to long term protection from fishing. [11] I believe this material is directly relevant to this case. (Attachments 5 & 6)

Monitoring restoration in the Rahui Tapu

43. If the Te Uri o Hikihiki proposals are adopted a practical, affordable and effective monitoring program is likely to be required. Fortunately at Mimiwhangata there is a lot of historic data and methodology to inform the next stage of work. There is also a proposed algal forest monitoring methodology to guide the implementation of rules restricting fishing to support ecological restoration, notably the algal forest. 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 ecological process monitoring approach and will complement more holistic ecosystem management approaches.

Thresholds proposed to inform management actions (restrictions on fishing)

[11] Kerr, V.C., 2018. Statement of evidence of V Kerr on behalf of Ngati Makino Heritage Trust (Environment Court), Kerr and Associates Whangarei, New Zealand

44. 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:

45. **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 *Pagrus auratus* and crayfish restrictions of fishing could be considered

46. **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.

47. Fishing controls considered should include areas mapped as reef edge habitats and adjacent soft bottom habitats and extend offshore or beyond reef edges to a minimum distance of 2 km where possible. (For more detail and references see Attachment 5, Northland Algal Forest Study.)

48. There are other complimentary monitoring methods which could be adopted from the work done previously at Mimiwhangata. In 2005 Dr. Grace prepared a report for DOC entitled, ‘Towards a Monitoring Strategy for Mimiwhangata’ (24). In this report Dr. Grace explains in some detail the early monitoring methods and explains the changes and additions from the latter years. He gives a number of recommendations about future monitoring and the restoration process.

Crayfish *Jasus edwardsii*

49. Dr. Shears in his evidence effectively covers the implications of chronically low abundances of crayfish, *Jasus edwardii*, on Northland's east coast and generally what we have directly learned from work at Mimiwhangata, Tāwharanui and the Leigh Marine Reserve. I agree with the statements Dr. Shears has made in sections (29-43) regarding the performance and limitations of our fisheries management for crayfish on this stretch of coast.

50. I will now provide further detail of what has been learned from the ecological studies associated with Mimiwhangata and I will relate the science to the long-term ecological evidence held within the mātauranga Māori of Te Uri o Hikihiki.

51. In 2006 a paper was published by Dr. Shears and our monitoring team in the international literature which reviewed the full data set of crayfish monitoring at Mimiwhangata (partial protection with recreational fishing) along with data from Tāwharanui marine park (full no-take protection).[12] The Tāwharanui data included data from adjacent sites which were outside the Marine Park and served as fished reference sites. The results were described as follows:

    a. *On average, legal-sized lobster were eleven times more abundant and biomass 25 times higher in the no-take marine park following park establishment, while in the partially protected marine park (Mimiwhangata) there has been no significant change in lobster numbers. Furthermore, no difference was found in densities of legal-sized lobster between the partially protected marine park and nearby fully-fished sites (<1 animal per 500 m2). Long-term data from fully fished and partially protected sites suggest long-*

[12] Shears NT, Grace RV, Usmar NR, Kerr V, Babcock RC (2006) Long-term trends in lobster populations in a partially protected vs. no-take marine park. Biological Conservation 132:222–231

> *term declines in lobster populations and reflect regional patterns in catch per unit effort estimates for the fishery. The long-term patterns presented provide an unequivocal example of the recovery of lobster populations in no-take MPAs, but clearly demonstrate that allowing recreational fishing in MPAs has little benefit to restoring populations of exploited species such as J. edwardsii.*

52. A version of these results can be seen in graphic form in Figure 6 below. The results are alarming and point to a collapse of crayfish at Mimiwhangata. Additional surveys at points north and south near but outside of Mimiwhangata showed similar results with very low levels of crayfish and no larger animals present.

