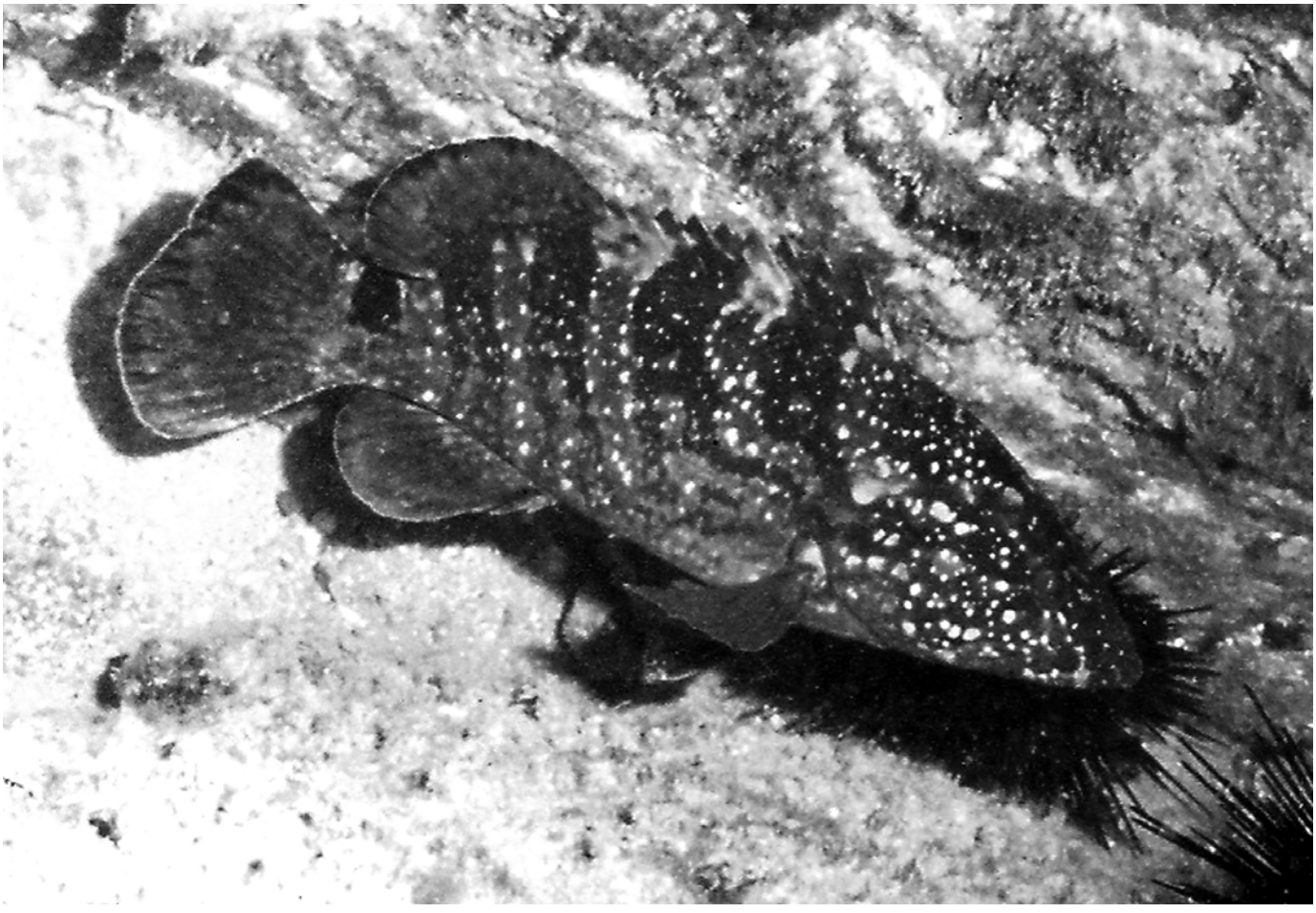
Mimiwhangata Marine Monitoring Programme

Summer 2004

Roger Grace and Vince Kerr

For

Department of Conservation,
Northland Conservancy
Whangarei, October 2004



Spotted black grouper (*Epinephelus daemelii)*

Abstract

In the summer of 2004 subtidal monitoring of ten permanent fish and crayfish transects was completed at Mimiwhangata. Red crayfish (*Jasus edwardsii)* numbers were found to remain low despite the limited take restrictions of the marine park. The number of red crayfish at Lunch Bay, previously reported as dropping between 2002 and 2003, dropped further in 2004. Historically, Lunch Bay had contained the best quality crayfish habitat of all the transects. Packhorse crayfish (*Sagmariasus verreauxi*) continued to be absent from all transects, although a few small packhorse have been reported at Mimiwhangata outside of the monitoring area.

The number of fish species found on transects remained stable. Two rare subtropical species were sighted: A painted moki (*Cheilodactylus ephippium)* was seen on the Grey Rock transect and another just outside of the Black Beach Reef transect. One small spotted black grouper (*Epinephelus daemelii)* was observed near the Black Beach Reef transect. 2004 was the poorest year on record since 1976 for settlement of juvenile red moki *(Cheilodactylus nigripes)* with only 3 counted on ten transects. Very few small snapper (*Pagrus auratus)* and no large snapper were seen on the transects.

