Analysis of Boundary Design for Two Proposed Marine Reserves in the Eastern Bay of Islands: a report to Fish Forever

Vince Kerr, Kerr & Associates, April 2014

Client Brief

The community-based Bay of Islands group Fish Forever have been investigating potential candidate areas for a proposed system of marine reserves in the Eastern Bay of Islands. Two areas have been identified as candidates to advance to a proposal stage. Fish Forever have requested this report to evaluate the proposed boundaries against the following set of criteria:

a) the ecological effectiveness of the boundaries in relation to the objectives of the proposed marine reserves;

b) the effectiveness of the boundaries in relation to ease of navigation and practicality of compliance and enforcement of the rules; and

c) the impact of the proposed marine reserves on recreational fishing hotspots and boundary areas.

Introduction

Fish Forever have set as a design goal that in the Bay of Islands a target of 10% of representative habitats will be protected in long-term fully protected areas. They have based this goal on the general goals for marine protection stated in the NZ Biodiversity Strategy (NZ Govt., 2000) and the Government's Marine Protected Area Strategy (DOC & MinFish., 2008). Fish Forever have also reviewed international literature, including the United Nations' recommendations on marine reserve network design, which have served to focus their design on the 10% minimum goal as the starting point for their work (Secretariat of the Convention on Biological Diversity, 2004). In addition they have used two New Zealand based guideline papers setting out design criteria (Kerr, 2010b and Thomas & Shears, 2004) .

The criteria that Fish Forever have considered are outlined below.

Ecological Principles

1. Representation

To maintain natural examples of the full range of New Zealand marine biota, each region with major differences in marine life must be represented, and within each region all obviously-different habitats must be represented.

2. Replication

To allow scientifically-valid measurements, to provide for social needs, and to prevent single accidents destroying sole examples, replicas of each habitat in each region must be included in the reserve system.

3. Network Design

Since most marine life has free-floating larvae (or other small reproductive and dispersal products) that drift a long way from their parents, single reserves are unlikely to be self-sustaining and the design of the system must be a network. Spacing of reserves is as important as their size. As more reserves are created, positive interactions and system benefits increase exponentially. Ideally reserves should be evenly spread through a region or planning area.

4. Sustainability – Viability

The total area of the high level protection reserve system must be sufficient to sustain its natural character. Reserves should be permanent or generationally reviewed to allow for ecological processes and benefits to be fully realized. The current international scientific consensus is that high level protected area networks produce maximum benefits to biodiversity, habitats and fisheries productivity where the extent of highly protected areas reaches 20-50 % of the total planning area (Bohnzack, 2000). Fish Forever have suggested that a practical initial design goal of 10% of protected areas would provide a basis for evaluating the network, provide a wide range of benefits (especially locally), and be consistent with developing New Zealand policy (Ballantine, 1999).

Ecological Criteria

a) Size of reserves: big is better and will achieve more in terms of species and habitats that are effectively protected or restored. Reserve boundaries usually become popular and productive fishing locations. This leads to a negative ‘edge effect’. Small reserves are affected to a larger degree. Where possible, reserves should be a minimum of 6 km of coastline and extend out to sea as far as possible. In some cases there may be a strong design case for much smaller reserves. Their effectiveness is less understood but indications are that they are still valuable for some species and habitats.

b) The above principles apply at all scales. Where possible, reserves for a given planning area should attempt to include and replicate all habitats of a given area. Reserves that maximize the diversity of habitats represented are preferred.

c) There is a strong argument to avoid boundaries which cut through habitats like reefs.

d) Where possible, include areas of soft sediments surrounding reef areas – there are very important ecological connections between reefs and the adjacent soft sediment areas. Ideally these soft sediment areas should extend 2 km from the reef.

e) Rocky reefs beyond approximately 30 m depth represent a significantly different community than shallow reefs. The 'deep reef' is dominated by encrusting invertebrates instead of algal species which form the community structure of shallow reefs. Where possible, a reserve should include a continuous sequence of these habitats within the reserve.

f) Islands, including little rocks on top of reefs, are hot spots for reef communities and pelagic species for a host of reasons. They provide a lot of habitat diversity with highly varied exposures, currents, and often physical complexity. Include them completely with surrounding reef if at all possible - avoid running boundary lines to them or thinking of them as good markers (they may be of course but also they are biodiversity hot spots).

g) Where possible, reserves should avoid disturbance to existing uses of the coastline, such as favourite fishing spots and important customary harvesting sites. Note that there have to be limits to this consideration due to the fact that in many areas the entire coast is heavily fished, thus the urgent need for reserves.

h) Reserves may create 'new favourite fishing places' around their boundaries - this aspect can be noted and enhanced with careful site selection. There are three distinct possibilities that can become a design focus. Where boundary lines cross a significant habitat, it is much more likely that spill-over of exploited species will enhance fishing opportunity (Freeman et al., 2009). The second possibility involves placing a boundary near some special feature located adjacent to but outside the reserve that was once a significant fishing spot, but is now only lightly fished or not fished at all due to overfishing. In this scenario the adjacent site becomes a new hotspot due to the proximity of the reserve. The third possibility is where a boundary is located near an existing popular fishing spot. In this case the existing 'hotspot' is potentially further enhanced by the reserve due to the spill-over effect. The potential for spill-over to adjacent fishing spots is not just about more fish being available. Reserves can create new opportunities to catch large or record size fish. (Callum et al., 2001). A recent major study in South Africa showed that reserves can have a significant positive effect of stabilising or even increasing commercial catch rates in a local fishery for an exploited specie despite the loss of 'fishing area' taken up by the reserves (Kerwath et al., 2013).

i) For some reserves secondary benefits, such as the need for public access or local economic development, become important design considerations. These considerations can be incorporated in the design process on a case by case basis as

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they are very real to communities.

j) Under the Precautionary Principle, design should be carried out using the best possible evidence currently available. Where uncertainty exists design decisions should err on the side of protecting biodiversity and habitats.

