Mimiwhangata Rāhui Baited Underwater Video Survey June 2025

Vince Kerr & Ceara Wallace

Photo: A diver photo of the BUV camera apparatus recording fish numbers, taken at Maitai Bay. Fish are blue maomao, (photo V. Kerr)

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Introduction

As a result of a 2013 challenge to the Northland Regional Coastal Plan, the Environment Court ruled that a Rāhui would be placed around the Mimiwhangata peninsula in 2023 under the authority of the RMA. The stated aim of the Rāhui was to restore the area's marine biodiversity. The area selected was similar to the previous proposals put forward by Te uri o Hikihiki and the Department of Conservation.

In April 2024, Kerr & Associates, in collaboration with Te Uri O Hikihiki Rahui Roopu and Northern Regional Council, completed a Year 1 BUV survey at Mimiwhangata. It was agreed that a Baited Underwater Video survey would be the most effective and time-efficient option to assess reef fish abundance, focusing on snapper (*Pagrus auratus*). The 2024 BUV survey was completed and results were written up in a technical report (Kerr and Wallace 2024). A second round of BUV survey was commissioned for summer 2025. Kerr & Associates would again conduct the on-water sampling, analyse the raw data, and produce a report on the findings.

Summary

BUV surveys provide a cost-effective method for estimating predatory reef fish's relative density and Biomass. This monitoring project is historically significant as there is a large body of existing data from the same area, including BUV survey, starting from 2002 and 2003. This means the data obtained from the current sampling can be compared to historical data and tracked over time to follow recovery. Evidence of such trends is crucial to showing the ecological value of having the rāhui tapu in place at Mimiwhangata.

Results from the 2025 BUV survey indicate a small increase in snapper size from the 2024 survey. However, this small increase and only two years of data do not allow statistical validation of a trend upwards in these measures. Current snapper numbers and Biomass calculated levels remain modest and typical of areas open to fishing. With the Rāhui fishing closure in place, future results are expected to show trends of increasing fish abundance snapper density and Biomass. Reef biodiversity, generally including the regeneration of kelp forests, is expected to grow slowly but then pick up pace and show a significant increase, especially in snapper size and Biomass, which is a key factor in kina population control which enables a transition from kina barren to kelp forest.

Methods

BUV Methodology

The BUV methodology used is described in our 2024 monitoring report, (Wallace & Kerr).

On-water sampling was completed in 2 days over the 9th and 10th of April, between 0900h and 1400h each day. Low tide was at 1144h on the first day. The moon phase was approaching full on these days. There was about 1.6m difference between high and low water on both days. The vessel and crew departed from Tutukaka Marina and travelled north to the survey sites. The wind was between 15 knots, increasing to 20 knots each afternoon, blowing from the West and Southwest. The BUV sites at Mimiwhangata are relatively protected from winds coming from this quarter so there was little impact on the survey.