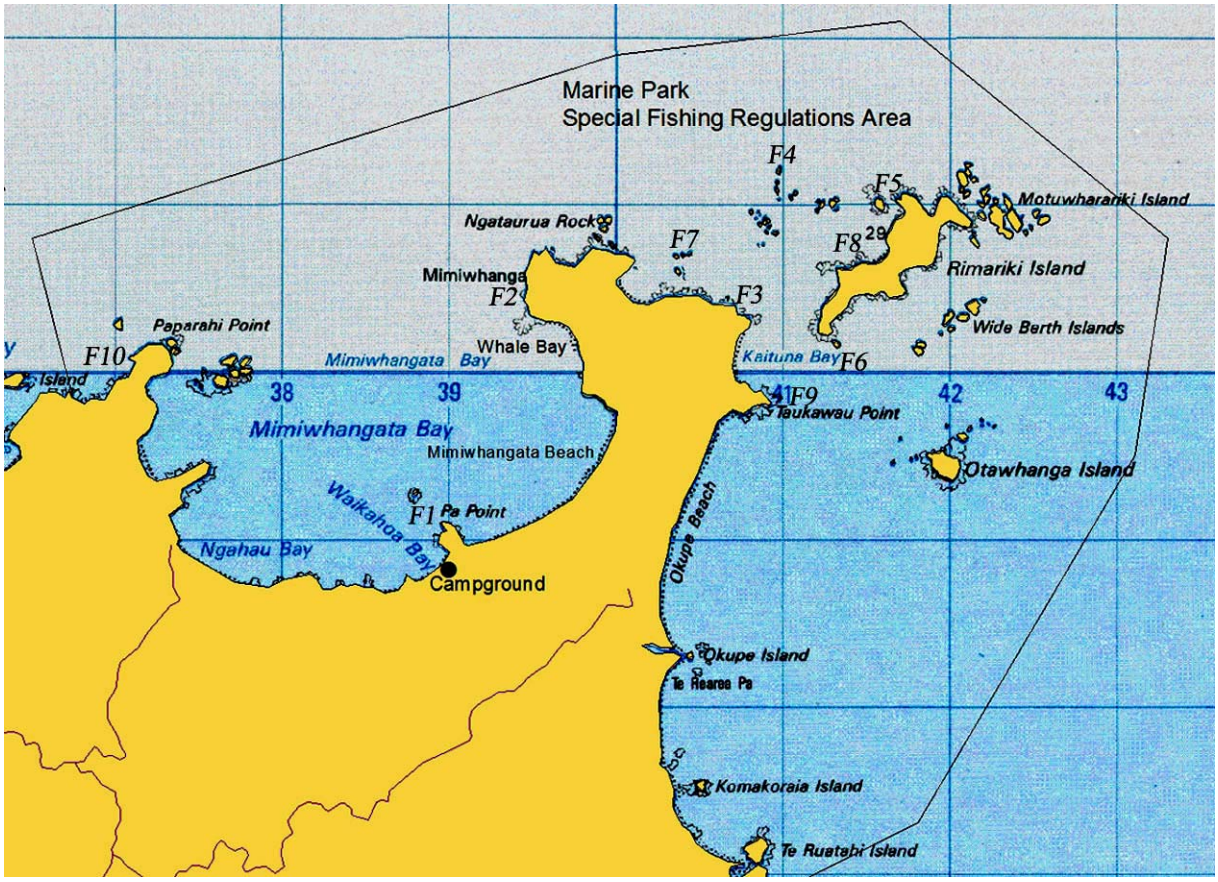
Introduction

The Mimiwhangata Marine Monitoring Programme was established in the winter of 1976, and was designed to provide long-term information on marine resources, particularly popular edible species, to aid in their management.

Monitoring was carried out regularly in the early years, and became intermittent prior to 1986 when the last comprehensive survey was completed. There followed a gap of 15 years until the winter of 2001 when only the intertidal sites were monitored. A full fish and crayfish survey of most intertidal and subtidal sites for was completed in summer 2002. In the summer of 2003 only the subtidal transects were surveyed. Results of the 2001 and 2002 monitoring as well as a restatement of the methods used since 1976 were presented in a report (Grace and Kerr, 2002, 2003) to the Department of Conservation.

In the summer of 2004 our survey team was successful in monitoring all ten of the historic fish and crayfish subtidal transects. Intertidal sampling was not carried out. A location map of the permanent transects labelled F1-F10 follows in Fig. 1 and GPS data for the sites is included in Appendix 1. In March, April and May monitoring was completed at Pa Point (F1), Grey Rock (F2), Lunch Bay (F3), Cocker's Rock Gut, (F4), Awash Rock (F5), Porae Point (F6), Flax Bush Bay (F8), Taukawau Point (F9), and Suicide Cove, Paparahi Point (F10). This report presents the results from the summer 2004 monitoring, and makes brief comparisons with the results from the summer 2002 and 2003 monitoring.

Figure 1 Mimiwhangata Historic Fish and Crayfish Transects F1 –F10



Methods

The following method is the original method followed in setting up fish and crayfish sampling transects at Mimiwhangata and in a parallel study at Tawharanui by the author (Grace 1978 & Grace 1979).