Practical Boundary Design Criteria

a) For shore boundaries look for a place where any or all of the listed features enhance effectiveness of a boundary marker:

    1. Prominent shoreline features such as a protruding point, large rock, change in geological formation, middle of a small beach etc.;

    2. Well known landmark;

    3. A position on the shoreline that can be lined up with a second marker placed on a hill or skyline feature lying in a line behind the shore marker. This can be used for an effective 'line of sight' visible for up to several kilometres offshore.

b) If practical use east-west or north-south lines which assist navigation.

c) Avoid complex boundaries that do not have good natural markers

d) If practical for lines off shore use a line that is close to a bathymetry contour line. This is a helpful locator/ navigation aid for fishermen.

e) Reliance on expensive buoy markers especially in waters over 20 m depth is to be avoided if possible.

f) For seaward boundaries that have good line of sight references to land straight lines can be effective.

g) In some cases where a shoreline is highly irregular a seaward boundary may best be defined by a distance offshore description. This method has both advantages and disadvantages.

Note: The above criteria were applied within the context of the general criteria laid out in the Marine Reserves Act 1971.

Methods and Summary of Design Process Used

Since 2011, Fish Forever have been carrying out a 'mark the chart' project based on their website (http://www.fishforever.org.nz/how-you-can-help-ff/have-your-say-mark-the-chart/16-have-your-say.html). To date 430 people have responded to this survey. Fish Forever have also carried out extensive discussions with a wide range of Bay of Islands groups and individuals documented in their discussion document (2014). From all of this work the two areas currently proposed stood out as having the most potential as candidate marine reserve areas. This first level design process was largely based on ecological values present and popularity with the community. Initially there were many versions of boundaries put forward for evaluation.

To assist further refinement of the candidate area boundaries, a GIS project was set up based on the Northland Marine Habitat Map (2010a) and supported by recent field survey work done by the author (in progress) and J. Gibb (2012). The field survey projects looked at refinement and description of habitats and geological values in the Waewaetorea and Maunganui proposal areas. Recently available high resolution aerial photography was sourced from the Ocean 20:20 Bay of Islands Coastal Survey Project which supported detailed study of key sites in the process.

Many alternatives of possible lines were drawn and tested against the ecological and practical criteria until the current configuration of the boundaries was arrived at.

Assessment included analysis of the amount of habitat represented in the proposal area compared to the amount of these habitats occurring in the Bay of Islands as a whole. The boundaries were also checked for the degree to which they included whole areas of important habitats such as reefs and wherever possible buffer areas of soft sediment bottom areas surrounding important reef structures.

Following the ecological assessment described above the boundaries were tested for their practical effectiveness which involved drawing possible lines of sight and assessing whether marker buoys could be practical as well as drawing lines of sight to potential shore markers and or prominent geological features. The shore marker site selection process and line of sight design was then checked and refined on the water with GPS chart sounder equipment similar to those most fishing boats would have. Pictures of the line of sight markers and shore markers were taken from various points where navigation would be important such as seaward corners. There were numerous adjustments made to the boundaries during these stages of the process.

Results of Boundary Analysis

Table 1 below shows that the two proposed areas account for 6.3% of the total area of the Bay of Islands and the Rahui area at Maunganui Bay accounts for 0.5%.

Area	Percentage of BOI design area
Maunganui Proposal	3.0%
Waewaetorea Proposal	3.3%
Rahui Area	0.5%

Table 1 Percentage of Bay of Islands within proposed reserves.

In order to determine to what extent the proposed marine reserves include representative habitats, a calculation was made of the total habitat areas for the Bay of Islands. That calculation is reproduced in Table 2 below.

		BOI Design Area	**% of area**
Depth	**Habitat**	**Hectares**	
intertidal	sand	68.5	0.23
intertidal	salt marsh	3.5	0.01
intertidal	rock	558.9	1.85
intertidal	mud	2,635.3	8.71
intertidal	mangroves	1,273.9	4.21
intertidal	gravel	26.6	0.09
shallow	seagrass	28.5	0.09
shallow	rodolith bed	51.2	0.17
shallow	reef	2,589.6	8.56
shallow	fine sediments	6,456.0	21.34
shallow	coarse sediments	4,776.5	15.79
shallow	channel	511.8	1.69
deep	reef	2,699.9	8.92
deep	fine sediments	6,207.6	20.5
deep	coarse sediments	1,587	5
	Island	778.2	2.6
Totals		**30,252**	**100.0**

Table 2. Calculation of habitat areas in Bay of Islands based on the (2010a) Northland Marine Habitats Map.

Table 3 below shows the percentage of representation of habitats within each proposal area, compared with the percentage of the total Bay of Islands habitat areas which occur in each proposal area.

Generally speaking, the two proposed marine reserves are effective in achieving representation of habitats commonly found in the outer coastal parts of the Bay of Islands. For instance both reserves include proportionately good percentages of intertidal habitats, typical coastal shores such as rock platforms and gravel and sand beaches. They do not represent well habitats that are typical of estuaries and more sheltered and inland parts of the Bay of Islands such as mangroves, mud flats and salt marsh. For the shallow and deep subtidal habitats the same is true: these proposal areas have good representation of reefs and fine and coarse sediment areas. It is significant that each of the proposal areas has a balance of shallow and deep reef areas and surrounding soft sediments which is the ideal arrangement to maximise the number of species which benefit from the reserves. The arrangement of boundary lines in relation to these key habitats will be discussed further for each reserve.

