Tonga Island Marine Reserve,

Abel Tasman National Park

update of biological monitoring,

1993 – 2007

Research, Survey and Monitoring Report Number 484

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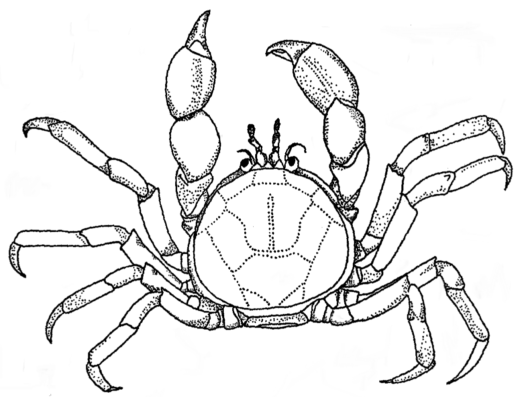

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1.0 INTRODUCTION

A number of studies have documented the impacts of marine reserve establishment in temperate areas of the world (Bell, 1983; McCormick and Choat, 1987; Buxton and Smale, 1989; Garcia-Rubies and Zabala, 1990; Bennett and Attwood, 1991; MacDiarmid and Breen, 1993; Dufour *et al*., 1995; Edgar and Barrett, 1997; Kelly *et al*., 2000; Willis *et al*., 2000, Davidson *et al.*, 2002, Shears *et al*., 2006). Some studies have reported the recovery of populations of particular species (Bennett and Attwood, 1993; Cole and Keuskamp, 1998; Kelly *et al*., 2000), while others have reported mixed responses to the establishment of a marine reserve (Cole *et al*., 1990). Particular studies have considered implications of marine reserve for fisheries management (eg. Hilborn *et al.* 2004). Several reasons have been suggested for the variation in responses to marine reservation. Kelly *et al*. (2000) suggested that failure to demonstrate the effects of protection did not mean that change had not occurred, but may reflect limitations in the sampling methodology and analysis. These authors suggested that limitations in methodology and survey design rendered conclusions from many of the published studies in temperate marine reserves questionable.

Most studies investigating temperate marine reserves have been conducted over relatively short time scales, while others have investigated only a small number of sites inside and outside these reserves. Few studies have extended beyond three years, with on-going funding being the principal problem. The time frame of university-based student studies may also limit the duration of such marine reserve investigations.

Problems in detecting the impacts of marine reserve establishment have been further compounded by the mixed responses that occur in species or communities (Cole, 1994; Willis *et al*., 2000). Based on temperate marine reserve studies, it is clear that the same changes will not necessarily occur in all reserves, or perhaps any two reserves. For example, MacDiarmid and Breen (1993) reported conflicting results for spiny lobsters (*Jasus edwardsii*) at two marine reserves and three control locations in north-eastern New Zealand. Results from the marine reserve areas revealed highest densities in one marine reserve and lowest densities in the other. The authors concluded that low abundance in the second reserve was probably due to a lack of suitable habitat and its location with respect to the continental shelf and major currents.

The present study is the continuation of an on-going monitoring programme investigating the impact of a marine reserve (i.e. removal of fishing) at Tonga Island Marine Reserve (located centrally along the Abel Tasman National Park coastline) (see Map 1). To date, data has been collected over a period of 15 years from Tonga Island Marine Reserve and adjacent control sites (Davidson 1999, 2001, present study). The baseline monitoring study was conducted in December 1993, with another sampling event in December 1994. These results were presented by Davidson in 1999, with an additional monitoring update report produced by Davidson in 2001. The present biological report presents results from all years (1993 – 2007).

Map 1. Tonga Island Marine Reserve.

Blue cod (*Parapercis colias*) was one of the key species selected for study, primarily because it is a widespread and important recreational fishery resource and it could be studied using established underwater visual methods. In addition, blue cod have been the focus of movement studies locally (Mace and Johnson, 1983; Cole *et al*., 2000) and in southern New Zealand (Carbines, 1998, 1999). Blue cod have also been the focus of fisheries-related research in the Marlborough Sounds (Blackwell, 1997, 1998).

Spiny lobster (*Jasus edwardsii*) was also specifically selected as many studies within and outside New Zealand have shown that this species often responds to protection (MacDiarmid and Breen, 1993; Kelly *et al*., 2000; Davidson *et al*., 2002, Shears *et al*., 2006).

2.0 STUDY AREA

The Abel Tasman coastline and the Tonga Island Marine Reserve are located centrally within Tasman and Golden Bays, Nelson. Tonga Island Marine Reserve was established in November 1993 (Map 1). The reserve is 1835 hectares in size and extends one nautical mile, or 1.852 km, offshore from mean high water. The marine reserve boundaries are from the headland immediately north of Bark Bay to Awaroa Head, and includes the shoreline of all islands and stacks within its boundaries.

The coastline within the marine reserve and to the north and south is next to the Abel Tasman National Park (see Dennis, 1985, for review). This coastline is sheltered from large ocean swells and is predominantly influenced by wind-generated waves which quickly subside with a drop or change in wind direction (Davidson 1992, Davidson and Chadderton 1994). High sediment input from the hill catchments both within and adjacent to this coast (e.g. Motueka River catchment), combined with regular sea-breezes and large tides (4.7 m extreme high tide), maintain water clarity at relatively low levels (approximately 2-8 m horizontal distance). Water temperatures range from 10^{o} C to 22^{o} C (Dix, 1970).

The Abel Tasman intertidal coastline is comprised of rocky shores and headlands interspersed by coarse sand beaches. A number of estuaries are located along this coastline (Davidson 1990). Subtidally, rocky reefs may extend to a depth of 14 m and are bordered by a low gradient soft sediment benthos. Subtidal soft shores are primarily characterised by broken shell and coarse sands with a silt component. Granite boulder and bedrock substrata dominate the Abel Tasman rocky coast. Less than 1% of rocky shores along the National Park coast are composed of limestone (Davidson, 1992, Davidson and Chadderton 1994). Davidson and Chadderton (1994) reported that subtidal communities found on limestone were dramatically different to communities inhabiting granite shores. Sample sites within the present study were confined to granite rock and adjacent offshore sediment habitats located in comparable shore aspects and depths.