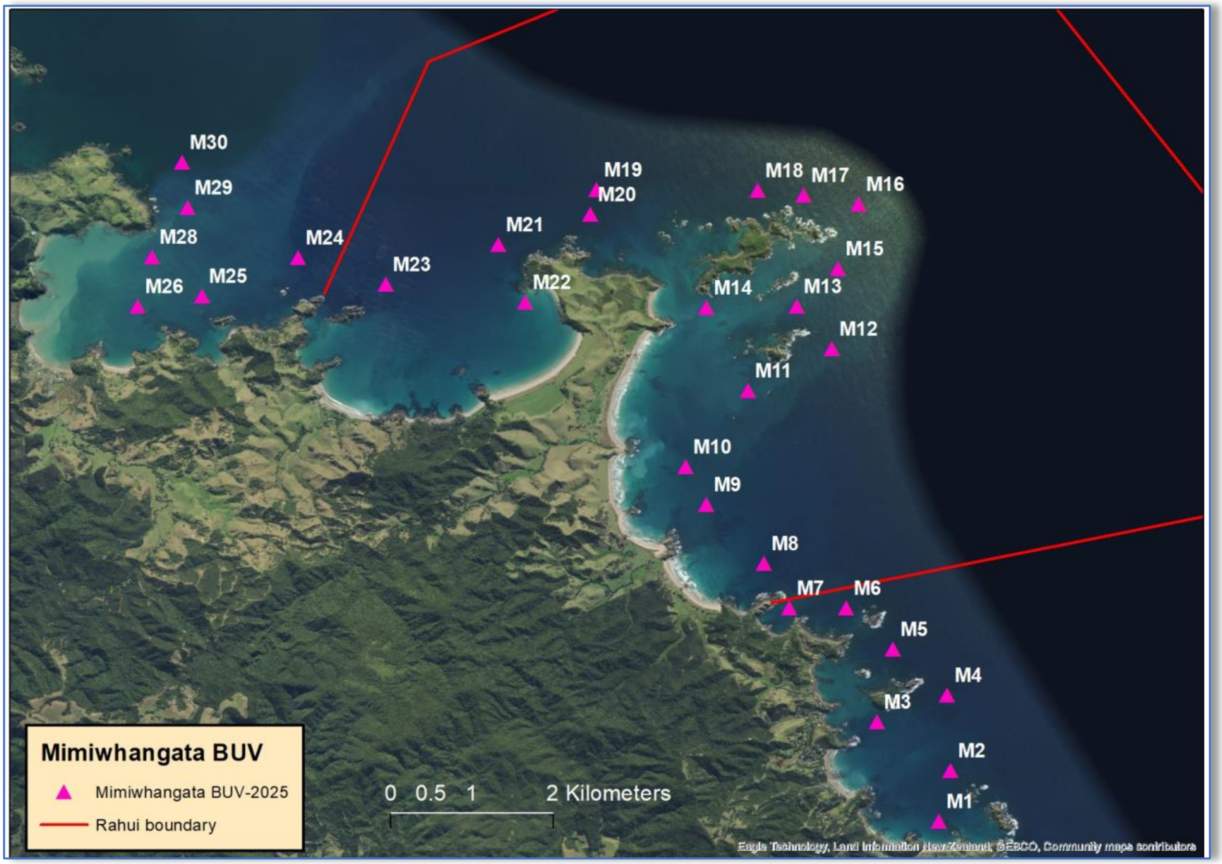

Figure 1 Location map of the 29 BUV sites at Mimiwhangata, which include sites inside and outside the current Rāhui boundary.

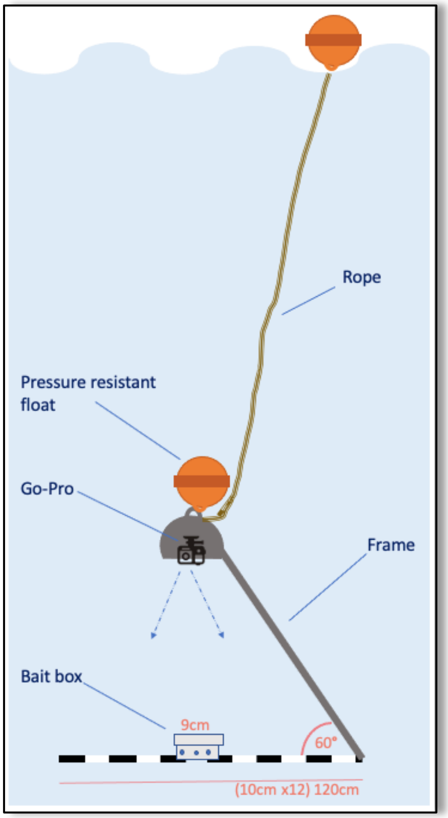

Figure 2 A diagram of the BUV apparatus

Video processing & Data analysis

All video footage was analysed to determine the relative total fish diversity, maximum snapper count, and maximum snapper biomass calculated from snapper lengths for each of the 29 sample sites. The maximum snapper count is defined as the maximum number of snapper observed in a single frame during the 30 minutes of recorded footage. The maximum snapper biomass is the total estimated weight of the snapper measured in a single frame. This is determined by converting snapper length estimates to Biomass using the equation described in (Willis & Babcock 2000).

$$W = aL^b$$

W is the weight (g), L is the length (mm), a is 7.194 ×10^{-5} and b is 2.793.

In some instances, the frame with the maximum snapper count differed from the frame with the maximum snapper biomass. Sometimes, a frame will have a snapper count lower than the maximum count frame but have a total higher Biomass. This can happen because large snapper are present and have exponentially greater Biomass than smaller snapper. Individual snapper lengths were measured in still frames of the video sequence with care taken to measure head-to-tail fork lengths as accurately as possible when the fish were at the same level as the bottom bar. These fish length data were then used to determine Biomass. These values were combined to determine the mean total snapper biomass for each site. Calculating

Biomass enables us to follow any trends in Biomass that occur over time and is a valuable measure of the large snapper returning to the reef community.