Size of Reserves

Both proposal areas are around 1,000 ha and have shoreline lengths of 7.34 km for the Maunganui proposal and 17.02 km for the Waewaetorea proposal area calculated in the GIS project from a 1:5,000 scale base map. While there is little agreement on how small reserves can be and still be effective, these two reserves are both larger than the Leigh Reserve which is 518 ha in area. They are however not as big as the Poor Knights Marine Reserve which is 2,400 ha or the Te Tapuwae O Rongokako Marine Reserve in Gisborne which is 2,450 hectares. These proposals are dwarfed in size compared to the largest marine reserve in New Zealand waters, the Kermedec Islands Marine Reserve, which is 748,245 ha in area. Both of the reserves have a number of special features and excellent habitat diversity and representation. Their size should not be a limiting factor. There are however some expected exceptions to this generalisation. Some marine species that have much larger home ranges or are primarily pelagic or migratory in their behaviours will benefit to a much more limited degree from reserves of this size. Taking dolphins as one example, over time they may frequent the reserves for a disproportionate amount of time due to the increased activity and biomass of prey in the reserves, thus benefiting from the reserve, however they would not be expected to become full-time residents there. One important point about these larger more mobile predator species, is that we don’t really know to what degree their behaviours will be affected by the reserves. It could be argued that anything that attracts these species back to the Bay, helps to secure and restore their food sources, and keeps them there longer is a good thing.

Network Benefits

Part of the design goal of these two proposals is that they form in combination an effective addition to the overall network of protected areas in the Bay of Islands as well as contributing to the larger Northland and Northeast Bioregion network of protected areas. In this case both reserves are between 3 and 4 kms from the settlement of Rawhiti which means the habitats immediately around Rawhiti stand to benefit most from any spill-over benefits. It is important to note that at any time marine life could move from either reserve towards the areas around Rawhiti, thus there is something like double the chance of a positive impact in these areas. There is a very good chance that marine life moving between the reserves could to some degree assist the restoration of marine life and habitats in each reserve. i.e. being only 4 kms apart from each other there could well be positive ecological connections.

The other nearest marine reserve is 53 kms away, the Poor Knight’s Marine Reserve. It is not known if there could be positive ecological connections between reserves at this size separated at this distance but it is a possibility as both these areas are bathed by the same current, the East Auckland Current and both areas experience settlement of larvae of subtropical species from that current. In some cases these sub-tropical species could move across this sort of distance. As more marine reserves are added to the network at appropriate distances, the chance for positive connection increases exponentially. The author would suggest that due to the quality environment and habitats of the two proposed reserve areas they will definitely contribute significantly to any future network of marine reserves established in this region.

		Maunganui Proposal	**% of proposal area**	**% of BOI Habitats**	**Waewaetorea Proposal**	**% of Proposal Area**	**% of BOI Habitats**
Depth	**Habitat**	**Hectares**			**Hectares**		
intertidal	sand	0.0	0.0	0.0	6.0	0.6	8.8
intertidal	salt marsh	0.0	0.0	0.0	0.0	0.0	0.0
intertidal	rock	11.4	1.3	2.0	36.3	3.6	6.5
intertidal	mud	0.0	0.0	0.0	0.0	0.0	0.0
intertidal	mangroves	0.0	0.0	0.0	0.0	0.0	0.0
intertidal	gravel	0.0	0.0	0.0	1.4	0.1	5.4
shallow	seagrass	0.0	0.0	0.0	1.4	0.1	4.9
shallow	rodolith bed	0.0	0.0	0.0	0.0	0.0	0.0
shallow	reef	47.4	5.2	1.8	193.5	19.3	7.5
shallow	fine sediments	1.5	0.2	0.0	91.3	9.1	1.4
shallow	coarse sediments	36.8	4.1	0.8	309.2	30.8	6.5
shallow	channel	0.0	0.0	0.0	0.0	0.0	0.0
deep	reef	102.7	11.3	3.8	102.2	10.2	3.8
deep	fine sediments	443.3	48.8	7.1	23.7	2.4	0.4
deep	coarse sediments	264.8	29.2	16.7	238.4	23.8	15.0
Totals		908	100		1,003	100	

Table 3 Calculated areas and percentages of habitats included in the proposed marine reserves and percentages of total Bay of Islands habitats included in the proposed reserves.

		Maunganui Bay Rahui Area	% of Proposal Area	% of BOI Habitats
Depth	Habitat	Hectares		
intertidal	sand	0.0	0.0	0.0
intertidal	salt marsh	0.0	0.0	0.0
intertidal	rock	11.2	7.1	2.0
intertidal	mud	0.0	0.0	0.0
intertidal	mangroves	0.0	0.0	0.0
intertidal	gravel	0.0	0.0	0.0
shallow	seagrass	0.0	0.0	0.0
shallow	rodolith bed	0.0	0.0	0.0
shallow	reef	35.6	22.6	1.4
shallow	fine sediments	22.2	14.1	0.3
shallow	coarse sediments	33.3	21.1	0.7
shallow	channel	0.0	0.0	0.0
deep	reef	7.3	4.6	0.3
deep	fine sediments	37.9	24.1	0.6
deep	coarse sediments	9.9	6.3	0.6
Totals		157.4	100.0	

Table 4 Calculated areas and percentages of habitats included in the Maunganui Bay Rahui Area and percentages of total Bay of Islands habitats included in the proposed marine reserves.

Ecological Criteria- Maunganui Marine Reserve Proposal

Map 1 below shows the proposed boundaries drawn over the top of the Northland Marine Habitats Map (2010a). As noted above, Table 3 sets out the areas of the various habitats included in the reserve. This proposal area has outstanding examples of exposed rocky shore and shallow and deep reefs. Care was taken to provide for soft sediment buffer areas around the major reef systems in the proposal area. For all the reef areas except the associated reefs of Bird Rock to the north there is at least 400 m of soft sediment area between the boundary and the edge of the reefs. In general terms this is not an ideal buffer distance (2 km would be better), but it is far better than having no buffer area around the reefs. For a reserve of this size this could be considered a fair trade-off.

For the reef on the northern boundary, this was a more practical decision, based on the need to achieve a good line of sight boundary line (discussed in the next section) and to keep the boundary a practical distance from Bird Rock. Bird Rock itself was omitted from inclusion on the grounds that it is such a popular fishing and diving location. Since the majority of this reef is outside the boundary it is suggested there will be little overall negative impact from having the line positioned here over the reef. Put another way, the alternative solution from an ecological view would be to contain all of the Bird Rock reef system and a soft sediment buffer area surrounding it in the reserve. This was considered impractical as it would impact too much on recreational fishing and spear-fishing.