The original locations of fish and crayfish transect sampling sites were decided on a subjective basis with consideration of the following criteria:

1. Approximately 10 sites were wanted to represent the study area, and spread around the area as well as possible, but with consideration also of the ability to dive at those areas reasonably reliably. There seemed little point, for example, in placing sites where it was unlikely we could dive on most occasions because of high swell or poor visibility.

2. As the purpose of the study was primarily to assess human exploitation impacts on the populations, it was decided to locate stations where divers would be likely to dive. There seemed little point in placing sites in what would seem “boring” areas for divers. With this in mind sites were chosen which were fairly prominent within the local area, looked interesting when nearby in a boat and where it was expected a diver new to the area would choose to dive.

3. The area at each site was explored to find the ‘best’ location in which to place the permanent 50 x 10 metre transect. Given that crayfish and reef fish numbers are dependent to a large degree on the abundance of good habitat, which in turn means high topographical complexity of the reef, with plenty of holes, overhangs, caves and tunnels, sites were chosen which contained the best of these features.

4. In most cases the zero end of the transect was placed at or close to the low water mark on the rocky shore, with the transect running more or less perpendicular to the shore at that point.

Transect/quadrat size

This programme was established in 1976/77, at which time there was little precedent to follow in terms of reef fish and crayfish monitoring protocols. As a result there was a requirement to invent a method, and decide on the quadrat size on a common sense basis. Given the topographical complexity of the chosen sites, the quadrat size had to be sufficient to result in reasonable numbers of fish and crayfish, but also able to be completed comfortably during a single dive. With those factors in mind the 50 x 10 metre sample size was determined.

Marking of sites

GPS was not available in 1976. Sites were marked on existing maps and on the most detailed aerial photographs available at the time. The location of the zero end of each transect was recorded as closely as possible on the aerial photograph, and if necessary a series of topside photographs from the boat was used to ‘zoom in’ on the exact position.

In some, but not all cases, the exact zero point was marked using a stainless steel bolt embedded head down in ‘expocrete’ in a small hole drilled with a hand-held star-drill. The exposed end of the bolt was raised about 40 mm above the rock surface. This formed a convenient peg to which the zero end of the transect line could be attached securely for each survey.

It is worth noting that, after some 28 years, most of the markers placed by this method are still in place and look almost as good as new. A few went missing as the piece of rock into which they were embedded broke away through natural erosive causes, but none were lost due to failure of the bolt or expocrete cement or the bond between the rock and the cement. At both Mimiwhangata and Tawharanui the rock type where this method was used is greywacke, a hard erosion-resistant rock, which contributed to the long-term success of this marking method. The rock is often jointed, resulting in chunks of rock containing the mark sometimes falling out.

Transect alignment

From the zero mark each transect ran offshore in a direction determined with reference to local land marks. This was indicated either by a back-sight from the zero point to a landmark on shore, or a direction from the zero point toward a landmark or feature visible in the distance but on the line of the transect. The transect line was swum out on the surface in the appropriate direction before the diver took the 50 m end of the line to the bottom and secured it temporarily. Thus the transect line was placed in the same spot on the bottom during each survey.

Transect mapping

Detailed topographic maps of each transect were drawn, for all sites at Tawharanui, and some sites at Mimiwhangata. The transect line was laid out on the bottom, and using a prepared underwater writing pad, major features were mapped in 5 metre squares along each side of the line, while swimming a few metres above the bottom.
The maps allowed major crayfish lairs, or specific reef fish holes, to be mapped, as well as the extent and nature of algal forests over the years. Any other features of special interest, such as

individual sponges, could also be mapped and their growth or decline recorded over a long time frame. The maps also helped the divers to be confident they were sampling in the right place.

Sampling method

Fish and crayfish were counted concurrently. Counts were not attempted if underwater visibility was less than 5 m. A diver ran out a 50 m line after securing the zero end to the zero mark, and placed the reel at the 50 m end. Generally two divers completed the counts. Starting at the 50 m end the two divers headed along one side of the line, enumerating animals within a 5 m wide strip. One diver concentrated on fishes swimming in open water, and stayed 1 m or so above the bottom, progressing reasonably quickly along the line. Upon reaching the zero end this diver then progressed back toward the 50 m end along the other side of the line. Meanwhile the other diver concentrated on fishes and crayfish more intimately associated with the bottom. This involved swimming a more complex course, making sure that every hole and crevice was examined. This took a lot more time than the first diver's counts, particularly if there was good algal cover on the rocks. Counts of semi-stationary animals such as crayfish could be accurately made by this method. There was a danger of multiple-counts of mobile fishes, or reef fish such as red moki, but by taking great care and recognising some of the individual fishes, and by comparing the notes of the two divers, in practice there was little error. There were few fishes missed by this method, which could be easy in such complex topography if a more “aerial view” approach was adopted. Counts were recorded on pre-prepared underwater writing pads. Lengths of the more prominent individual reef fish were recorded, though for schooling or more abundant fishes such as sweep or spotty recording lengths of individuals was not attempted.

Crayfish were recorded as legal or sub-legal in size, often with additional notes indicating for example, if sub-legal specimens were all very small or just sub-legal etc. Particularly large individuals were also noted, with an estimate of their size in terms of weight. No attempt was made to sex crayfish. Because of the complex topography on many transects, sexing individual crayfish would be very difficult or impossible in some of the holes.