Hapu Involvement

Noah Edwards, a local Rangatahi from Whananaki joined us on the first day of on-water surveying. Holly Hetaraka and Roxy Pene, Kaitiaki from Te Uri o Hikhiki joined us on the second day. All three assisted with the work onboard and observed the practical components of the BUV survey. The Hapu Kaitiaki assisted well with the field work and expressed a desire to be more involved in the future.

Results

Twenty-nine BUV sites were surveyed around the Mimiwhangata Peninsula, inside and outside the Rāhui area. A record of the drop location, date, and time were recorded for each site, which is included in this report in Appendix 1. Of the 29 sites surveyed, 26 of these drops met the criteria of having 30 minutes of continuous and uncompromised footage suitable for analysis. Problem sites: M17 had its frame dragged, causing the bait cage and measuring bar to be partially obscured; site M18 was not consistently on the bottom for the full 30 minutes, and M30 had kelp interference obscuring the view of the bait cage and bar. For the three sites with insufficient video coverage of the fish the total count and lengths of snapper could not be accurately determined. The video footage for the three cases was analysed and best estimates where possible were recorded, as seen in **Table 1**.

Results of Snapper Density and Biomass

Site	In / Out Rāhui	Max # Snapper	Max Length	Mean Length (cm)	Mean biomass (kg)	Total biomass (kg)
M1	**Out**	13	15	13.5	0.068	0.9
M2	**Out**	18	30	25.28	0.38	6.91
M3	**Out**	10	30	27.5	0.48	4.77
M4	**Out**	8	25	21.25	0.24	1.93
M5	**Out**	5	30	21	0.26	1.32
M6	**Out**	4	25	23.75	0.32	1.27
M7	**Out**	16	35	31.56	0.72	11.47
M8	**Out**	10	30	25	0.37	3.73
M9	**Out**	16	30	25.31	0.4	6.32
M10	**In**	21	40	31.43	0.7	14.71
M11	**In**	24	40	26.25	0.51	12.13
M12	**In**	23	45	29.78	0.64	14.76
M13	**In**	14	40	29.29	0.62	8.66
M14	**In**	0	0	0	0	0
M15	**In**	6	30	24.17	0.34	2.06
M16	**In**	6	25	19.17	0.18	1.11
M17	**In**	7	NA	NA	NA	NA
M18	**In**	8	30	23.13	0.31	2.44
M19	**In**	6	30	17.5	0.18	1.07
		4	70	35	1.82	7.27
M20	**In**	10	35	24	0.41	4.14
M21	**In**	10	35	25.5	0.43	4.28
M22	**In**	8	40	29.38	0.64	5.12
M23	**Out**	17	35	23.53	0.36	6.09
M24	**Out**	6	30	25.83	0.43	2.59
M25	**Out**	5	30	23	0.32	1.59
M26	**Out**	13	35	28.46	0.54	7.04
M28	**Out**	6	40	29.17	0.61	3.68
M29	**Out**	10	30	26	0.42	4.2
M30	**Out**	4	20	13.75	0.1	0.42

Table 1. *Summary of 2025 BUV snapper data from the 29 surveyed sites. Site M19 has two records, one for the frame with Max Snapper and another frame for Max Biomass. The Max biomass frame is highlighted in light blue. Cells highlighted in red indicate sites where data was compromised and could not be validated as accurate.*

Table 1 indicates whether sites fall inside or outside the Rāhui boundary. Sites M11 and M12, both within the Rāhui area, had the greatest maximum snapper number recorded, with 24 and

23 snapper, respectively. M12 had the greatest total snapper biomass recorded for a site, with an estimated 14.8kg. No snapper were recorded at site M14, which is located inside the Rāhui boundary.

The maximum snapper length surveyed was 70cm, recorded at site M19, compared to 50cm maximum length recorded in 2024.

Comparison of results between inside and outside of the Rāhui

To facilitate comparison of BUV data year to year, inside and outside protected areas and with other protected areas, the data for the 26 sites was used to calculate means of Max Snapper and Max Biomass. Sites M17, M18 and M30 (shaded red in Table 1) were not used in these calculations to produce the results shown in Figure 3 and Table 2 below. For M19 the maximum Biomass was taken from a frame which differed from the frame where the maximum snapper count was taken. This row of data in Table 1 is shaded grey.