Lines that touch the shorelines are positioned in a way in which they will have the least negative impact. They extend straight out from the shoreline where the extent of the fringing reef is relatively constrained.

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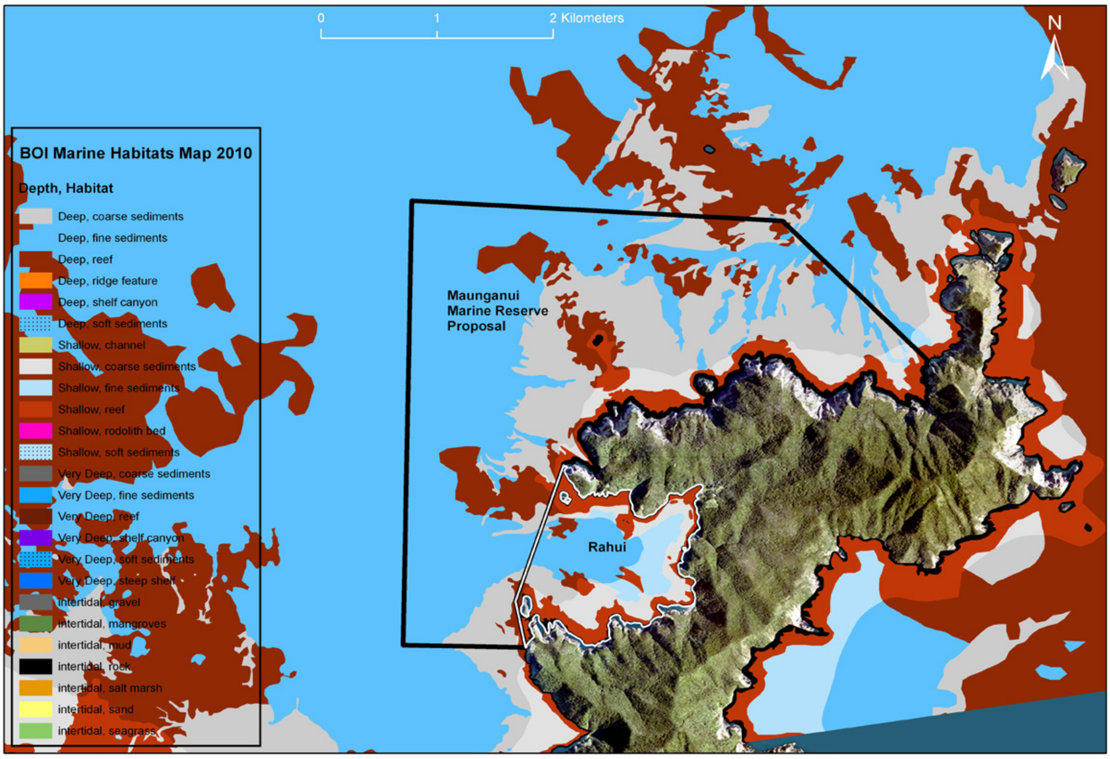


Map 1. Proposal at Maunganui Bay and Rahui area. Base layer is the Northland Habitat Map (2010a).

Practical Boundary Design Criteria - Maunganui Marine Reserve Proposal

Various options for boundaries were examined for this proposal area. Once the basic ecological objectives and possibilities were worked through, attention was focused on how to create the most cost-efficient and practical boundaries from a user navigation point of view and a management and compliance perspective. The proposed lines of sight and shore marker locations were all checked from the relevant seaward positions and judged to be the best and most practical options.

A distance off shore boundary, such as that used at the Poor Knights Marine Reserve, was considered and ruled out as not as easy to navigate as a system with good lines of sight and effective shore markers.

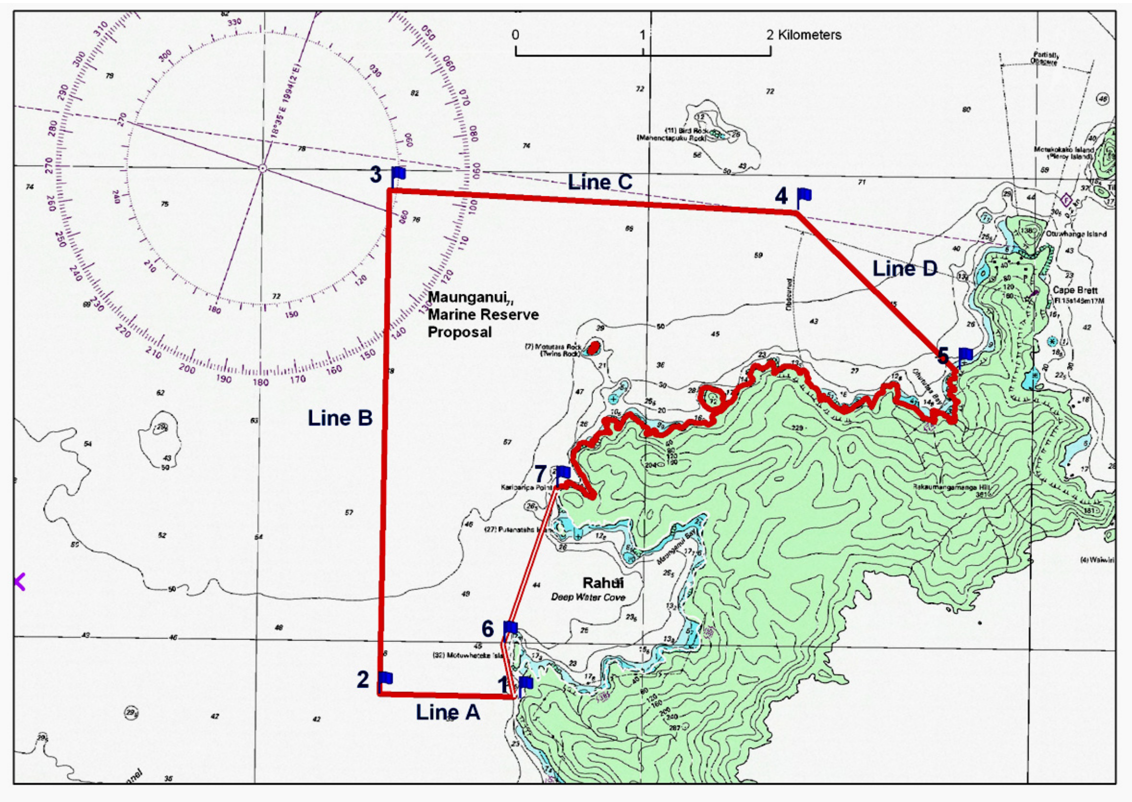
As shown in Maps 2 and 3, it is proposed that Line D utilises shore markers at point 5 with one placed above the splash zone and one further up the hill, creating a sighting line out to sea which enables skippers to ‘line up’ the two markers. This line also has a seaward line of sight marker of Bird Rock which is easy to see from the distances involved. In the information gazetted for the marine reserve there could also be a bearing listed for Line D to assist with navigation.