Results

Table 1 Crayfish 2002, 2003, 2004 Number in 500 m^{-2}. (2 @ 50 x 5 m**)**
(Note**:** XX indicates not sampled that year)

Stn.	Locality	Red crayfish						
		Legal			Sub-legal			Total
		2002	2003	**2004**	2002	2003	**2004**	**3 years**
F1	**Pa Point**	0	0	**0**	1	0	**0**	1
F2	**Grey Rock**	0	1	**0**	0	0	**0**	1
F3	**Lunch Bay**	10	3	**2**	28	18	**4**	65
F4	**Awash Rock**	0	XX	**0**	1	XX	**0**	1
F5	**Cockers Rock Gut**	0	0	**1**	0	0	**1**	2
F6	**Porae Point**	2	1	**6**	5	2	**12**	28
F7	**Black Beach Reef**	0	XX	**0**	0	XX	**0**	0
F8	**Flax Bush Bay**	0	0	**0**	0	0	**0**	0
F9	**Taukawau Point**	2	XX	**0**	31	XX	**22**	55
F10	**Suicide Cove**	XX	XX	**0**	XX	XX	**0**	0

Stn.	Locality	Packhorse/Green crayfish						
		Legal			Sub-legal			Total
		2002	2003	**2004**	2002	2003	**2004**	**3 years**
F1	**Pa Point**	0	0	**0**	0	0	**0**	0
F2	**Grey Rock**	0	0	**0**	0	0	**0**	0
F3	**Lunch Bay**	0	0	**0**	0	0	**0**	0
F4	**Awash Rock**	0	XX	**0**	0	XX	**0**	0
F5	**Cockers Rock Gut**	0	0	**0**	0	0	**0**	0
F6	**Porae Point**	0	0	**0**	0	0	**0**	0
F7	**Black Beach Reef**	0	XX	**0**	0	XX	**0**	0
F8	**Flax Bush Bay**	0	0	**0**	0	0	**0**	0
F9	**Taukawau Point**	0	XX	**0**	0	XX	**0**	0
F10	**Suicide Cove**		XX	**0**	XX	XX	**0**	0

Table 2 Reef fishes 2004 survey results
(Note: full table with 2002 & 2003 survey results in Appendix 2)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
English Mackerel		c.20								
Painted moki		1								
Yellow moray				1						
Scorpionfish (dwarf)				1					1	1
Kahawai		c.200								
Red mullet (goatfish)	12	2	10	4	5	8	1	8	11	4
Silver drummer						c.30			c.5	
Parore	5	12	2	8	c.8	6	4	20	7	9
Blue maomao	1	1	1		2	c.20	1		18	8
Sweep	c.15	c.40	c.100	c.12		c.100	c.50	2	c.11	1
Black angelfish			5	1	c.22	3	4	1		
Demoiselle		8		c.85	7		8			
Kelpfish	11	10	14	9	c.20	9	c.20	4	8	11
Marblefish			2	1	1	2	1		2	
Red moki	5	c.15	16	6	c.20	c.8	9	c.12	c.15	7
Porae							1			
Spotty	c.35	c.40	c.25	c.25	c.35	c.200	c.11	c.40	c.50	c.70
Orange wrasse										
Banded wrasse	2	6	c.5	7	6	c.4	c.7		5	5
Sandagers wrasse				4	1					
Red pigfish			3	2	1		3			
Butterfish			1	1		c.15		1	2	
Leatherjacket	1	4	7	15	4	14	6	2	2	
Spotted black grouper										
Conger eel (northern)	1			1						
Red-banded perch										
Rock cod	1	1		1						
Koheru	c.100	c.6		2						
Jack mackerel		c.200				c.400	c.80			
Slender roughy	3	c.20	5			2		1		9
Bigeye		1				c.100				
Trevally			3			1				
Snapper	2			1		2				
Long-snouted pipefish						1			1	
Eagleray		1	1							
Short-tail stingray										
Kingfish										
Piper		c.80								
Oblique-swimming	c.20	8 c.60	c.18	c.200	c.40	c.100		8	2	
Anchovy										
John dory	1	1		1						
Bar-tailed goatfish										
Plagiotremus										
Number of species	**16**	**22**	**18**	**24**	**15**	**20**	**18**	**12**	**16**	**11**

Table 3 Number of Fish Species, 2002, 2003, 2004

Number in 500 m^{-2} (2 @ 50 x 5 metres)

Station	Location	Number of fish species			Mean	STDEV
		2002	2003	2004		
F1	Pa Point	15	19	16	16.67	2.08
F2	Grey Rock	19	19	22	20.00	1.73
F3	Lunch Bay	20	22	18	20.00	2.00
F4	Awash Rock	20	XX	24	22.00	2.83
F5	Cockers Rock Gut	19	19	15	17.67	2.31
F6	Porae Point	24	20	20	21.33	2.31
F7	Black Beach Reef	17	XX	18	17.50	.71
F8	Flax Bush Bay	14	12	12	12.67	1.15
F9	Taukawau Point	14	XX	16	15.00	1.41
F10	Suicide Cove	XX	XX	11	N/A	N/A

Table 4 Other marine life, 2004

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Centrostephanus	2	12	14	c.23	2	3	4	12	1	6
Charonia sp.	0	0	0	0	0	0	0	0	0	2
Octopus	0	0	0	0	0	0	0	0	0	1
Broad squid	0	0	0	0	0	0	0	0	7	0
Red shrimps	0	0	0	0	0	0	0	0	0	0
Astrostole scabra	0	0	0	0	1	0	0	0	0	0
Penion sp.	0	0	0	0	1	0	0	0	0	0
Wandering anemone	0	0	0	0	0	0	1	0	0	0