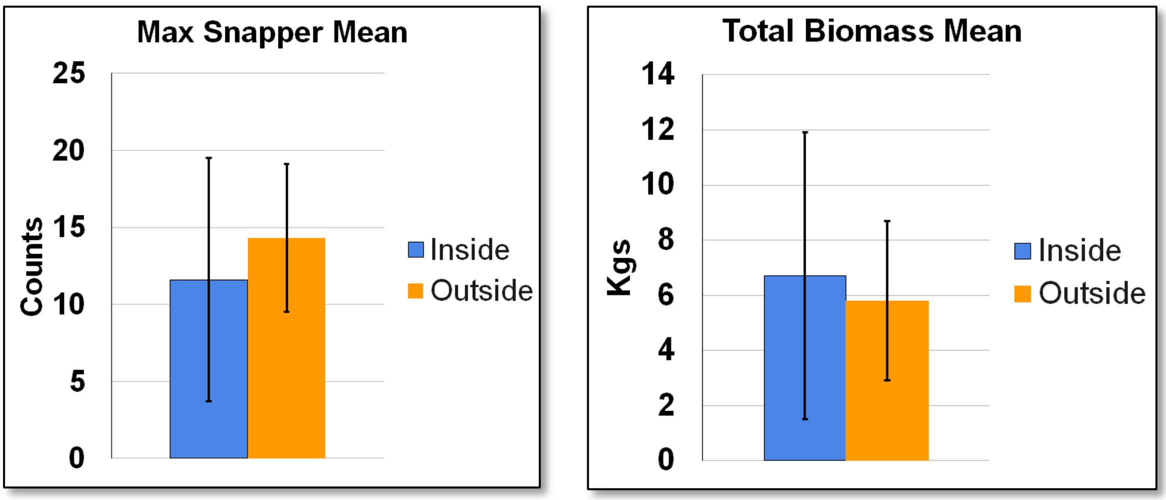

Figure 3 Graph 3a (left) The mean of maximum snapper counts for the 26 BUV sites divided into sites inside and outside the Rāhui. Graph 3a & 3b(right). The mean of the maximum biomass calculations for the 26 sites divided into sites inside and outside of the Rāhui, (Year 2025.) Error bars are for the calculated standard deviation for each group of inside and outside BUV sites.

Comparison between Year 1 (2024) and Year 2 (2025) and inside and out of the Rāhui

Location	Year	Mean MAX Snapper Count	Mean Biomass (kg)
Inside Rahui (n = 11)	**2025**	12	6.7
Inside Rahui	***2024***	*10.23*	*3.95*
Outside Rahui (n = 15)	**2025**	14	5.8
Outside Rahui	***2024***	*5.4*	*1.2*

Table 2. Summary of 2024 & 2025 BUV data showing maximum and mean snapper counts and Biomass inside and outside the Rāhui tapu area of Mimiwhangata, inside Rāhui sites n=11, outside n=15 sites

In comparable no fishing reserves on the Northern East Coast of Northland notably the Maitai Bay Rāhui now in its ninth year and the Leigh Marine Reserve now over thirty years old, snapper numbers in the recovering reserve typically remain low and similar to fished areas. Biomass figures remain low for several years as the fish slowly return to the reserve in the first 1-4 years. Also, fish that have taken up residency on the reefs grow yearly. This trend of recovery in Northland protected area is well documented for Leigh, (Shears and Babcock, 2002), Maitai Bay (Kerr, 2018), Wallace and Kerr, 2024) and for Poor Knights Islands, (Buisson, 2009).

As a rough guide at years 10-15 we could expect the number of snappers to double and the Biomass to more than double and increase as high as 5-7 times the current values because weight of snapper increases exponentially with size and many larger fish will become resident in the Rāhui as well as visiting as transients. With this in mind, the differences we see in our results between year 1 and year 2 between inside and outside the Rāhui are minor in nature and could statistically be explained by sampling variation in the samples making up the calculation of means for the BUV site groups in and out of the Rāhui area. However, as populations of fish increase, we can expect smaller sampling errors and larger increases over time, which will show a very clear trend of growth, especially in Biomass.