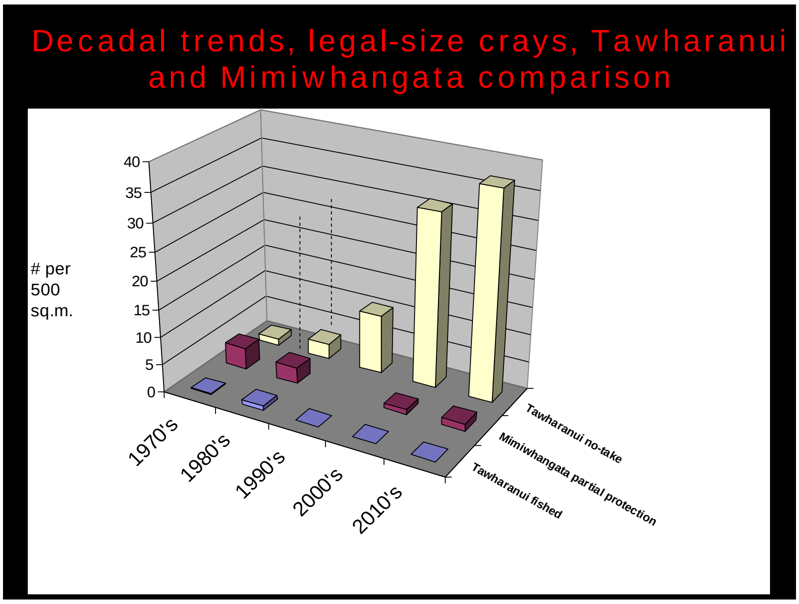

Figure 6 This graph shows the clear trends and contrast between a recovering population of crayfish in the Tāwharanui no take area and the very low levels persisting in the Marine Park at Mimiwhangata which are comparable to fished areas near the Tāwharanui Marine Park.

53. We had several discussions with the kaumātua Houpeke Piripi and Puke Haika about these results. They agreed with the description

that at Mimiwhangata numbers were extremely low with large animals being now very rare. In these descriptions they were quick to add how dramatic this decline has been compared to their early memories of the crayfish at Mimiwhangata and their historic record. Puke recited stories about their traditional method of catching crayfish which was in very shallow water where they would feel for the crayfish with their feet or simply see the antenae and then reach down and grab them. Puke also described the large crayfish that were common and in great detail. He had a particular method of catching very large packhorse crayfish well over 10kg in size. Puke would face the large animal as it challenged him approaching with antenae waving and large claws waving, then in one quick motion would throw a burlap sack over the animal's back and wrap up the animal in a bear hug before swimming to the surface and getting assistance to land the giant packhorse. Puke was a large and very powerful man but he described this encounter as one he approached with great caution. He told us the power in these animals' foreclaws could easily break bones in man's hand. Packhorse crayfish are now rarely seen at Mimiwhangata.

Figure 7 A historic photo showing the large crayfish that were once common on the Northland coast. Their large size enabled then to play a quite different ecological role to our current sparse population of sub-legal and barely-legal sized animals. A large crayfish can easily and quickly open the largest kina and virtually any shellfish species.

54. While the decline in numbers and standing biomass (loss of large animals) is concerning, there is also a growing story of the ecological consequences of allowing such prolonged fishing pressure. The large-scale loss of algal forest and its causes has been well documented. Removing medium to large crayfish form the system certainly contributes to the formation and persistence of kina barrens. There are also many more subtle impacts associated with population decline. There is a substantial body of literature in New Zealand that delves into these ecological consequences. Dr. Alison Diarmid wrote a review paper in 2012 that summarises what we know to date.[13] Dr. Diarmid reviewed historical accounts of crayfish abundance and ecology dating back to Cook's voyage which closely paralleled what we were told by the Mimiwhangata kaumātua.

55. I will briefly list the ecological concerns identified in her paper below:

    a. Fecundity in crayfish increases geometrically with size of female

    b. Female crayfish at mating time prefer 'large males'

    c. Large male crayfish can service many times more crayfish than smaller animals

[13] MacDiarmid, A. B., Freeman, D., Kelly, S., 2013. Rock lobster biology and ecology: contributions to understanding through the Leigh Marine Laboratory 1962–2012, New Zealand Journal of Marine and Freshwater Research, 47:3, 313-333

d. Low abundance populations lacking in large animals may fail to effectively reproduce or do so at greatly reduced levels to a population with a more normal ages structure

e. Crayfish have complex social behaviours which varies with time of year around growth, moulting and mating periods. There is evidence that low abundance levels and impacted age structures can detrimentally affect these behaviours. There is evidence that recruitment on to reefs is reduced when there are no or few older crayfish present.

f. Crayfish periodically leave their home territory on the reef to feed on surrounding soft bottom habitats up to 4km from the home reef but typically 1-2kms. Management of fishing and design of protection and restoration areas needs to take these behaviours into account.

g. Research on diets has found that crayfish have a widely varying diet and may be important in grazing and control algal turf habitats that are often a response to long term persistence of kina barrens.

h. Loss of genetic diversity is a possiblity at such high fishing levels

i. Loss of habitat utilisation due to algal forest decline – most notably in the previously high productivity shallow portion of the *Ecklonia radiata* forests.

j. Four ecosystem New Zealand modeling studies for shallow coastal reefs were reviewed by Dr Diarmid which showed that crayfish have gone from being one of most important predators in the system to the least important in terms of biomass and impact – crayfish's role in the Hauraki Gulf was described as 'functionally extinct' in ecosystem terms.