3.0 SAMPLING SUMMARY SINCE 2001

Data collected in relation to the Tonga Island Marine Reserve has been presented in two previous reports (Davidson, 1999, 2001). This report presents data from 2001 through to 2007 and provides comparisons over the entire sampling period since 1993. The location of sites sampled since 2001 are presented in Table 1 and Figures 1-6. Sampling history is summarised in Table 2. Coordinates for sites sampled prior to 2001 but not sampled since 2001 are presented in Davidson (1999, 2001).

Table 1. Reef fish and lobster sites sampled since 2001 (shore profiles sampled 2001 only).

Type	Coordinates	Location	Treatment	Substratum
Reef fish	40 47.05806,172 59.90864	Separation Point, 1	Control	Boulder, cobble
Reef fish	40 48.22062,173 00.59191	Totaranui north, 2	Control	Bedrock
Reef fish	40 48.92921,173 01.00318	Totaranui Reef, 3	Control	Bedrock
Reef fish	40 51.12408,173 02.62163	Awaroa, 4	Control	Bedrock, boulder
Reef fish	40 51.15995,173 02.77066	Canoe Bay, 5	Reserve	Boulder, cobble
Reef fish	40 51.39304,173 03.44764	Abel Head, 6	Reserve	Boulder, cobble, bedrock
Reef fish	40 51.72980,173 03.67184	Cottage Loaf, 7	Reserve	Boulder, cobble, bedrock
Reef fish	40 53.10127,173 03.51041	Reef Pt. 8	Reserve	Bedrock, boulder
Reef fish	40 53.45573,173 04.13343	Tonga Is. 9	Reserve	Bedrock, boulder
Reef fish	40 54.23512,173 03.74018	Foul Pt. 10	Reserve	Bedrock, boulder
Reef fish	40 54.58073,173 04.14347	Whale Rock, 11	Reserve	Bedrock, boulder
Reef fish	40 55.10164,173 04.30913	Bark Bay Reef, 12	Control	Boulder, cobble, bedrock
Reef fish	40 56.35684,173 03.70098	Totara Rocks, 13	Control	Bedrock, boulder
Lobster	40 47.05806,172 59.90864	Separation Point, 1	Control	Boulder, cobble
Lobster	40 51.12408,173 02.62163	Awaroa, 2	Control	Bedrock, boulder
Lobster	40 51.27420,173 02.94736	Canoe Bay, 3	Reserve	Bedrock, boulder
Lobster	40 51.70603,173 03.66512	Cottage Loaf, 4	Reserve	Boulder, cobble, bedrock
Lobster	40 53.43768,173 04.13356	Tonga Is. 5	Reserve	Bedrock, boulder
Lobster	40 54.23333,173 03.75072	Foul Pt. 6	Reserve	Bedrock, boulder
Lobster	40 54.58073,173 04.14347	Whale Rock, 7	Reserve	Bedrock, boulder
Lobster	40 55.10164,173 04.30913	Bark Bay Reef, 8	Control	Boulder, cobble, bedrock
Lobster	40 56.28063,173 03.74358	Totara Rocks, 9	Control	Bedrock, boulder
Shore profile	40 46.92579,172 59.81331	Separation Pt. (north), 1	Control	Bedrock, boulder, sand, shell
Shore profile	40 47.04179,172 59.90323	Separation Pt. 2	Control	Bedrock, boulder, sand
Shore profile	40 48.67368,173 00.81487	Totaranui, 3	Control	Bedrock, cobble, sand
Shore profile	40 51.09813,173 02.66039	Awaroa Head, 4	Control	Bedrock, boulder, sand, shell
Shore profile	40 51.45515,173 03.48456	Brereton Cove, 5	Reserve	Bedrock, boulder, sand, shell
Shore profile	40 53.33155,173 03.98949	Tonga Is. 6	Reserve	Boulder, cobble, sand, shell
Shore profile	40 53.92518,173 03.27818	Onetahuti, 7	Reserve	Boulder, sand
Shore profile	40 54.57867,173 04.16220	Whale Rock, 8	Reserve	Bedrock, boulder, sand, shell
Shore profile	40 55.09445,173 04.30222	Bark Bay Reef, 9	Reserve	Bedrock, boulder, sand, shell

Table 2. Sampling history along the Abel Tasman coastline from 1993 to 2007.

Group	1993	1994	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Reef fish density	+	+		+	+	+	+		+	+	+	+
Reef fish size					+	+	+		+	+	+	+
Lobster density		+	+	+	+		+		+		+	+
Lobster size and sex			+	+	+		+		+		+	+
Benthic quadrats	+					+						
Kina density	+						+					
Kina size	+						+					
Cooks turban density	+						+					
Cooks turban size	+											
Topshell density							+					
Cats eye density	+						+					
Cats eye size	+											
Limpet density							+					
Scallop size and density		+		+				+			+	
Horse mussel density		+		+				+			+	
Shore profiles						+						

Figure 1. Location of reef fish sites sampled from 2001-2007 for reserve (RF) and control (CF) sites along the Abel Tasman coastline.