Line C is a line formed by a line of sight between Otuwhanga Island (The Goat) and Mt Pocock, a prominent high hill top on the western side of the Bay of Islands. There could be bearings also listed for sightings in either direction to each of the landmarks.

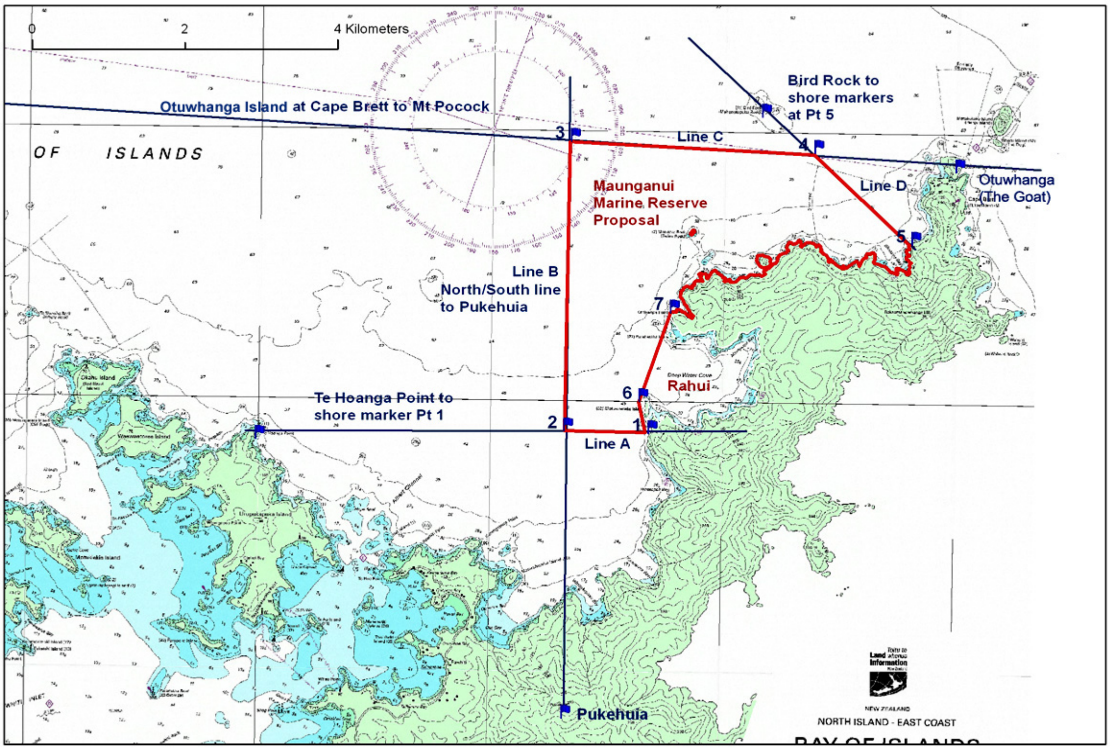
Line B is formed with a north/south bearing and sighting line from the prominent peak Pukehuia behind Oke Bay to the south. While the landmark Pukehuia is some considerable distance away it is a relatively easy landmark to spot, and effective at the distances involved.

Line A is an east/west bearing sighting line running out from two shore markers. This line can also be lined up with Te Hoanga Point at Urupukapuka Island. The two shore markers are proposed to be located just above the splash line and further up the hill so that they will be effective for 'lining up' purposes for a distance of up to 2 km offshore.

The lines forming the boundary with the current Rahui are proposed to have no shore markers or buoys marking them. If the Rahui continues with a no fishing designation this boundary is not seen as presenting any practical problems in terms of requiring further markers. If the Rahui is wound up then either the previous Rahui area could be added to the proposed marine reserve or additional markers could be established as needed.



Map 2. Proposal area at Maunganui Bay and coast showing boundary points and lines, including theboundary of the current Rahui area.



Map 3. Map of Maunganui Bay and coast showing the lines of sight which form the boundary lines of the proposal area.

Ecological Criteria- Waewaetorea Proposal

The habitat diversity of the area around the four islands, Motukiekie, Okahu, Waewaetorea and Urupukapuka, is by any measure very high and complex. This has much to do with the nature and location of these islands and their effect on currents and wave exposure. It is well known that islands produce the highest levels of habitat diversity and, as a result, biological diversity. In this case there is the added complexity of three distinct channels within the proposal area: the Waewaetorea, Okahu, and Motukiekie-Waewaetorea Islands channels. Channels such as these add unique dimensions to these areas with their currents sweeping through complex habitats such as patch reefs or biogenetic habitats like the algal turf beds that are common there. As a result they can become biodiversity hotspots.