Crayfish

Since monitoring began in 1976, moderate numbers of red crayfish have been regularly seen at 2 transects: Lunch Bay (F3) and Taukawau Point (F9). Porae Point (F6) sometimes had a few whereas other transects contained only one or two and were sometimes devoid of crayfish altogether. Our experience suggests that red crayfish populations exhibit specific site preferences. In a fished population of crayfish, as at Mimiwhangata, regularly occupied crayfish ‘lairs’ occur in specific places away from which only small numbers of crayfish may be found sporadically. Their presence is related strongly to topography of the rocky seabed, as well as to the level of exploitation.

All 10 transects were monitored in 2004. At Lunch Bay where there is a very broken rocky area and a specific crevice which usually supports a number of red crayfish, total numbers were down from the previous two years. Taukawau Point, which was not sampled in 2003, also showed a decrease in both legal and sub-legal sized red crayfish. Porae Point was the exception

showing a drop from 2002 to 2003, followed by an increase in numbers in 2004 of both the legal and sub-legal size crayfish. Pa Point, Grey Rock, Black Beach Reef, Awash Rock and Flax Bush Bay all had no red crayfish, which is consistent with low or zero counts in the monitoring history since 1976. Cockers Rock Gut transect had one legal and one sub-legal red crayfish in 2004 after having none in 2002 and 2003.

In the past couple of seasons there have been reports of a few small packhorse crayfish appearing again in the area. Recently we have seen two cast shells of sub-legal packhorse washed ashore on the eastern side of Mimiwhangata. There were no packhorse crayfish counted on the ten transects monitored in 2004.

Fish

The number of fish species found on each transect has fluctuated from year to year since monitoring began in 1976 and ranges from 14 to 26 species. For an unexplained reason species numbers were low in 1984 (15 to 18 species found on each transect) but picked up again in 1986 (22 to 26 species) (Grace, 1984, 1986). The numbers of species on each transect recorded in 2004 is within the historic fluctuation range. Over the years 2002, 2003 and 2004 there are roughly equal numbers of transects that have increased, decreased and fluctuated in their species numbers. The standard deviations of total species number for each transect over the recent three year period are relatively low (Table3) supporting the interpretation that the observed variation in species numbers is likely due to natural fluctuations and/or inherent sampling error.

None of the three rare subtropical species seen on or near the Pa Point transect in 2003, the bar-tailed goatfish *(Upeneus francisi)*, the mimic blenny (*Plagiotremus tapeinosoma)* and the spotted black grouper, were seen on that transect in the 2004 monitoring. Another subtropical species, a painted moki, recorded in 2003 just off the Grey Rock transect in a hole sometimes occupied by a small spotted black grouper, was also recorded on the transect in the 2004 count. The grouper was not there in 2003 or 2004, but was noted in 2002. The only spotted black grouper seen in 2004 was at a location just to the west of the zero point (outside of the transect) of the Black Beach Reef transect where one individual was seen in a crevice. In this location a painted moki was also present.

Settlement of juveniles has varied from year to year, and from species to species. In 1986 for example, recruitment of juvenile red moki was the worst of previous records, with only four juveniles seen on a total of 10 transects. In contrast, the 1981 season produced 19 juveniles on only four transects. In 2002 a total of 21 juveniles of young red moki were seen on nine transects. 2003 appeared to have been good for recruitment, a total of 13 juveniles around 15cm in length appearing on the six transects. In 2004 there were only 3 juvenile red moki of 15cm or less counted on the ten transects making this the worst recruitment year for red moki so far recorded since 1976. The reason for this variance in recruitment of juvenile red moki from year to year is not known.

In the 2002 survey snapper were only seen on only one transect. This was a group of six 20cm long fish. In 2003 a few snapper were seen of around 15cm length at Pa Point (4), Cockers Rock Gut (2) and Flax Bush Bay (1). In 2004 a total of 5 snapper all under 25cm in length were counted on three of the ten transects: Pa Point (2), Awash Rock (1) and Porae Point (2). No large snapper were observed by divers during the 2004 monitoring.

Other marine life

The large purple-spined urchin (*Centrostephanus rogersii)* continues to be present in small though relatively constant numbers at some sites, particularly at those with cleaner water conditions.

Octopus appear on most transects from time to time. In 2004 one individual was counted on the Suicide Cove transect. A small group (7) of broad squid were counted on the Taukawau Point transect. The red shrimps noted at Grey Rock in 2002 and 2003 were not present in 2004.

In 2004 reports were received of small tuatua appearing at the south western end of Mimiwhangata beach. These beds were described as patchy and small. Freshly dead small articulated shells were found on the south western end of the beach. Tuatua were also reported at Waikahoa Bay where campers harvest them. Localised, temporary and patchy beds of tuatua are expected to occur from time to time as a normal pattern for this species. No formal monitoring of the tuatua was undertaken in 2004.