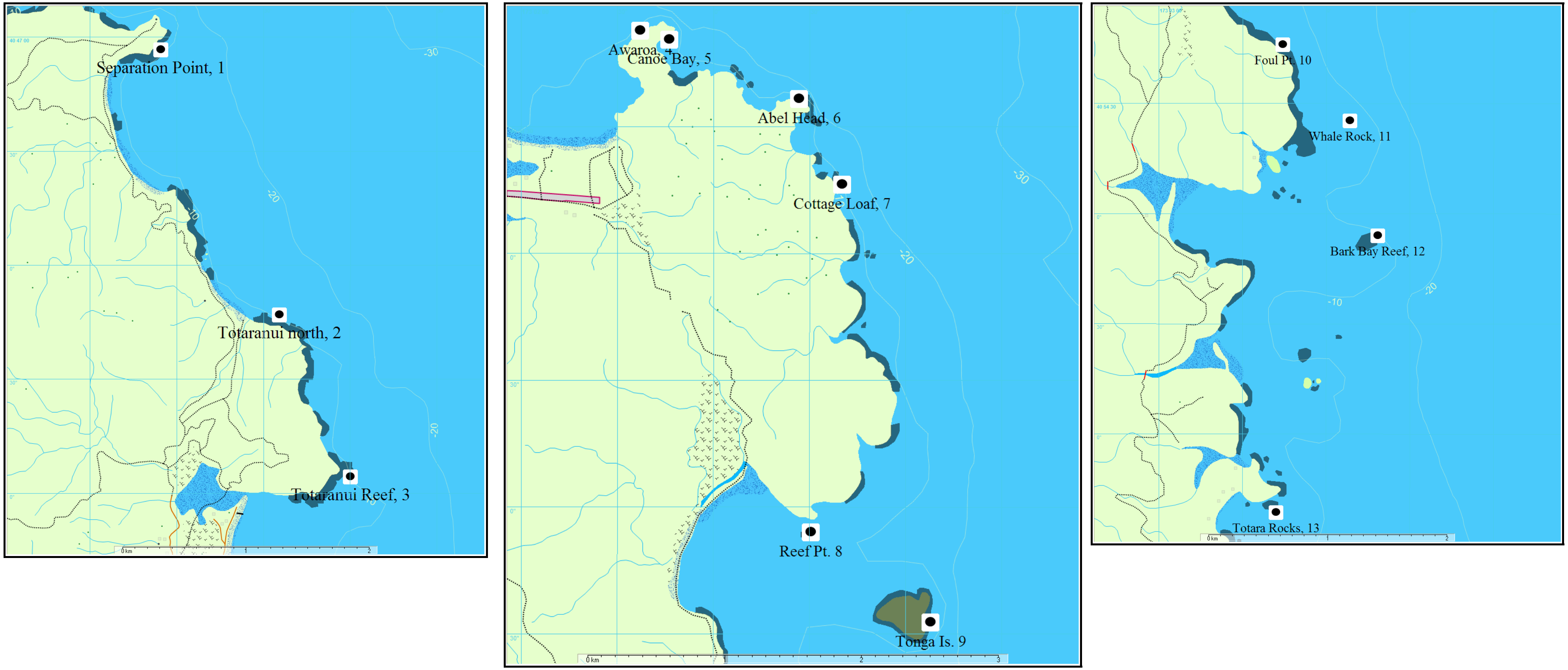

Figure 2. Location of lobster sites sampled from 2001-2007 for reserve (RL) and control (CL) sites along the Abel Tasman coastline.

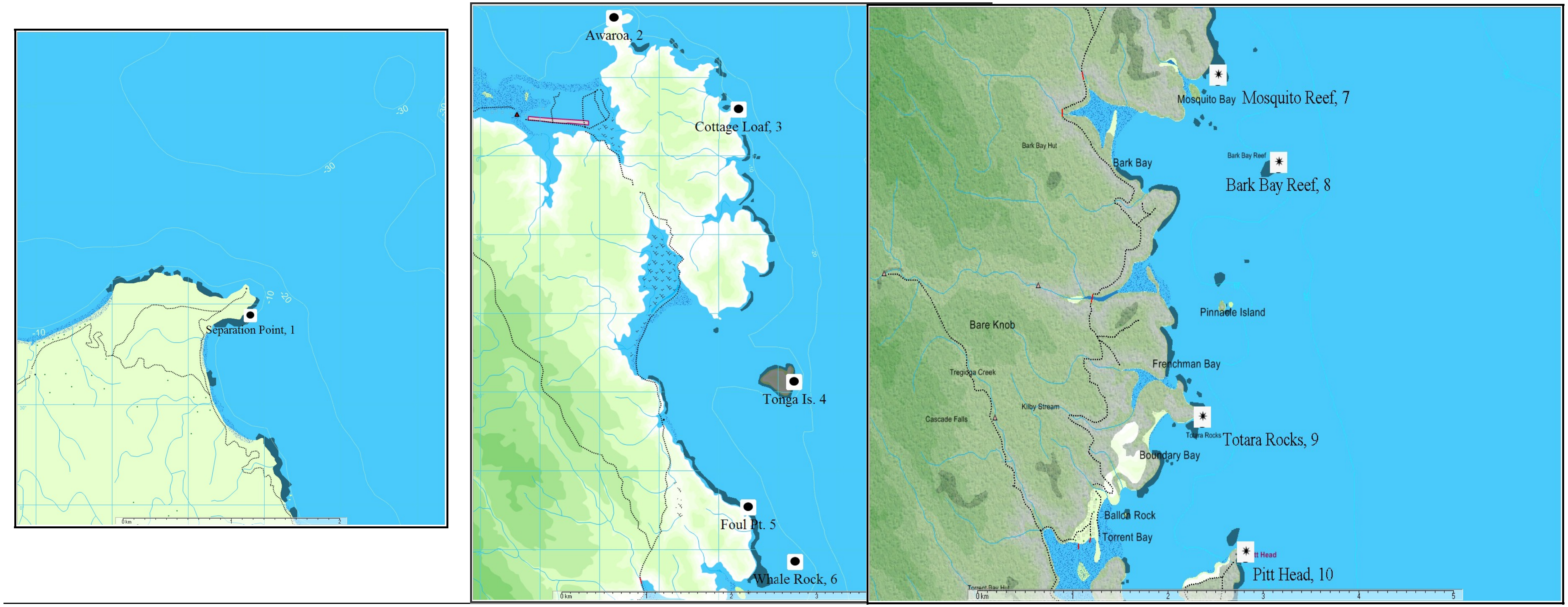

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Figure 3. Location of shore profiles from reserve (RP) and control (CP) sites collected in March 2001 along the Abel Tasman coastline.