Map 4 below illustrates how the boundaries have been placed in relation to the main physical habitats as mapped in the Northland Marine Habitat Map (2010a). This habitat forms a basis for designing around the most significant habitat boundaries such as shallow and deep reefs and major soft bottom areas. However in an area like this the 2010 map represents a highly simplified picture of actual habitat complexity and, as noted in the report (2010a), the quality of aerial photos available at the time the map was drawn was limiting. A more recent survey of the area resulting in a finer scale habitat map with more habitat divisions is currently being written up by the author. This new habitat map has habitat areas defined for algal turf, finer scale boundaries between gravels, fine sands, cobble areas and kina barren, shallow mixed weed, *Ecklonia radiata* kelp forest and deep sponge dominated reefs. This more detailed information was available to Fish Forever in draft form for the purpose of the design process.

The Waewaetorea proposal area incorporates an impressive list of shallow and intertidal habitats:

- Rocky shore platforms of virtually all degrees of exposure and the intermediate transition areas, i.e. very exposed to sheltered.
- Special features of the rocky shoreline, including large 'guts', a selection of small islets, and exposed rocks of various exposures.
- A significant seagrass bed at Entico Bay and additional patches in other sheltered areas.
- A small estuary and example of mangroves not commonly found associated with islands.
- Significant areas of a biogenic algal turf habit on the sheltered side of Waewaetorea and Urupukapuka Islands and in the Channel between these islands and the Motukiekie Islands.
- Semi-sheltered and sheltered gravel and sand beaches of the four islands in the proposal area, which represent some of the best examples of these beaches in the Bay of Islands. The beaches are even more significant because they adjoin the complex channel areas between these islands.

The area of shallow rocky reef in the Waewaetorea proposal area is significant in the context of the overall Bay of Islands (being 19.28% of the proposal area and 7.47 % of the Bay of Islands shallow rocky reef habitats). These shallow reefs are very diverse, including a full range of exposures, some very complex structural topology, pinnacles and guts, and diverse tidal and oceanic currents.

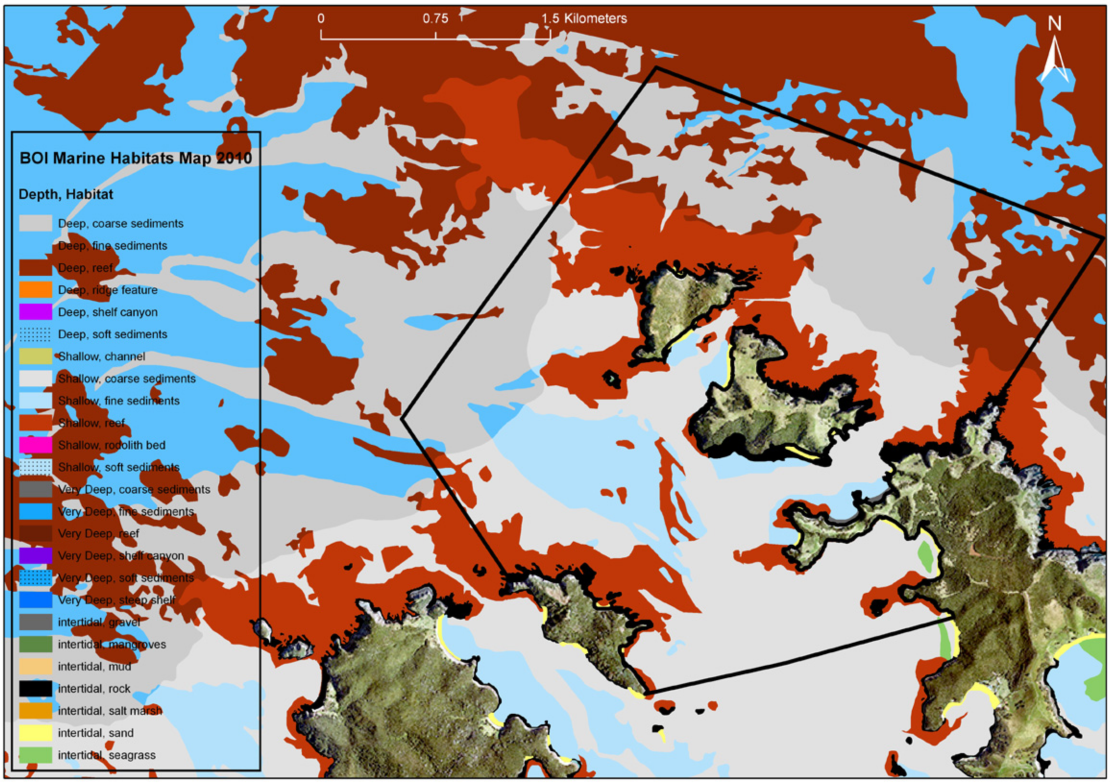
The shallow reef kelp forests in the Waewaetorea proposal area range in composition from those typical of very exposed sites to those of more sheltered situations. On the sheltered sides of islands, kina barrens are common and in places extensive. On the more exposed sides of the islands the *Ecklonia radiata* kelp forests are mainly quite healthy with small isolated kina barrens.

Just over one third of the proposal area lies in depths greater than 30 m, described as 'deep' habitats in the 2010 habitat map. The 102 ha of deep reef habitats in the proposal area represents 3.79% of the Bay of Islands deep reef habitats area. In the recent habitat survey conducted by the author, video ground truthing was carried out in a number of locations on these reefs. Overall the quality of this sponge and filter feeding community could be described as high. Generally speaking the depth zone of 30-60 m is one of the most productive zones of this type of deep reef, with complex reef structures and significant currents of oceanic water masses. All these conditions are met for the examples in the proposal area.