Figure 8 A crayfish eating a pipi sitting in a shallow estuarine seagrass bed, illustrating the wide ranging ecological connections of this key species, taken in Parenenga Harbour (Kerr & Grace)

Reef Fish

56. Reef fish have been the subject of monitoring efforts at Mimiwhangata during both periods 1976 – 1986 (Grace) and 2001-2011 (Grace and Kerr) and (Auckland University). In the first period, the transect studies designed by Dr. Grace were paired with Tāwharanui Marine Park which had 'no take' status. In the later period the early period permanent transects were surveyed and Auckland University scientists set up a randomised sampling regime which offered the ability to compare Mimiwhangata to a range of other fully protected areas and reference fished areas. All of the studies that occurred at Mimiwhangata are referenced in Appendix 1. Of these reports there have been several internationally published papers reporting on the results. To summarise this large body of work I would like to quote from one of these published papers from the Auckland University work: (15)[14]

[14] Denny CM, Babcock RC (2003) Do partial marine reserves protect reef fish assemblages? Biological Conservation 116:119–129

a. *Fish assemblages in the Mimiwhangata Marine Park, an area closed to commercial fishing but open to most forms of recreational fishing, were compared with adjacent fished areas. Two survey methodologies were used; baited underwater video and underwater visual census. Snapper (Pagrus auratus), the most heavily targeted fish species in the region, showed no difference in abundance or size between the Marine Park and adjacent control areas. When compared to the fully no-take Poor Knights Island Marine Reserve and two other reference areas open to all kinds of fishing (Cape Brett and the Mokohinau Islands), the abundance and size of snapper at the Marine Park were most similar to fished reference areas. In fact, the Marine Park had the lowest mean numbers and sizes of snapper of all areas, no-take or open to fishing. Baited underwater video found that pigfish (Bodianus unimaculatus), leatherjackets (Parika scaber) and trevally (Pseudocaranx dentex) were significantly more common in the Marine Park, than in the adjacent control areas. However, none of these species are heavily targeted by fishers. Underwater visual census found similar results with five species significantly more abundant in the Marine Park and five species more abundant outside the Marine Park. The lack of any recovery by snapper within the Marine Park, despite the exclusion of commercial fishers and restrictions on recreational fishing, indicates that partial closures are ineffective as conservation tools. The data suggest fishing pressure within the Marine Park is at least as high as at other 'fished' sites.*

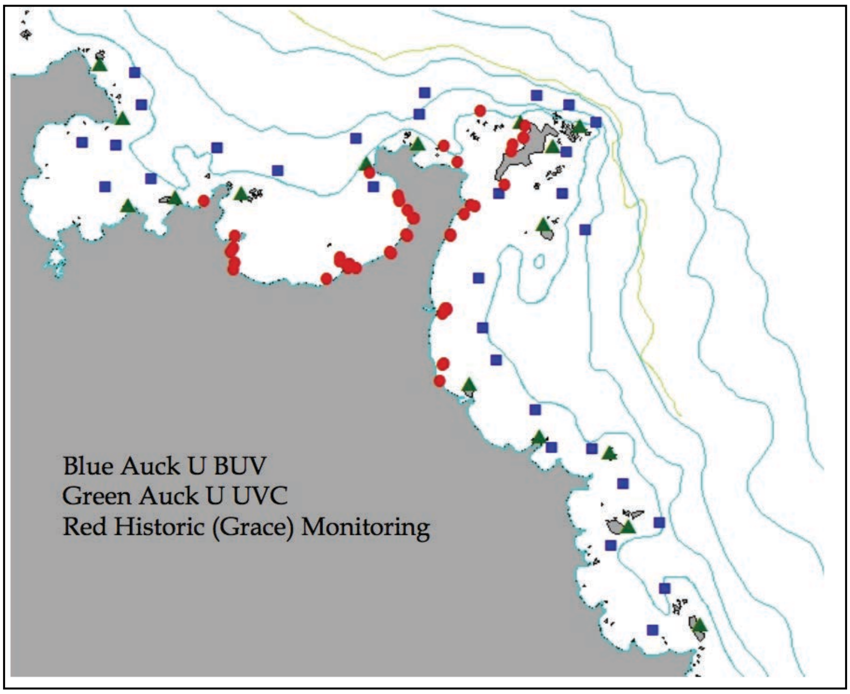

Figure 9 Sampling locations for reef fish at Mimiwhangata Park showing the permanent transects from the early period (Grace) and BUV and UVC sites established in the Auckland University survey.