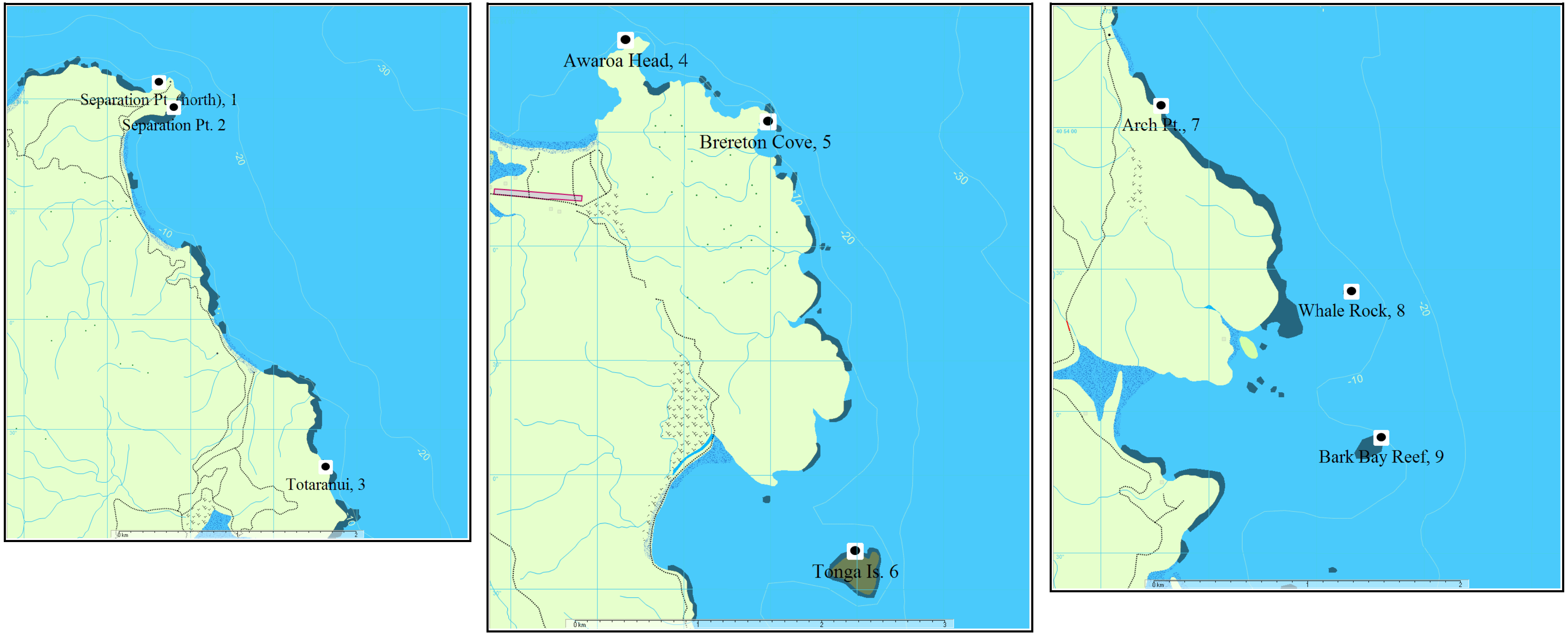


Figure 4. Location of benthic quadrat samples from reserve (RB) and control (CB) in March 2001 along the Abel Tasman coastline.

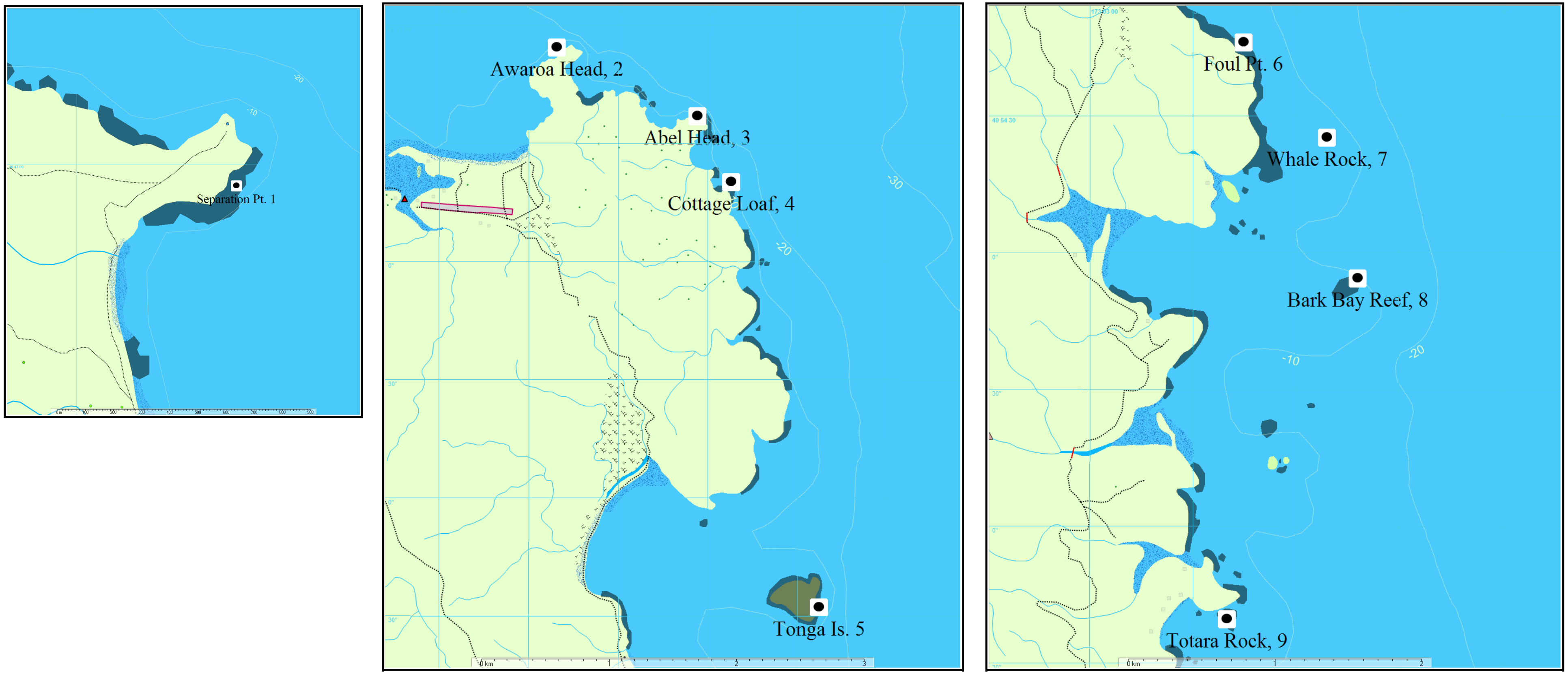


Figure 5. Location of quadrat samples for key species density (kina, Cook's turban, topshell, cats-eye, and limpet) and size (kina) collected in April 2002 along the Abel Tasman coastline.