Location of boundary lines for this proposed marine reserve presents considerable challenges. Generally speaking the proposed boundary lines work very well for shallow reefs with two exceptions. The exceptions are Line B extending out from the northwest tip of Motukiekie Island and Line E extending northeast out from Te Hoanga Point on Urupukapuka Island. In both cases lines cut through the shallow reef. While this is not ideal from a conservation perspective, it has proved necessary for practical reasons (discussed below). From a recreational fishing perspective these two boundary lines may produce enhanced fishing in the areas adjacent to these two boundaries due to fish and crayfish freely moving across these reef structures (Freeman et al., 2009). Both of these areas are currently popular fishing areas.

The extensive shallow reefs around Okahu and Waewaetorea Islands have good soft bottom buffer areas around them. To the seaward side of the proposal these shallow reefs have continuous connection with areas of deep reef which adds more opportunity for ecological connections to occur and species to move from habitat to habitat within the reserve area.

The effectiveness of the boundary lines across deep reefs is quite compromised in this proposal due to practical constraints of size and the large areas these deep reefs cover in this part of the Bay of Islands. The plus here is that there are some significant areas of deep reef within the boundary and some of these reefs have good soft bottom habitat areas associated with them.



Map 4. Proposal at Waewaetorea, Okahu, Urupukapuka and Motukiekie Islands. Base layer is the Northland

Habitat Map (2010a).

Practical Boundary Design Criteria - Waewaetorea Proposal

As described above for the Maunganui Proposal boundary design process, the basic ecological objectives and possibilities were the initial focus. The next step was to create the most cost-efficient and practical boundaries from a user navigation point of view and a management and compliance perspective. The proposed lines of sight and shore marker locations for this proposal, as illustrated in Maps 5 and 6 below, were all checked from relevant seaward positions and judged to be the best and most practical options.

A distance off shore boundary, such as that used at the Poor Knights Marine Reserve, was considered and ruled out as not as easy to navigate as a system with good lines of sight and effective shore markers.

Line A runs between shore markers on the shore of Urupukapuka Island in Paradise Bay and the south easternmost tip of Motukiekie Island. These will be highly effective shore markers and navigation of this line should pose no problems.

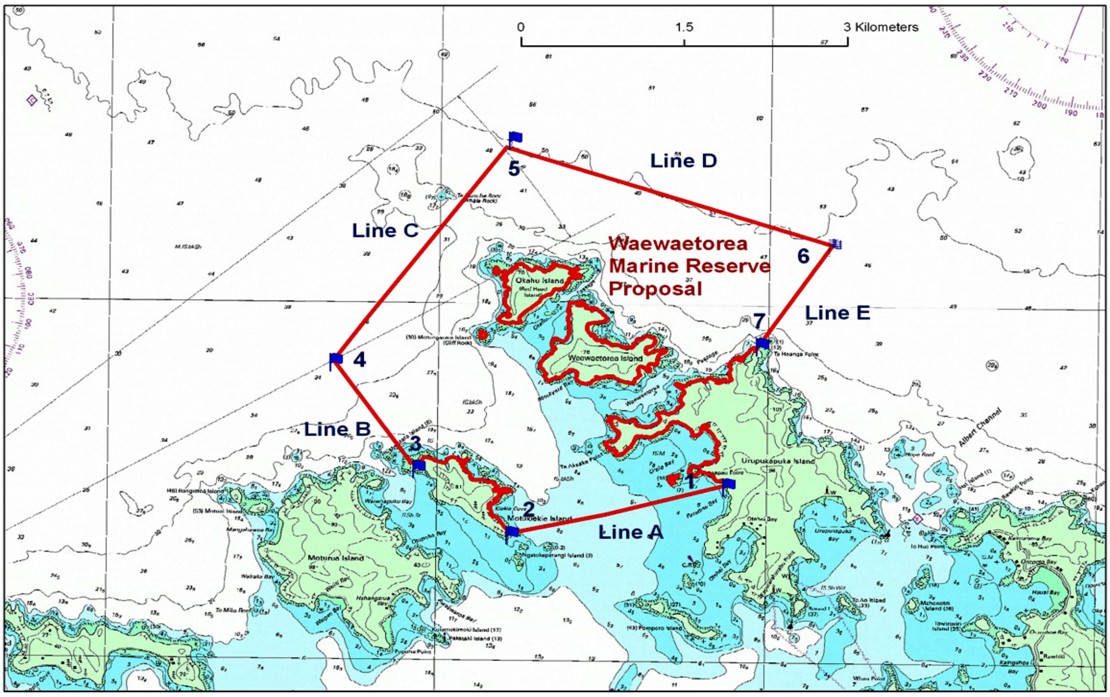
Line B runs northwest out from Pt 3 to Pt 4 off the northwest point of Motukiekie Island. The line is a line of sight with the Ninepin Island which is readily seen from this distance. There will be a bearing listed for either end of this line sighting. The location of the shore marker at Pt 3 also has a suitable site for a second shore marker to be placed up the hill that could be used to 'line up' the two markers, forming an accurate line of sight for up to 2 km off shore. One reason this line was placed here was to avoid the various reefs associated with the channel between Motukiekie and Moturua Islands which is a well–known and valuable fishing spot.

Line C is a line of sight and bearing line to Rangitea Island from Pts 4 and 5. This line will have a back bearing to Rangitea Island. The final location of this line was given a great deal of thought and there were many iterations explored. Essentially a balance was sought between wanting to include as much of the reef system as possible and wanting to exclude nearby Whale Rock and the reefs immediately around it, on the ground that it is a significant fishing and spearfishing area.