Fish biodiversity

A total of 19 fish species were recorded across all 29 BUV sites surveyed (**Appendix 2**), compared to 20 species in 2024. Snapper were the most predominant predator species across all sites. Other notable predator species included kingfish, kahawai, and eagle rays. Sites on rocky reef habitats appear to have higher biodiversity with more reef fish species than sites with sandy substrate, which generally had higher numbers of snapper present. While the increase in biodiversity is comparable to that in 2024, it is too soon to describe this as a trend as there are many site and seasonal variables involved that could account for the relatively small increase in just one year.

Discussion

One of the values of the standardised BUV method is that it allows for comparing predator fish species abundance and Biomass between fished and unfished areas at Mimiwhangata and comparisons with other protected areas. At Mimiwhagnata, there is the added value of BUV monitoring data collected between 2002 and 2006, when the partial protection Marine Park was in effect. This will provide us with the opportunity going forward to compare a partial protection management regime with open fishing to full protection over long time spans which is a unique opportunity in New Zealand and rare internationally.

In our results, even in year 2 of the Rāhui, there is a hint that the Biomass of snapper is increasing. It is expected that this increase will become dramatic in time. This future trend change will mark a turning point for the transition of kina barrens into kelp forests. This, in turn, due to the prime importance of kelp forests ecologically, will lead to other increases in biodiversity and productivity. The presence of large snapper on our reefs is a key requirement for the restoration of kelp forests along with crayfish. Larger snapper and crayfish are primary predators that, amongst other ecological roles, control kina populations, which avoids the situation where kina density and grazing become out of control and kina barrens are formed and maintained. Only the large snapper can physically crush big kina with its jaws. Snapper can be a long-lived species that can grow up to ~100cm in length

Recommendations

We recommend that the BUV monitoring at Mimiwhagnata be continued with the current system. It is one of the best methods for the shallow reef predator fish species and will clearly show trends in fish density and Biomass over time. It has the added advantage that it is relatively inexpensive to achieve yearly monitoring. In the first ten years of the restoration process, it is helpful to continue with annual monitoring because this increases the chances of having a clear, statistically valid record of the trending results due to full protection status. Also, it is unknown just how fast or how large the recovered fish populations will become. The Rāhui is larger than any other reserve in the North Island, and it has a very rich array of habitats, complex exposures, and islands and is large relative to other North Island protected areas. These factors may result in Mimiwhangata performing at a higher level than what we expect of a fully protected area on our coast.

Due to the high interest in the Mimiwhangata Rāhui and its ecological significance to the area, it would now be a good time to thoroughly review the monitoring and research work that is possible for Mimiwhangata. Other methods could be considered for understanding the changes that are taking place in the reef fish community. Just to name two main methods. A snorkel-based timed swim on permanent transects has proved useful at Maitai Bay (Kerr, 2018) and has been carried out each year for the last eight years. At Mimiwhangata, a scuba diver-based random transect method was set up and trialled in 2003 (Usmar et al.). These two methodologies have a list of pros and cons but certainly complement the BUV approach. The two diver-based studies have the added advantage of involving divers spending a lot of time underwater at many locations and observing the reef communities' changes over time. This local knowledge of the people in the water over long periods is arguably some of the most valuable learning opportunities.

Acknowledgments

Ceara Wallace led our field team, with Blair Jones, our skipper, and Hapu assistants Roxy Pene, Holly Hetaraka, and Noel Edwards. With very little 'warm-up,' they got through the work without incident and achieved all the drops planned. While the BUV system and this survey may appear simple, getting all gear working correctly for each drop in the right location for the right amount of time is much harder out on the ocean than it sounds.
Well done to the field crew. Thanks also to the Northland Regional Council team for all its efforts to make the monitoring program happen.

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Appendix 1

Record of the BUV site coordinates, drop date, and time the 29 surveyed sites of the Mimiwhangata Rāhui Tapu and surrounding area.