In March 2004 there was a very large cyclone-generated north east swell that affected Mimiwhangata. Following the swell event there was a sizeable number of scallops washed up on Mimiwhangata beach, numbering in the 100's (pers. comm. Chris Moretti, DOC Ranger). This event is evidence there is still a scallop population somewhere in Mimiwhangata Bay. Several days after the storm event a limited number of fresh scallop shells were collected on Mimiwhangata Beach and their sizes measured and recorded (Appendix 4).

Discussion

Crayfish

Since monitoring began in 1976 there has been little change in overall abundance of red crayfish, apart from a substantial increase in juvenile red crayfish in the first few years of the programme. We watched these grow to a take-able size, but then they disappeared, not translating into an obvious increase in small but legal sized crayfish. This pattern appears to have been repeated on a smaller scale over the last three years of monitoring on the Lunch Bay and Taukawau Point transects where the large number of juvenile crayfish in 2002 did not translate into a larger 2004 crayfish count.

Numbers of larger sized red crayfish have generally remained low in the area despite no legal commercial harvesting since 1994. It is now probable that amateur fishing is keeping crayfish numbers down. Experience within totally protected marine areas such as the marine reserves at Goat Island, Hahei, and Gisborne, as well as the totally protected Tawharanui Marine Park, shows that under a total protection regime take-able red crayfish numbers increase spectacularly within five years of protection where the habitat is suitable (Kelly 1999, Kelly et al., 2000, Hagget & Kelly, 2003). It is expected that the same would happen at Mimiwhangata under total protection.

In May and June 2004 the authors repeated monitoring of the historic transects set up at Tawharanui Marine Park and at adjacent 'control sites' outside the Park. These transects were set up around the time Mimiwhangata monitoring was commenced and with the same methodology (Grace, 1979). This allowed comparison between areas with 'partial protection' (Mimiwhangata) and areas that have no special protection (Tawharanui control sites) and also areas with full protection (within Tawharanui Marine Park). Preliminary results show that the Mimiwhangata counts mirror those of the Tawharanui no-protection control sites. These show

no improvement over time and many very low counts. In contrast the counts from transects within the fully protected area at Tawharanui show large increases in total numbers of red crayfish as well as an increase in larger individuals. By 1989 the trend of larger numbers of crayfish inside the fully protected Marine Park at Tawharanui was well established (Grace 1989). Later work confirmed this result (Marine Environmental Research, 1994, Nuthall & Russell, 1996, Grace & Kerr, 2004, unpublished data). This data is being analysed further at the time of writing this report and will be reported in coming months in a separate publication examining the multi-reserve, partial vs. full protection comparison for red crayfish at Tawharanui and Mimiwhangata.

Packhorse crayfish, also called green crayfish, were present in the early days of monitoring as occasional individuals on several of the transects, particularly Taukawau Point. In the early 1970's during investigations and exploration for the Mimiwhangata Marine Report (Ballantine, et al., 1973), an aggregation of large packhorse crays was seen near the eastern end of Rimariki Island, but we know of no large packhorse seen in the area since then. By 2002 packhorse crayfish of any size were absent from all transects. From a biodiversity perspective this raises a particular concern for the packhorse crayfish species, because the Mimiwhangata coastal reefs are typical of the north-eastern coast and have had a ban on commercial take since 1994. Without substantial protection on a regional basis it is unlikely we will see many, if any, large packhorse reappearing at Mimiwhangata and certainly not in the size and numbers reportedly present in the area in the early 1960's.

Fish.

Since monitoring began in 1976 there has been no obvious trend in fish numbers detected from the counts on the fish transects. Caution must be taken in any analysis of the data because of the gap in monitoring which occurred between 1986 and 2002, and the limitations on statistical analysis imposed by the original methods selected.

In relation to snapper monitoring in particular, it is important to note that the visual diver method used here is known to be inadequate for the monitoring of snapper because the larger fish from legal size upwards are diver shy (Willis & Babcock, 2000, Willis, et. al, 2000). An indication of juvenile numbers can be made with this method. The observations of 2002, 2003, 2004 showing few sightings of juvenile snapper contrast with the records of the 70's and the early 80's when juvenile snapper were consistently seen and schools of larger snapper were occasionally seen (Ballantine et al., 1973, Darby & Darby 1973, Dart et al., 1982, Commissioner for the Environment, 1982). Also appearing in these historic reports are anecdotal accounts of the period preceding the 70's, describing large snapper frequently seen and caught at Mimiwhangata and that close in-shore commercial trawling, long lining and set netting was having a detrimental impact on snapper abundance in the period leading up to 1970.

Recommendations

Further analysis of data

The current data set at Mimiwhangata lacks a set of reference transects outside of the Marine Park. As stated previously in the crayfish discussion the opportunity exists to examine the reef fish monitoring data from Mimiwhangata alongside the Tawharanui data. This will enable us to compare changes that have occurred to reef fish populations from similar habitats that have different management regimes in place, i.e. full protection, partial protection and no protection. Such an analysis, with results from a long time period, could yield useful information on some

of the reef species. Using the data from Tawharanui as a comparison for Mimiwhangata could help to identify any differences between a partial protection management regime and a no protection regime.

Another potential for this data set and future monitoring is the comparison or correlation of fish and crayfish data with measurement of change of condition and extent of algal forest. Three of the transects, Pa Point, Black Beach Reef and Porae Point, have long term aerial photo series prepared for them and have been recommended as algal forest change monitoring sites (Kerr & Grace 2004 in prep.). With the habitat descriptive work completed to date, and field notes from monitoring data there is a unique opportunity to examine ecological impacts of algal forest changes over time.