57. Following the 2003 publications of results, monitoring continued for another period ending with the last survey in 2011. Results of BUV were reported by Buisson in (2009) (29). In this analysis, Mimiwhangata results were compared to the Poor Knights Islands, Cape Brett, Karikari Peninsula and North Cape. Overall results were quite similar to those reported by Denny (2003). Mimiwhangata results showed low counts and virtually no large fish and were comparable to the fished locations. However, in comparison to the snapper data at Poor Nights Marine Reserve which by 2009 had been in full no-take status as a marine reserve for ten years, there was a dramatic difference. Figure 10 below represents average biomass of the snapper per BUV drop. The Poor Knights level of biomass reflects a rapid recovery of snapper after 10 years of full protection (543% increase) resulting from the increased presence of large individuals. This is similar to the long-term recovery seen at Leigh Marine Reserve and is indicative of what a more natural age structure of a snapper population would

look like on our shallow reefs.

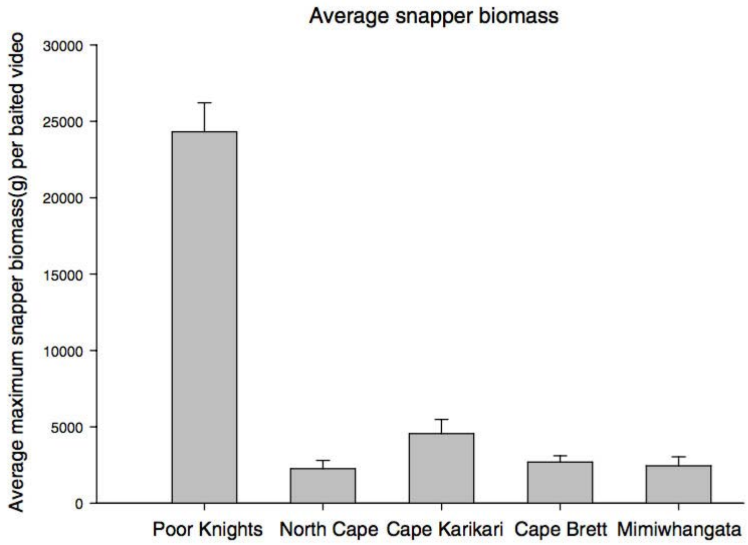

Figure 10 Average maximum snapper biomass per baited video in 2009 and standard error bars (from Buisson 2009)

58. The results of these surveys are clear evidence that there is a long-term impact of fishing popular species like snapper which is frequently spatially focused on areas like reefs and islands. The specific spatial nature of the impact of fishing close to shore and on and near reefs does not appear to enter into consideration within our fisheries management system. There is clear evidence that our history and current pattern of fishing removes a large portion of the medium and large size individuals from the population.. The Mimiwhangata experience has shown that this approach has led to major tropic changes to algal forest largely due to the removal of these large snapper from the system along with crayfish and hāpuku. While we can dramatically see and measure the decline of algal forest the question arises what other impacts are occurring that haven’t been clearly identified, such things as loss of genetic diversity, loss of learned behaviors, reduced breeding success and the many other ecosystem level connections that a keystone species like snapper or crayfish are associated with.