Wpt	Longitude	Latitude	Drop Date	Drop time
M1	174 27.7860874 E	35 29.2674488 S	10.04.2025	09:19
M2	174 27.8640877 E	35 28.9314488 S	10.04.2025	09:08
M3	174 27.3720876 E	35 28.6074492 S	10.04.2025	09:49
M4	174 27.8400882 E	35 28.4274492 S	10.04.2025	09:59
M5	174 27.4800880 E	35 28.1214490 S	10.04.2025	10:30
M6	174 27.1680883 E	35 27.8514493 S	9.04.2025	14:21
M7	174 26.7900877 E	35 27.8514491 S	9.04.2025	14:13
M8	174 26.6220880 E	35 27.5514493 S	9.04.2025	13:42
M9	174 26.2380885 E	35 27.1614489 S	9.04.2025	13:34
M10	174 26.1000883 E	35 26.9094492 S	9.04.2025	13:05
M11	174 26.5140892 E	35 26.3994495 S	9.04.2025	12:54
M12	174 27.0720897 E	35 26.1234497 S	9.04.2025	12:13
M13	174 26.8380896 E	35 25.8414499 S	9.04.2025	11:40
M14	174 26.2380899 E	35 25.8474498 S	9.04.2025	12:22
M15	174 27.1140899 E	35 25.5894498 S	9.04.2025	11:28
M16	174 27.2520906 E	35 25.1574502 S	9.04.2025	11:04
M17	174 26.8860908 E	35 25.0974501 S	9.04.2025	10:45
M18	174 26.5800907 E	35 25.0674499 S	9.04.2025	-
M19	174 25.5060899 E	35 25.0614494 S	9.04.2025	10:02
M20	174 25.4640903 E	35 25.2294496 S	9.04.2025	09:29
M21	174 24.8520896 E	35 25.4274495 S	9.04.2025	09:20
M22	174 25.0320896 E	35 25.8114493 S	10.04.2025	13:36
M23	174 24.1020890 E	35 25.6914493 S	10.04.2025	13:24
M24	174 23.5200890 E	35 25.5174490 S	10.04.2025	12:57
M25	174 22.8780887 E	35 25.7694489 S	10.04.2025	12:43
M26	174 22.4520883 E	35 25.8414488 S	10.04.2025	12:16
M28	174 22.5480885 E	35 25.5114491 S	10.04.2025	12:06
M29	174 22.7820893 E	35 25.1814489 S	10.04.2025	11:33
M30	174 22.7460895 E	35 24.8814493 S	10.04.2025	11:25

Appendix 2

Summary of fish biodiversity captured on video during the BUV survey at Mimiwhangata in 2025.

	BUV site:																													
Species	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M28	M29	M30	**TOTAL**
Big eye																														**0**
Blue Maomao																				**1**								**10**		**11**
Dwarf Scorpion Fish																														**0**
Eagle Ray			**1**									**1**	**1**							**1**		**1**	**1**					**1**		**7**
Goatfish				**1**	**1**										**1**	**1**	**2**	**1**					**2**		**2**			**2**		**13**
Grey Moray																		**1**												
Hammerhead Shark																														**0**
John Dory	**1**								**1**																					**2**
Kahawai																						**1**								**1**
Kingfish										**1**	**1**													**1**						**3**
Leather Jacket																														**0**
Orange Wrasse															**1**															
Pigfish		**1**		**2**		**1**						**1**			**1**	**2**	**2**	**2**	**1**	**2**			**2**					**1**		**18**
Porae																														**0**
Red Moki		**1**																		**1**										**2**

Species	BUV site: M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M28	M29	M30	TOTAL
Scarlet Wrasse				**1**																										**1**
Snapper	**13**	**18**	**10**	**8**	**5**	**4**	**16**	**10**	**16**	**21**	**24**	**23**	**14**		**6**	**6**	**7**	**8**	**6**	**10**	**10**	**8**	**17**	**6**	**5**	**13**	**6**	**10**	**4**	**304**
Spotty						**1**																								**1**
Sweep		**2**		**3**																					**2**				**9**	**16**
Trevally	**2**		**4**					**2**		**1**			**2**								**1**					**22**	**1**	**4**		**39**
Two-spot Demoiselle															**12**					**4**										**16**
Yellow Moray					**4**	**1**									**1**	**2**													**1**	**9**
Stingray Short Tail				**1**													**1**													
Shark sp unknown														**1**																
TOTAL Biodiversity	**3**	**4**	**3**	**6**	**3**	**4**	**1**	**2**	**2**	**3**	**2**	**3**	**3**	**1**	**6**	**4**	**4**	**4**	**2**	**6**	**2**	**3**	**4**	**2**	**3**	**2**	**2**	**6**	**3**	
TOTAL Fish counted	**16**	**22**	**15**	**16**	**10**	**7**	**16**	**12**	**17**	**23**	**25**	**25**	**17**	**0**	**22**	**11**	**12**	**12**	**7**	**19**	**11**	**10**	**22**	**7**	**9**	**35**	**7**	**28**	**14**	**443**