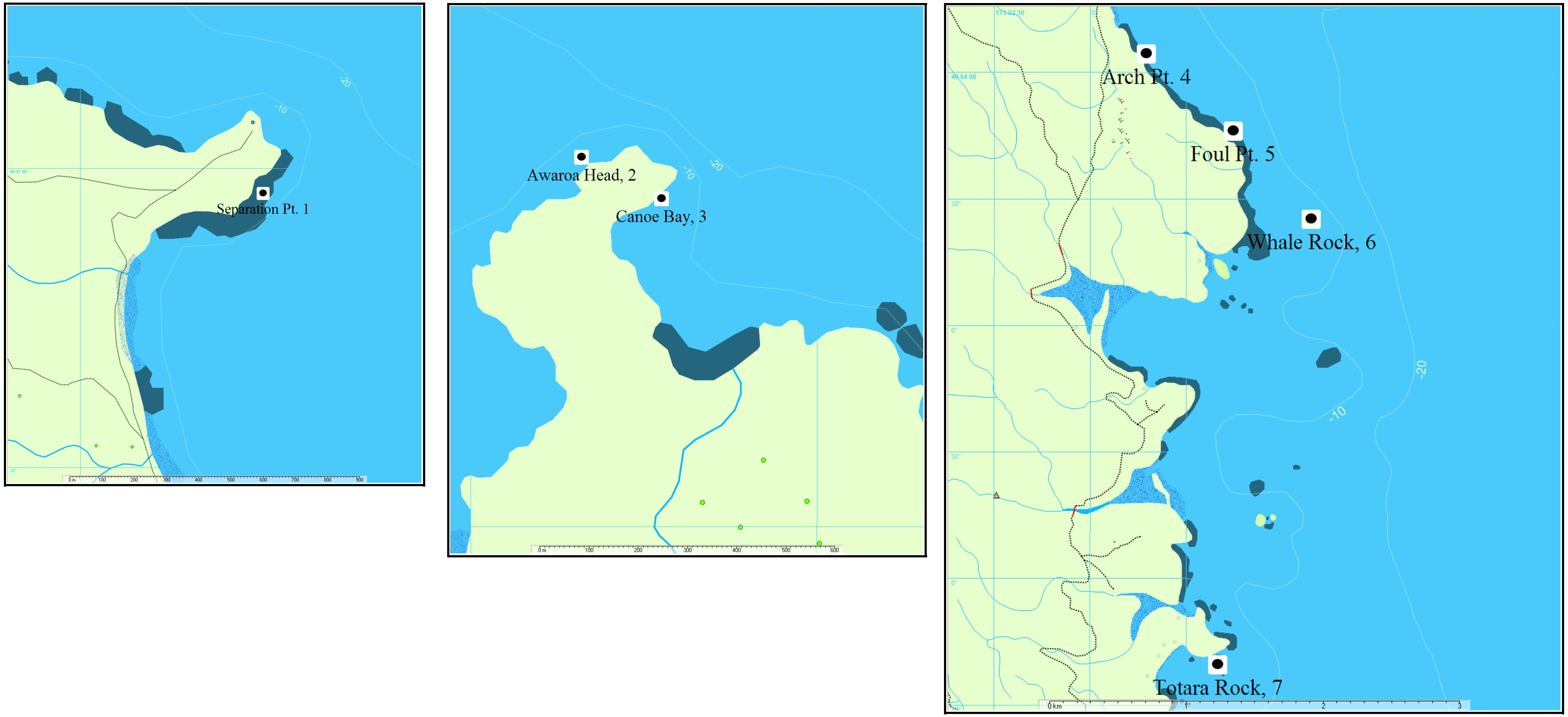


Figure 6. Location of scallop and horse mussel sample sites collected in March 2003 and April 2006 along the Abel Tasman coastline. Note: T2 reserve site was not sampled in 2006.

4.0 MATERIALS AND METHODS

4.1 Fish density derived from underwater visual transects

Blue cod and other reef fish abundance were investigated using established underwater visual transect methods (Bell, 1983; McCormick and Choat, 1987; Choat *et al*., 1988; Buxton and Smale, 1989; Cole *et al.,* 1990; Cole, 1994; Willis *et al*., 2000).

All transects were established parallel to shore in boulder and reef habitat at depths from 5 m to 12 m. Blue cod sizes were estimated by divers to the nearest centimetre of body length. In most years, lengths of other reef fish such as blue moki, red moki, tarakihi and butterfish were also recorded. Divers recorded the presence and density of other reef fish, excluding triplefins and cave- and crevice-dwelling species. Diver estimation of blue cod size was standardised using plastic model fish, the sizes of which were validated underwater prior to fieldwork.

At each site, a lead weight at the start of the transect line was dropped onto the substrate within the designated depth range. The line was automatically reeled off a spool as the diver holding the spool swam away from the lead weight. At a distance of 5 m from the weight (indicated by a marker on the line), the diver started counting fish present within an estimated 2 m wide x 2 m high x 30 m long "tunnel". A total of 12 replicates were collected on each occasion. Transects were swum at a constant slow speed, but fast enough to ensure that swimming fish did not overtake the divers. Underwater visibility was at least 4.5 m horizontal distance for the collection of fish transect data.

From 2000 to 2007, divers estimated the length of particular reef fish during the collection of fish density transects (i.e. blue cod, tarakihi, blue moki, red moki, butterfish, and magpie moki). In 2005, additional measurement of reef fish were collected from two reserve and two control sites. At each of these additional samples, two divers estimated reef fish length during 30 minute free swims. Where possible, all fish sighted during the swim were estimated for length.

4.2 Spiny lobster density, sex and size

Spiny lobster density was investigated from a variety of sites located within Tonga Island Marine Reserve and adjacent control sites in December 1994, December 1998, February 1999, May 1999, November 1999, March 2000, December 2000, December 2002, February 2004, April 2006 and February 2007 (Figure 2, Table 1). Lobster data collected between February 1999 and December 2000 were presented in Davidson (2001).

In 1994, density of spiny lobsters was sampled from 30 x 4 m quadrats, with between 3-13 quadrats sampled per site depending on the number of divers available to collect data.

From 1998 onwards, lobster density, size and sex were sampled using 25 x 4 m quadrats (100 m^2), with a total of 10 quadrats per site. Since 1998, quadrats were also depth-stratified so that five quadrats were counted at a depth of 4-7 m and five were counted at 9-11 m at each site. In most years five reserve and five control sites were sampled.

Lobster size estimate methodology also changed over the duration of the monitoring programme. In the 1994 survey, total body length was estimated and grouped into 4 size classes: juvenile (< 150 mm), small (150 – 250 mm), medium (250 – 350 mm), and large (> 350 mm). From 1998 onwards, carapace length (CL) replaced total body length estimates and was estimated to the nearest 5 mm.