59. Contrasting with the picture of negative impacts and biodiversity decline at Mimiwhangata is the positive picture of restoration, which has taken place in our full no-take areas at Poor Knights and Leigh where we can clearly see recovery at the trophic level (algal forests) and specifically for the exploited species of the reef system like snapper. These areas today act as a vital baseline allowing ecological impact studies to take place by providing a baseline similar to an unfished system against which to understand fishing impacts or other disturbances to the system. Studies of recovery are positive; evidence is building of their larger scale contribution as nursery areas to help support recovery and productivity of the greater area. Possibly, their greatest contribution is that they are a form of insurance against losing species and ecological function, which is central to a concept of a precautionary approach to managing the ocean.[15] [16]

Reef fish diversity at Mimiwhangata

60. Because of the biogeographic position and its influence of tropical and sub-tropical species, Northland's east coast has the highest fish diversity in New Zealand by some margin. Brook in 2002 reported on surveys of fish diversity conducted around Northland's coast. [17] In these surveys, the Mimiwhangata results were at the top of coastal sites generally but were lower than Northland's top fish diversity sites led by the Poor Knights Islands followed by Cape Brett, the Karikari Peninsula and Cape Reinga. Mimiwhangata had 63 species of fish, with the subtropical component making up 19% of species. The top-ranking sites had a range of 98-80 species and a proportion of subtropical species

[15] Le Port A, Montgomery JC, Smith ANH, Croucher AE, McLeod IM, Lavery SD. 2017 Temperate marine protected area provides recruitment subsidies to local fisheries. Proc. R. Soc. B 284: 20171300.

[16] Ballantine, B., 2014. Fifty years on: Lessons from marine reserves in New Zealand and principles for a worldwide network. Biological Conservation 176: 297-307.

[17] Brook, F.J., 2002. Biogeography of near-shore reef fishes in northern New Zealand. Journal of the Royal Society of New Zealand 32(2): 243-274.

making up a range of 30-37 % of the fish fauna. It is important to note that this figure is not an absolute measure of diversity because it is based on limited amount of looking and sampling, the actual total diversity could be considerably higher, in the range of 20-30% higher.

61. The proportion of sub-tropical species occurring on Northland's east coast reefs with exposure to oceanic currents is by far the highest of any region and demonstrates the importance of our biogeographical position in relation to the East Auckland current that sweeps past the Northland coast each summer. That current brings biodiversity in the form of fish larvae and occasionally adult species from tropical coral reef systems of New Caledonia and Vanuatu. These areas are visited by currents connecting them with Australia's Great Barrier Reef and further afield to Micronesia and eventually Indonesia (believed to be origin of tropical reef fish evolution). Similar west to east currents also distribute tropical species across the central Pacific all the way eastwards to French Polynesia. Our fish fauna is constantly evolving and part of the overall diversity of the central Pacific.

62. As we experience rapid climate change, this connection to the tropical biodiversity of the north may prove to be an important factor for our fish fauna to adjust to these changes and warming. Northland will likely lead in these changes as the most northerly part of our coastal system and its position in direct contact with the East Auckland current.

63. At Mimiwhangata Dr. Grace and myself compiled a composite list of all the species we had encountered in all surveys. This list is included in this evidence as Attachment 2. There are 71 fish species appearing on our list. The importance of this view of overall fish diversity is to show that these systems are very complex and productive ecologically. Each of these species utilises the reef environment in complex patterns that span the full range of feeding styles and lifestyle strategies. Mimiwhangata in terms of diversity of species is special and significant on a

Northland scale. Indeed, in terms of fish diversity, all these top sites in Northland would top any national list in terms of reef fish diversity. The current concern at Mimiwhangata is that this complex system may be going through a process of overall decline with ecological aspects being lost before we can know of their presence scientifically. We may be crossing an ecological line where irreversible losses are occurring or resilience in the face of rapid climate chance is being reduced. [18]

Seagrass, *Zostera novazelandica*, and the important benthic community at Mimiwhangata Bay

64. Figure 11 below shows an aerial image from 2019 of the east end of Mimiwhangata Bay. The dark mottled patch is a subtidal seagrass bed. The bed shown in the photo is approximately 18 hectares in size. This is quite an unusual occurrence to have a bed of this size located in what I would describe as a moderate exposure site. Large northeast swells generated from cyclones do sporadically affect even this end of the bay which is the more sheltered end often used as an anchorage for visiting yachts but not in a northeast swell condition. Dr. Grace and myself first observed this seagrass bed around the 2005 period as a series of small patches. It has since that time been steadily expanding.

65. Seagrass beds are a recognised biogenic habitat of special significance to many fish species in the early parts of their life cycle. They also support a rich and diverse invertebrate fauna. Dr. Morrison summarises this importance in Section (15) of his evidence in the context of the Bay of Islands. I am not aware of other seagrass beds of this size anywhere between the Bay of Islands and Whangarei Harbour associated with the open coast. I would say that this bed has special significance because of its proximity to the diverse shallow reefs of Mimiwhangata.