Monitoring values and priorities in future

The historic fish and crayfish monitoring suite at Mimiwhangata offers a rare long term data set that will assist any future studies, especially if the management regime changes to a fully protected marine reserve status. Any comparison of the Mimiwhangata monitoring results with those of Tawharanui would offer a unique opportunity to test conclusions drawn about the impact of marine reserves by having monitoring 'replicated at reserve level'.

Two weaknesses of the historic fish and crayfish monitoring at Mimiwhangata in terms of quantitative analysis are: (1) lack of control areas outside the current Marine Park, (2) limitations in spatial replication and the non-random manner in which the permanent transects are sited which limit calculations of variance and use of other statistical means to test various hypotheses for explaining change in abundance of various species over time. Note: One transect at Paparahi Point is inside the current Marine Park, but is outside the proposed marine reserve (DOC, 2004).

Suggested solutions to design and analysis limitations of historic monitoring transects

(1) Control transects outside of the current reserve, and outside of any future possible changed boundaries, should be set up to establish a pre-change baseline data set adding adequate controls to cover questions relating to any management change which may take place.
(2) If the existing suite of Auckland University replicated transects are monitored simultaneously with the historic transects, it is possible to check or support conclusions drawn on long term trend change derived from the historic transects against the statistical power of the Auckland university monitoring suite. There is another comparison potential between the two studies that is important to note here. The Auckland suite of transects attempts to achieve a replicated, representative set of data from the shallow reef environment, including sufficient non-treatment control areas both north and south of the current Marine Park. Two methods are used (UVC, underwater visual census and UBC, underwater baited video) which compliment each other in terms of reliability for all species (Willis & Babcock, 2000, Willis et al., 2000, Denny & Babcock 2002, Usmar et al., 2003, Denny & Babcock, 2004). The historic transects were initially designed to show change by targeting areas where habitat quality and complexity was highest. In modern terminology the historic transects were stratified by habitat quality. This approach has shown itself to be useful in the comparison of crayfish data, where in the heavily fished state, the Auckland survey reported many zeros or very low counts, whereas on the historic transects that specifically targeted to include 'good' crayfish habitat the counts are no longer high, but sufficient to allow for the time series comparison to be made. In the case of crayfish, the comparison afforded by the two methods raises interesting questions and statistical analysis challenges relating to the 'non-random' way crayfish use the reef habitat. These questions have been highlighted by the approach used for the historic transects.

In the future the best option is to have one completely integrated and rationalised monitoring program. We are now in the fortunate situation that we are spoiled for possibilities, given the history and array of methods used at Mimiwhangata. It is suggested that an expert group be called together to work out a future monitoring/research program which may draw from objectives and resources of any interest groups, the Department of Conservation, MinFish, Auckland University and the Kaitiaki ropu of local Tangata Whenua.

Acknowledgements

The authors wish to thank Chris and Nadine Moretti at Mimiwhangata, who have been extremely helpful with many practical aspects of our work and visits to Mimiwhangata. Thanks to the Department of Conservation for the financial support of much of the work for this study. We also thank Diane Kerr for her editing and proof reading contributions.

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Appendix 1 Location of historic transects

Waypoint Comment	Waypoint Description	New Zealand Grid Eastings	New Zealand Grid Northings
F1	Pa Point	2638949	6639092
F2	Grey Rock	2639375	6640315
F3	Lunch Bay	2640656	6640479
F4	Awash Rock	2640992	6641222
F5	Cocker's Rock Gut	2641635	6641016
F6	Porae Point	2641337	6640144
F7	Black Beach Reef	2640452	6640720
F8	Flax Bush Bay	2641469	6640734
F9	Taukawau Point	2640917	6639824
F10	Suicide Cove	2636956	6639919

Appendix 2 2002, 2003 & 2004 Fish monitoring Number in 500 m^{-2} (2 @ 50 x 5 metres)