Lobster quadrats were haphazardly placed and oriented within the depth stratum. Underwater visibility was at least 2.5 m during all lobster counts. Two divers independently searched all crevices, caves and cracks within each quadrat using a dive torch. The size and sex of lobsters encountered were recorded. A core group of five divers were involved in most of the surveys. The size and sex of some lobsters could not be measured because they were deeply concealed beneath boulders or within caves. As a result, the number of lobsters in density and size data do not correspond.

4.3 Kina density and size

Kina (*Evechinus chloroticus*) density and size data have been collected on two sample occasions (1993 and 2002). Kina were sampled from either rock or rubble habitat free of foliose macroalgae. All kina encountered within quadrats were measured *in situ* using callipers to the nearest 5 mm length.

In 1993 control kina density and size were sampled from a total of nine stations across six sites while reserve kina were sampled from 14 stations across 12 reserve sites. At each station, kina were counted and measured from 34 to 66 haphazard 1 m^2 quadrats collected from predetermined depth ranges (see Davidson 1999 for methods).

In 2002, kina were sampled from a reduced number of sites (i.e. four reserve and three control). Kina data were again collected from within a predetermined depth range (see Appendix 16 for depths), but only one station was sampled at each site. Kina density was determined from a total of sixty quadrats at each site. Where insufficient kina were encountered in quadrats, additional size-frequency samples were collected from adjacent areas by divers thoroughly searching rocky habitats. The maximum width of between 79 to 125 kina were measured at each site.

4.4 Cook's turban size and density

Cook's turban snails (*Cookia sulcata*) density and size measurements were collected in 1993 and 2002.

Snail maximum length (mm) and density were collected from predetermined depth ranges. Snail data were collected from rock or rubble substratum without foliose macroalgae. All snails encountered within the haphazardly deployed $1m^2$ quadrats were either measured and counted. Where sufficient numbers for measurement purposes were not collected from quadrats, additional individuals were measured from adjacent areas by divers thoroughly searching each site. Each Cook's turban was measured using callipers to the nearest 1 mm.

In 1993, snails were measured from a total of 10 stations across six control sites while reserve samples were collected from 12 stations across 11 sites. Between 34 and 176 individuals were measured in 1993.

In 2002, a reduced number of sites were sampled (four reserve and three control). Snail sizes and density were collected from within a predetermined depth range (see Appendix 17 for depths), but only one station was sampled at each site. Snail density was determined from a total of 60 quadrats at each site.

4.5 Cats-eye, topshell and limpet

Cats-eye snail (*Turbo smaragdus*), topshell (*Trochus* sp.) and limpet (*Cellana* sp.) abundance were collected in 1993 and 2002. Invertebrates were sampled from rock or rubble barrens (i.e. no cover of foliose macroalgae).

In 1993 the density of these species were established from 21 to 46 haphazard $1m^2$ quadrats sampled from predetermined depth ranges (see Appendix 18-20 for depths),. In 2002, the density of these species were established from 60 quadrats sampled from four reserve and three control sites.

Cats eye snail sizes were collected in 1993 (Davidson, 1999). Control invertebrates were sampled from eight stations across six sites and seven reserve stations across six sites (see Davidson 1999). In 1993, all cats-eyes encountered within quadrats were measured with additional individuals being measured from adjacent areas when sufficient numbers were not present in quadrats. Cats-eyes were measured *in situ* using callipers to the nearest 1 mm.

4.6 Scallop density and size and horse mussel density

Scallops and horse mussels were counted and the maximum width of scallops measured in March 2003 and April 2006. These data had been previously sampled in December 1994 and September 1999 (see Davidson 2001). The same methodology was used in all years, however in 2003 an additional reserve site was sampled 2003 (Figure 6).

In 2003 and 2006, two control sites located in Bark Bay (Bark Bay centre and Bark Bay north). In 2006 two reserve sites were located in Tonga Roadstead (Tonga north-west and Tonga south) (Figure 2, Table 1). In 2003 an additional reserve site was sampled in Tonga Roadstead (Tonga north T1).

At each site 10 replicate sets, each consisting of 50 contiguous 1 m^2 quadrats were sampled. Each set of 50 quadrats were deployed by divers instructed to swim at least 10 m distance from the previous set of quadrats. For each set of quadrats divers used a different compass bearing to the previous set to ensure divers remained within approximately 150 m distance of the start point.

5.0 RESULTS AND DISCUSSION

5.1 Underwater visual surveys

Visual fish count data collected from December 2000 to February 2007 have been presented in the present report in Appendices 1 to 7, while fish count data collected prior to December 2000 have been presented in previous reports (Davidson, 1999, 2001).

Divers observed a total of 15 species of reef fish from cobble, boulder and bedrock habitats in the Tonga Island Marine Reserve (Figure 7). Magpie moki (*Cheilodactylus nigripes*) was the only species recorded from control and reserve sites in 2007 but not in 2003. Spotty was the most abundant reef fish on all sample occasions from both reserve and control treatments (Appendices 1-7). Tarakihi abundance varied dramatically between years but was often the next most abundant species after spotty. Blue cod, banded wrasse, scarlet wrasse, sweep, blue moki and goatfish were regularly recorded from both reserve and control sites (Appendices 1-7). Leatherjacket, marblefish, red moki, magpie moki, butterfish and sea perch were recorded sporadically as individual adults. No butterfish were recorded or observed by divers during the study.

Blue cod (*Parapercis colias*) were recorded from pooled reserve and control groups on all sample occasions (Figure 8). Pooled reserve versus control mean density for blue cod (< 300 mm total length) was significantly different between the reserve and control treatments only in April-May 2006 primarily due to a drop in this size of cod at control sites during that year (Table 3). The mean density of small blue cod for the pooled control treatment generally remained low (i.e. below 0.3 individuals per 60 m^2) over the 15 years except for a one sample peak in February 2005.

The density of small blue cod from the pooled reserve treatment increased over the duration of the study and was significantly higher in 2006 compared to at the start of the study (i.e. 1993) (T - -2.67, P< 0.008). Low numbers of large blue cod (≥300 mm length) were recorded on four sample occasions at control sites (December 2000, March 2001, February 2005, April-May 2006). No large blue cod were recorded from the reserve treatment in the first two sample years (Figure 8). The density of blue cod ≥300 mm TL has remained significantly higher at reserve sites compared to the control treatment since December 2000 (Table 3).