[18] Ling, S.D., Johnson, C.R., Frusher, S., Ridgway, K., 2009. Overfishing reduces resilience of kelp beds to climate-driven catastrophic phase shift. Proc. Natl. Acad. Sci. USA 106, 22 341–22 345.

66. Mimiwhangata Bay also has a rich and diverse benthic environment. Dr. Grace and I did a number of exploratory scuba dives there. There is a wide range of substrates ranging from clean sand to shelly and gravelly sands. The most dominant benthic species is the small bivalve clam *Tawera spissa* that forms very dense beds. Once following a cyclone swell I observed piles of dying Tawera stacked up in mounds waist high on the beach. There would have been many tonnes of shellfish washed up on that day. There are also historical accounts of scallops being present in Mimiwhangata Bay but they have not been seen in recent years.

67. From my experience at Mimiwhangata I would say that the benthic area of Mimiwhangata Bay is a very important nursery area for snapper and a number of other important fish species. On dives there in the summer months significant numbers of newly recruited juvenile snapper can be seen. The development of the seagrass bed will be enhancing this function of the bay.

Figure 11 Subtidal seagrass bed at the east end of Mimiwhangata Bay (2019)

Spotted black grouper, *Epinephelus daemelii*

68. The New Zealand Coastal Policy Statement and our Northland Regional Policy Statement place great emphasis on the protection of endangered and threatened species. However, in the marine environment development of a threats classification is poorly developed with few species being recognised. This is compounded by the disperse nature and mobility of many species in the marine environment. We are still discovering new fish species and new sub-tropical species can arrive in Northland at any time becoming a range extension for those species, important in the context of protecting species' resilience to climate change.

69. Mimiwhangata has been shown to be one of those sites where subtropical species establish. Dr. Grace had a soft spot for the very elusive spotted black grouper and was always on the lookout for them at Mimiwhangata. There are several specific spots where these fish were found. They were typically ledges or small caves of a certain size. Dr. Grace and I would check on these specific holes most years. More often than not there would be a young spotted black grouper there. What is extraordinary about this is that over time these were not the same fish; we could tell this was the case because they were always the same size. The adult black grouper and breeding population is centered around the Kermadec Islands. Apparently as young fish they go on a long journey with some individuals ending up on Northland's east coast. The fish we observed over the years at Mimiwhangata were always the same size up to about 3-5kg. How these fish find these specific holes and why they make this great journey remains a mystery. There is no measure of how many of these young groupers visit northern New Zealand but probably they are rare. Certainly they are rarely seen. Many of the grouper species worldwide appear on threatened and endangered species lists as they are sought after

food fish globally. Under the Wildlife Act 1953, in all New Zealand waters the spotted black grouper is protected.

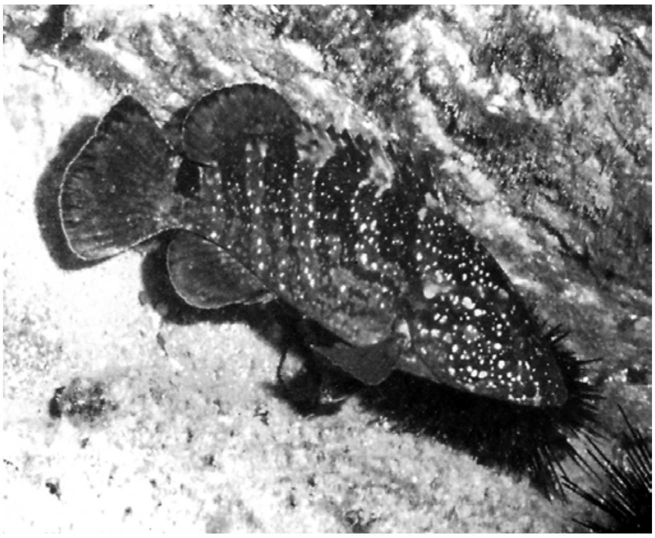

Figure 12 A Spotted black grouper (*Epinephelus daemelii*) appearing on the cover of a Mimiwhangata monitoring report in 1984 photo Dr. Grace (8)