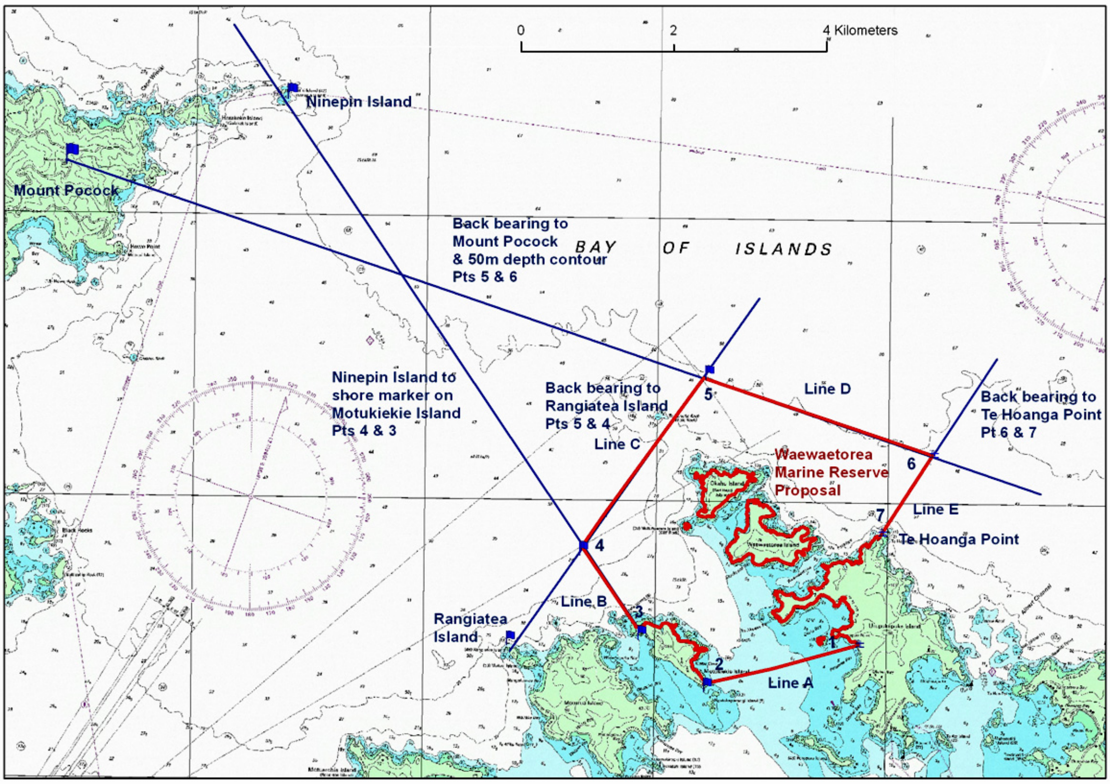
Line D is a line of sight line to Mt Pocock from Pts 4 and 5. Mt Pocock's outline is quite pronounced on the northwest shore of the Bay of Islands from these distances. There will be a bearing listed to Mt Pocock from Pts 4 and 5. This line has another feature that will aid navigation: it was designed to follow the 50 m depth contour line for its entire length. This will allow any vessel with a depth sounder to know simply by depth if they are in or out of the reserve areas when in the vicinity of the boundary.

Line E is formed as a line of sight extending out for a shore marker at Pt 7. This location has an ideal site for a second shore marker to be placed up on the hill allowing for an accurate line of sight 'lining up' the two shore markers. There will also be a back bearing listed from

Pt 6 back to Pt 7.



Map 5. Proposal area at Waewaetorea, Okahu, Urupukapuka and Motukiekie Islands showing boundary points and lines.



Map 6. Proposal at Waewaetorea, Okahu, Urupukapuka and Motukiekie Islands showing the lines of sight which form the boundary lines of the proposal area.

Summary

The process that Fish Forever used to design the current marine reserve proposal was systematic and made good use of best possible information available to them. They have also demonstrated the utility and practice of setting specific design goals for their process. This practice is modelled and recommended as best practice internationally but not as yet practiced in a clear and transparent manner elsewhere in this country. Fish Forever have used a comprehensive blend of practical and design criteria and have introduced a 'network design concept', which is also not widely observed to date in New Zealand but is now widely accepted in international literature.

After working through all the discussions and preliminary designs it is the author's opinion that Fish Forever have arrived at some very useful proposals and that in both ecological terms and practical terms these are good boundary proposals, worthy of further consideration by the public and the government for implementation.

Limitations of this Report and Analysis

Ultimately the decision regarding best boundaries and the creation of a marine reserve must be made in accordance with the process prescribed in the Marine Reserves Act, at the hands of the Ministers involved. This report describes the process followed by Fish Forever. It is not the only way marine reserves could be designed. Along the way there are numerous possible answers to many of the design questions and, therefore, potential for other good alternative designs.

In various sections of this report there are considerations described around recreational fishing areas being impacted by the reserve and concessions made in locating boundaries to avoid significant recreational fishing areas. The process also assessed the possibility of enhanced future fishing opportunities for some adjoining fishing locations. There is however a larger consideration of impacts of the proposed reserves on recreational fishing more generally. Fish Forever are still studying this issue and gathering more information, and are fully aware of its importance to the local community.

The process reviewed in this report does not attempt to review impacts of the proposals on customary fishing in the areas concerned. At the time of writing this report, the hapu of the Rawhiti area have requested more time to consider their position.

Design processes should always be informed by best possible information and should not wait for some future breakthrough in information. At the same time it is important to recognise the limitations of the information being used. For this process Fish Forever were fortunate to have considerable local knowledge and experience 'on the water' within the group and the wider community. In addition it was helpful to have a comprehensive marine habitat map, high quality aerial photography, and additional special-purpose survey work. However it should be noted that even with all these advantages there remains a lot of unknown detail about these areas in terms of habitat complexity, actual biodiversity, and ecosystem health. There have been many observations made of specific species abundance and local ecology but there has been very little quantitative survey work done in these areas at the species level. The sea is very complex and no site is ever likely to have everything known and mapped to the extent we might like. This is the case with these proposal areas. For example, the habitat map used is a Northland scale map drawn at 1:5,000 scale which uses a simplified physical habitat based system of classification. In this process the habitat map serves as a proxy for ecosystems and species. It must be understood that there are limitations to using broad scale habitat information in this way.

Fish Forever wish to be transparent about how they arrived at their proposal and would emphasise that their proposal is just that – a proposal. It is the beginning of a comprehensive process, including full public consultation, which will no doubt significantly inform the selection of boundaries of any marine reserves created in the Bay of Islands.

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