Table 3. T-test of density data for two size groups of blue cod for all sample years along the Abel Tasman coast.

Reserve versus control	< 300 blue cod (TL)				> 300 blue cod (TL)			
	T value	P value	Df	Sig.	T value	P value	Df	Sig.
December 1993	-0.7243	0.4698	169	NS	+Inf	0.0	169	NS
December 1994	0.67107	0.50634	37	NS	+Inf	0.0	37	NS
September 1999	0.6726	0.5022	155	NS	1.5173	0.1312	155	NS
December 2000	0.3731	0.7095	154	NS	1.7276	0.0861	154	Sig.
March 2001	1.0358	0.3019	154	NS	1.9722	0.0504	154	Sig.
April 2002	1.1576	0.2488	154	NS	1.6587	0.09921	154	Sig.
February 2004	1.5077	0.13336	154	NS	4.3700	0.00002	154	Sig.
February 2005	0.8525	0.3952	154	NS	3.5593	0.00049	154	Sig.
April-May 2006	-2.3388	0.0206	154	Sig.	-2.4779	0.01429	154	Sig.
February 2007	-1.1498	0.2519	154	NS	-3.74409	0.00026	154	Sig.

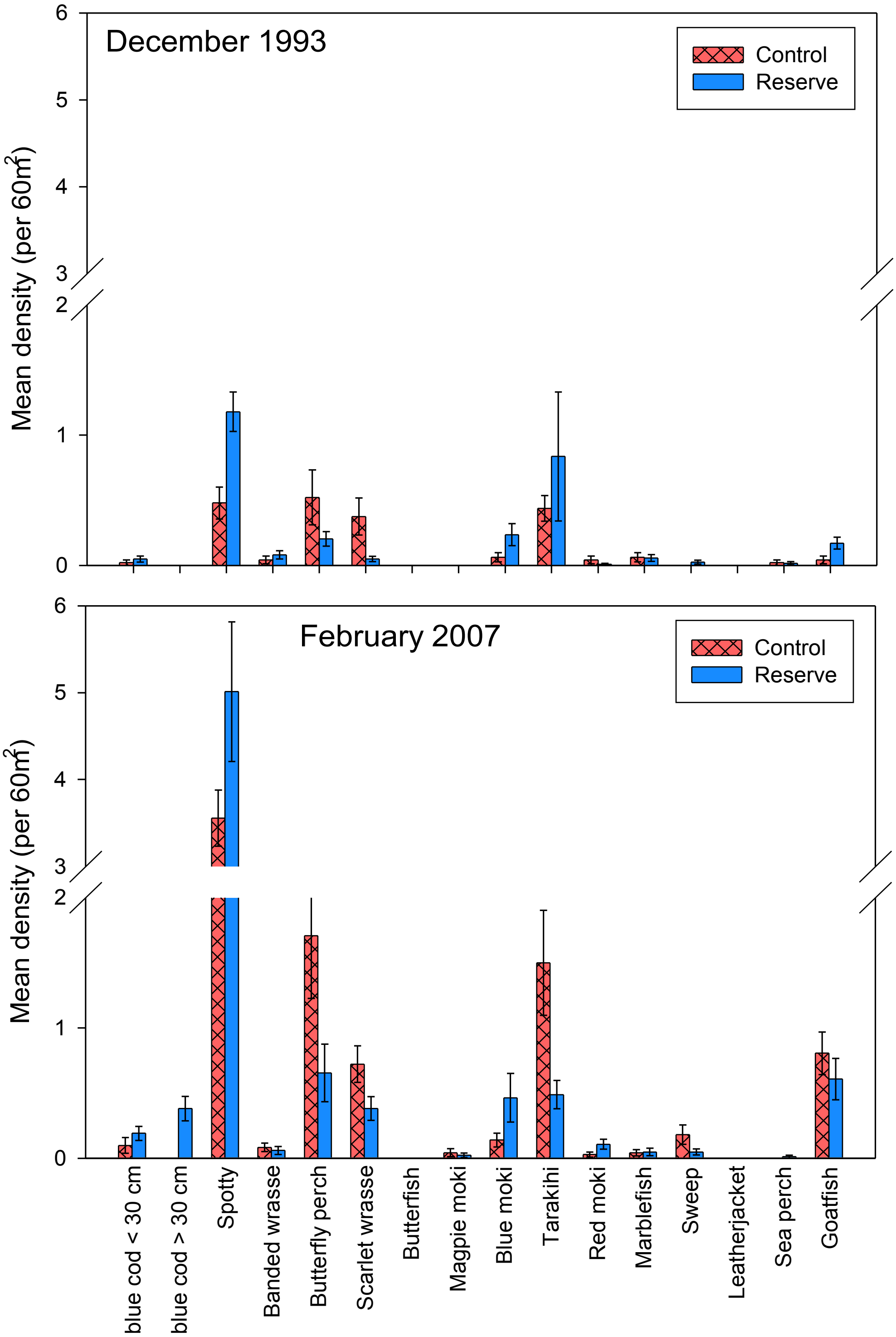
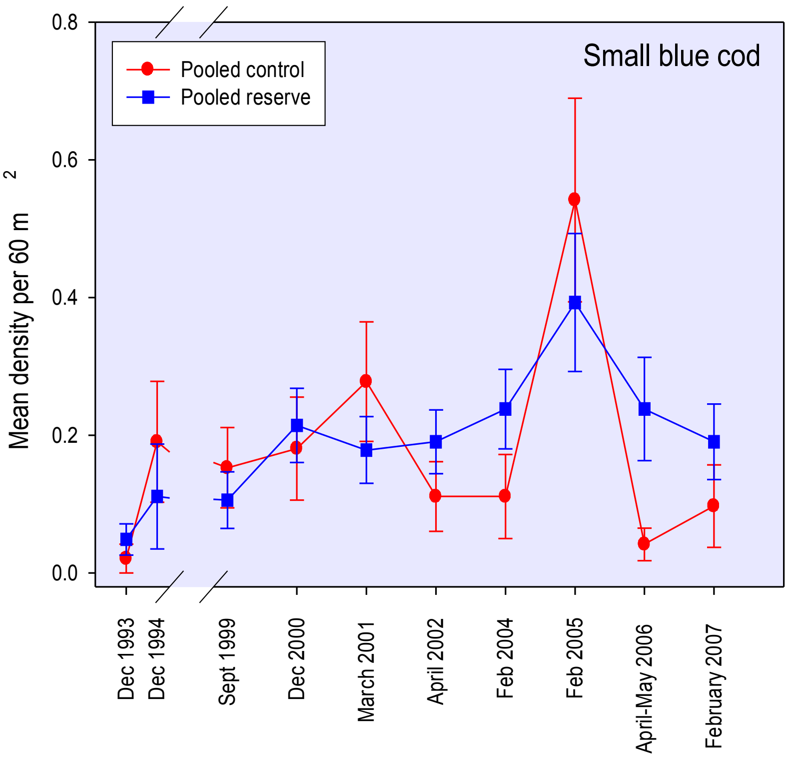


Figure 7. Mean densities of all reef fish sampled in December 1993 and February 2007 from pooled reserve (blue) and control sites (red hatched). Error bars are +/- 1 s.e.