70. Conclusion

71. Mimiwhangata joins the Poor Knights Islands and the Leigh Marine Reserve as being one of the most studied coastal sites in New Zealand. The scientific importance of this parallels the high biodiversity values and a long and rich association of the tangata moana, Te Uri o Hikhiki, who hold in their knowledge system our longest view of the ecology of this area. We now have a clear picture of major losses of species abundance, natural age structures and potentially loss of genetic diversity. Kelp forests have been in multi-decadal decline. This is a concern because this habitat has wide ranging ecological connectivity and importance as a primary coastal energy source. Kelp forests supply energy sources to adjoining habitats via the rapid turn-over of organic matter production and regular storm induced dispersal of drift kelp to literally fuel beach systems adjacent to reefs, soft bottom areas and the water column plankton and larval communities. The kelp

forests themselves support a rich diversity of fish and invertebrate species that reside in the forest or visit the forests during part of their life cycle. By 1986 Dr. Grace in his monitoring reports signaled these concerns, but even now decades later fishing pressure remains.

72. As the decades of decline have been measured and explored our ecological studies have added detail to the losses and understanding of the local ecology. The greatest value of the Mimiwhangata studies is that Dr. Grace had the foresight to pair the monitoring framework and methods with the full no-take Tāwharanui Marine Park. These studies have shown that fishing impacts can be reversed and algal forest can restore once the balance of predators and grazers is restored. This paired study has shown that partial protection in the form of allowing some forms of fishing impairs recovery, whereas full no-take protection supports a process of substantial recovery. The full no-take protection area studies have allowed for the opportunity for Mimiwhangata to be compared to the more natural state or near natural baseline resulting in the full no-take reserves. Ecological studies must have this natural ‘control area’ to be truly valid in a scientific sense. It is clear that Mimiwhangata’s future under its present fished status is uncertain. It is not fully known how serious or how long term the ecological impacts will be at Mimiwhangata, but we do know they are not minor. In contrast, the full no-take areas have demonstrated many benefits to the area restored but also in contributing disproportionately to supporting adjacent fished area via spawning and spill-over benefits. Arguably the greatest benefit of the full no-take reserves is that they provide protection against localised or even regional biodiversity loss and ecological function.

73. The proposals of Te Uri o Hikihiki in my opinion are consistent with and supported by the body of science work completed at Mimiwhangata.

Dated 25 March 2021

Attachment 1 Mimiwhangata research and monitoring reports

1. Commissioner for the Environment. 1982. .Mimiwhangata Marine Park: Environmental Impact Audit. Wellington: Commission for the Environment, December.
2. Dart, J., Drey, B. & Grace, R. V. (1982). Mimiwhangata Marine Park Environmental Impact Report. 143p.
3. Darby, J. and Darby, M. 1973. Mimiwhangata 1973: Ecological Report. Auckland: Turbott & Halstead.
4. Ballantine, W.J., Grace, R.V., Doak, W.T., 1973. Mimiwhangata Marine Report, Auckland, Turbott and Halstead/New Zealand Breweries Limited. 98 p.
5. Grace, R.V.; Grace, A.B. 1978: Mimiwhangata marine monitoring programme: report on progress 1976-1978 Vol. 1. Report for Lion Breweries. Mimiwhangata Trust.
6. Grace, R.V. 1981. Mimiwhangata marine monitoring programme: report on progress to 1981. Mimiwhangata Farm Park Charitable Trust and Bay of Islands Maritime and Historic Park.
7. Grace, R.V. 1981. Paparahi Marine Survey. Report to Mimiwhangata Farm Park Charitable Trust. Hauraki Gulf Maritime Park Board.
8. Grace, R.V. 1984: Mimiwhangata marine monitoring programme. Report on progress to 1984. Bay of Islands Maritime and Historic Park.
9. Grace, R.V. 1985: Mimiwhangata marine monitoring programme. Report on progress to 1985. Bay of Islands Maritime and Historic Park.
10. Grace, R.V. 1986: Mimiwhangata marine monitoring programme. Report on progress to 1986. Bay of Islands Maritime and Historic Park.
11. Grace, R.V., Kerr V.C. 2002. Mimiwhangata deep reef survey draft report 2002. Unpublished report to Department of Conservation, Northland Conservancy, Whangarei.
12. Grace, R.V.; Kerr, V.C. 2002: The Mimiwhangata Marine Investigation Progress Report August 2002. A report to Northland Conservancy, Department of Conservation (unpublished).
13. Grace, R.V. Kerr, V.C., 2002. Mimiwhangata Marine Park Draft Report 2002 Historic Marine Monitoring Update. A Report to Northland Conservancy, Department of Conservation, Whangarei September 2002
14. Denny, C. M., Babcock, R.C. 2002. Fish survey of the Mimiwhangata Marine Park, Northland, Report to Department of Conservation, Northland Conservancy, Leigh Marine Laboratory, University of Auckland
15. **Denny CM, Babcock RC (2003) Do partial marine reserves protect reef fish assemblages? Biological Conservation 116:119–129**
16. Denny, C.M., Babcock, R. C. 2002. Fish survey of the Mimiwhangata Marine Park, Northland. A report to the Department of Conservation, Northland Conservancy. Leigh Marine Laboratory University of Auckland.
17. Usmar NR, Denny CM, Shears NT, Babcock RC (2003) Mimiwhangata Marine Park monitoring report 2002-2003, Leigh Marine Laboratory, University of Auckland.
18. Grace, R. V., Kerr, V.C. 2003. Mimiwhangata marine monitoring programme, summer sampling 2003, update on historical monitoring. Report to Department of Conservation, Whangarei.