Fish Species															
	F1			F2			F3			F4			F5		
	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004
English Mackerel						c.20									
Painted moki						1									
Yellow moray				1	1			2		2		1		1	
Scorpionfish (dwarf)	1	2										1			
Kahawai	c.100					C.200	c100								
Red mullet (goatfish)	121	32	12	c.16	11	2	c32	8	10	2		4	16	9	5
Silver drummer							1	7					2	2	
Parore	30	19	5	13	c.12	12	1	4	2	10		8	c.30	c.30	c.8
Blue maomao		4	1	8	5	1	5	7	1				5	c.40	2
Sweep	c.40	24	c.15	c70	c.20	c.40	c.130	c.20	c.100	3		c.12	c.30	c.35	
Black angelfish							8	5	5	1		1	c.13	c.10	c.22
Demoiselle				c25	c.34	8				c.300		c.85	c30	c.28	7
Kelpfish	11	16	11	13	9	10	c12	7	14	10		9	3	8	c.20
Marblefish				2	1			4	2	3		1	1		1
Red moki	2	c.8	5	c20	c.12	c.15	c20	c.20	16	3		6	c10	c.15	c.20
Porae				1				1					1		
Spotty	c.40	c.70	c.35	c20	c.30	c.40	c32	15	c.25	12		c.25	c.20	c.28	c.35
Orange wrasse															
Banded wrasse	5	c.13	2	3	6	6	5	5	c.5	6		7	4	3	6
Sandagers wrasse										1		4	1		1
Red pigfish				2			2	3	3	3		2			1
Butterfish							1	1	1	1		1			
Leatherjacket	2	6	1	3	6	4	4	3	7	8		15	c.8	7	4
Spotted black grouper															
Conger eel	1	1	1		1							1			
Red-banded perch													1		
Rock cod	1	3	1			1						1			
Koheru			c.100	7		c.6	6			c.50		2			
Jack mackerel	c.80			c.20	c.400	c.200	c.50	15							
Slender roughy	4	13	3	c.60	c.64	c.20			5	1					
Bigeye	2	c.54		c.60	x	1	c.50	x						x	
Trevally					1		3	15	3						
Snapper		4	2									1	c.6	2	
Long-snouted pipefish															
Eagleray						1	1		1						
Short-tail stingray										1					
Kingfish															
Piper		c.100				c.80		12							
Oblique-swimming blenny			c.20	c.25	c.10	8, c.60		4	c.18	c.350		c.200		x	c.40
Anchovy															
John dory		1	1			1						1			
Bar-tailed goatfish		2													
Plagiotremus		2			1			1							
Number of species	15	19	16	19	19	22	20	22	18	20		24	19	16	15

Fish Species															
	F6			F7			F8			F9			F10		
	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004
English Mackerel															
Painted moki															
Yellow moray	1														
Scorpionfish (dwarf)								1				1			1
Kahawai				c.100											
Red mullet (goatfish)	15	4	8	2		1	20	18	8	14		11			4
Silver drummer			c.30	3						1		c.5			
Parore	12	6	6	c.58		4	4	5	20	9		7			9
Blue maomao	1	c.5	c.20	c.43		1				c.15		18			8
Sweep	c.90	c.25	c.100	1		c.50	18		2	c.60		c.11			1
Black angelfish	3	3	3	5		4	2	1	1						
Demoiselle	1	1				8	1	1							
Kelpfish	6	8	9	14		c.20	7	8	4	16		8			11
Marblefish	2	1	2	1		1	2			4		2			
Red moki	c.10	c.7	c.8	18		9	6	c.10	c.12	18		c.15			7
Porae	1	1				1									
Spotty	c.34	c.42	c.200	c.35		c.11	30	c.34	c.40	c.31		c.50			c.70
Orange wrasse							1								
Banded wrasse	3	1	c.4	10		c.7		2		7		5			5
Sandagers wrasse				2											
Red pigfish						3	1								
Butterfish	5	7	c.15	5					1			2			
Leatherjacket	14	3	14	1		6	4	2	2	2		2			
Spotted black grouper										1					
Conger eel															
Red-banded perch															
Rock cod		1													
Koheru	c.100	c.20													
Jack mackerel	5		c.400			c.80									
Slender roughy		2	2						1	1					9
Bigeye	c.45		c.100	c20			c.31			c.43					
Trevally	c.100		1												
Snapper			2					1							
Long-snouted pipefish	3		1									1			
Eagleray	1														
Short-tail stingray							1								
Kingfish	1	2		3											
Piper															
Oblique-swimming blenny		c.80	c.100						8			2			
Anchovy	1														
John dory	1														
Bar-tailed goatfish															
Plagiotremus															
Number of species	24	20	20	17		18	14	12	12	14		16			11

Appendix 3 Other marine life Years 2002, 2003 & 2004

	F1			F2			F3			F4			F5		
	2002	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**
Centrostephanus	2	2	**2**	15	14	**12**	23	14	**14**	13		**c.23**	5	4	**2**
Charonia sp.	0	0	**0**	0	1	**0**	0	-1	**0**	0		**0**	0	0	**0**
Octopus	0	1	**0**	0	0	**0**	0	1	**0**	0		**0**	0	0	**0**
Broad squid	0	0	**0**	0	0	**0**	0	0	**0**	0		**0**	c.100	0	**0**
Red shrimps	0	0	**0**	14	2	**0**	0	0	**0**	0		**0**	0	0	**0**
Astrostole scabra	1	1	**0**	0	0	**0**	0	0	**0**	0		**0**	0	0	**1**
Penion??															**1**
Wandering anemone															

	F6			F7			F8			F9			F10		
	2002	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**
Centrostephanus	6	4	**3**	5		**4**	16	17	**12**	1		**1**			**6**
Charonia sp.	0	0	**0**	0		**0**	0	-1	**0**	0		**0**			**2**
Octopus	0	0	**0**	0		**0**	0	-1	**0**	1		**0**			**1**
Broad squid	0	0	**0**	0		**0**	0	0	**0**	0		**7**			**0**
Red shrimps	0	0	**0**	0		**0**	0	5	**0**	0		**0**			**0**
Astrostole scabra	0	0	**0**	0		**0**	0	0	**0**	0		**0**			**0**
Penion sp.															
Wandering anemone						**1**									

Appendix 4 Scallops collected after March 2004 storm on Mimiwhangata Beach

Size mm	**# of Scallops**
105-110	1
100-105	4
95-100	2
90-957	7
85-905	5
80-850	0
75-801	1
70-750	0
65-70	1
n = 21	

Note: Only 25% were above legal size.