19. Grace, R.V.; Kerr, V.C. 2003: Mimiwhangata Marine Park draft report 2003 historic marine survey update. A report to Northland Conservancy, Department of Conservation.
20. Kerr, V.C., and Dr R. V. Grace, 2004. Mimiwhangata Marine Reserve Proposal: Community Discussion Document. Published by Northland Conservancy, Department of Conservation. Northland Conservancy, PO Box 842, Whangarei, NZ.
21. Grace, R.V.; Kerr, V.C. 2004: Mimiwhangata Marine Park monitoring report 2004 historic marine survey update. A report to Northland Conservancy, Department of Conservation (unpublished).
22. Grace, R.V., Kerr, V.C., 2004. Mimiwhangata Marine Monitoring Programme, summer 2004. Report for Department of Conservation, Northland Conservancy.
23. Kerr, V.C.; Grace, R.V. 2004: Mimiwhangata species list 1973-2004. A report to Department of Conservation, Northland Conservancy (unpublished).
24. Grace, R.V., 2005. Towards a Strategy for Future Marine Monitoring at Mimiwhangata. A report for the Department of Conservation, Northland Conservancy.
25. **Kerr, V.C., Grace, R.V., 2005. Intertidal and subtidal habitats of Mimiwhangata Marine Park and adjacent shelf. Department of Conservation Research and Development Series 201, 55 p.**
26. Grace, R.V., Kerr, V.C., 2005. Mimiwhangata marine monitoring programme, summer 2005. Report to Department of Conservation, Whangarei.
27. Grace, R.V., Kerr, V.C., 2006. Mimiwhangata Marine Monitoring Program, Summer & Autumn Sampling. Report to the Department of Conservation, Northland Conservancy.
28. **Shears, N.T., Grace, R.V., Usmar, N.R., Kerr, V.C., Babcock, R.C., 2006. Long-term trends in lobster populations in a partially protected vs. no-take Marine Park. Biological Conservation. 132 (2006) 221-231.**
29. Buisson, P.R. de, 2009. Poor Knights Islands Marine Reserve and Mimiwhangata Marine Park fish monitoring. Department of Conservation, Whangarei
30. Kerr, V.C. 2010. Marine Habitat Map of Northland: Mangawhai to Ahipara Vers. 1. Technical Report, Department of Conservation, Northland Conservancy, Whangarei, New Zealand.
31. Mitchell, J. et al. (2010). Bay of Islands OS 20/20 survey report. Chapter 2: Seafloor Mapping. NIWA.
32. Kerr, V.C., Buisson P.R. de., 2011. Re-survey of reef fish and crayfish historic transects at Mimiwhangata. (unpublished data).
33. Kerr, V.C., 2016. Significant marine ecological areas of Northland: a GIS based mapping, supporting technical reports and a collection of 45 assessment worksheets covering harbours and estuaries, open coastal areas, estuarine wading and aquatic birds, coastal and island wading and aquatic birds and general marine values of highly mobile and dispersed species (marine mammals and seabirds). Prepared for the Northland Regional Council. Kerr & Associates, Whangarei, New Zealand. *(Note: view on NRC GIS web pages)*
34. Kerr, V.C., Grace, R.V., 2017. Estimated extent of urchin barrens on shallow reefs of Northland's east coast. A report prepared for Motiti Rohe Moana Trust. Kerr & Associates, Whangarei.

Grace, R.V., 2005. Towards a Strategy for Future Marine Monitoring at Mimiwhangata. A report for the Department of Conservation, Northland Conservancy.