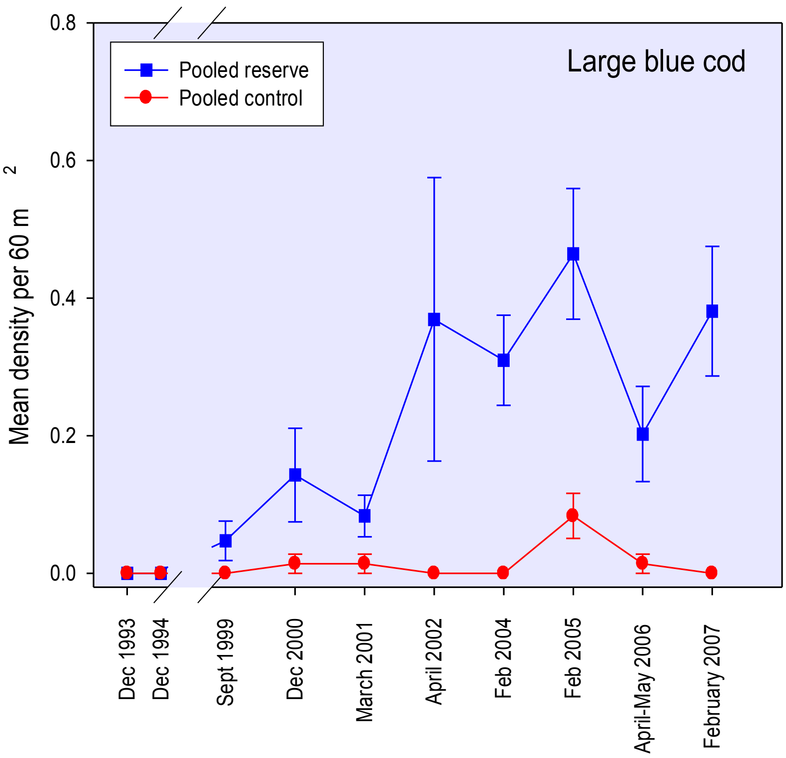


Figure 8. Pooled mean density of blue cod (< 300 mm (small) and ≥300 mm (large)) from all control and reserve sites sampled from 1993 to 2007. Error bars are +/- 1s.e. Large blue cod include 300 mm individuals. Note x-axis time sale is not regular.

Spotty (*Notolabrus celidotus*) were recorded from both treatments in all years (Figure 9). Little difference between the pooled reserve and control treatments was recorded in each sample year. Spotty density, however, varied between years generally increasing at both treatments over the duration of the study, peaking in April-May 2006. Significantly more spotty were recorded in April-May 2006 than December 1993 (reserve, $T = 7.024$, $P < 0.00001$; control, $T = 5.415$, $P < 0.00001$). The reason for this increase is unknown and unlikely to be related to the reserve establishment as it has occurred in both treatments.

Tarakihi (*Nemadactylus macropterus*) were recorded from both treatments in all years (Figure 9). Tarakihi abundance varied considerably between years, with peaks recorded in December 1994, December 2000, February 2005 and February 2007 (Figure 9). Very low densities were recorded for both treatments in September 1999, April 2002 and April-May 2006. Both pooled reserve and control treatments followed similar trends over the duration of the study with relatively small differences between the treatments. During the peaks, however, the pooled mean density of tarakihi was consistently higher at the control treatment compared to the reserve treatment. Tarakihi abundance showed no overall increase or decrease over the duration of the study, instead it was characterised by highs and lows. This pattern appeared independent of reservation and occurred in both reserve and control areas.

Apart from December 1994, the abundance of blue moki (*Latridopsis ciliaris*) has been higher from the pooled reserve group compared to the control treatment throughout the study. Blue moki abundance was significantly higher for the pooled reserve treatment from December 2000 onwards, apart from April 2002 and February 2005 (Figure 10, Table 4). The higher density of blue moki from the reserve treatment is probably due to the impact of reservation. The density of blue moki in the reserve treatment at the end of the study was higher than at the start of the study but this difference was not significant due the relatively large statistical variation around the mean ($T=-1.14$, $P=0.256$) (Figure 10).

Red moki (*Cheilodactylus spectabilis*) have not shown any increasing or decreasing trend at either reserve or control treatment (Figure 10). Their densities for both treatments were very low with occasional individuals being recorded at reserve and control sites. No change in their abundance can be attributed to reservation.

The abundance of all other reef fish species were very low and have not been plotted. Of note, however, was the occurrence of magpie moki (*Cheilodactylus nigripes*) in reserve transects in February 2005 and in both reserve and control transects in February 2007 (Figure 7, Appendix 5 and 7). This species seems to be more widespread than in the past and their increased incidence in transects suggests their abundance is also increasing.

Table 4. T-test of density data for blue moki for all sample years along the Abel Tasman coast.

Reserve versus control	Blue moki (TL)			
	T value	P value	Df	Sig.
December 1993	1.5136	0.1319	169	NS
December 1994	1.2350	0.2248	36	NS
September 1999	1.5181	0.1310	155	NS
December 2000	2.8505	0.0049	154	Sig.
March 2001	2.1170	0.0358	154	Sig.
April 2002	1.1370	0.2573	154	NS
February 2004	2.5776	0.0109	154	Sig.
February 2005	1.0688	0.2868	154	NS
April-May 2006	2.0820	0.0389	154	Sig.
February 2007	-1.567	0.1192	154	NS

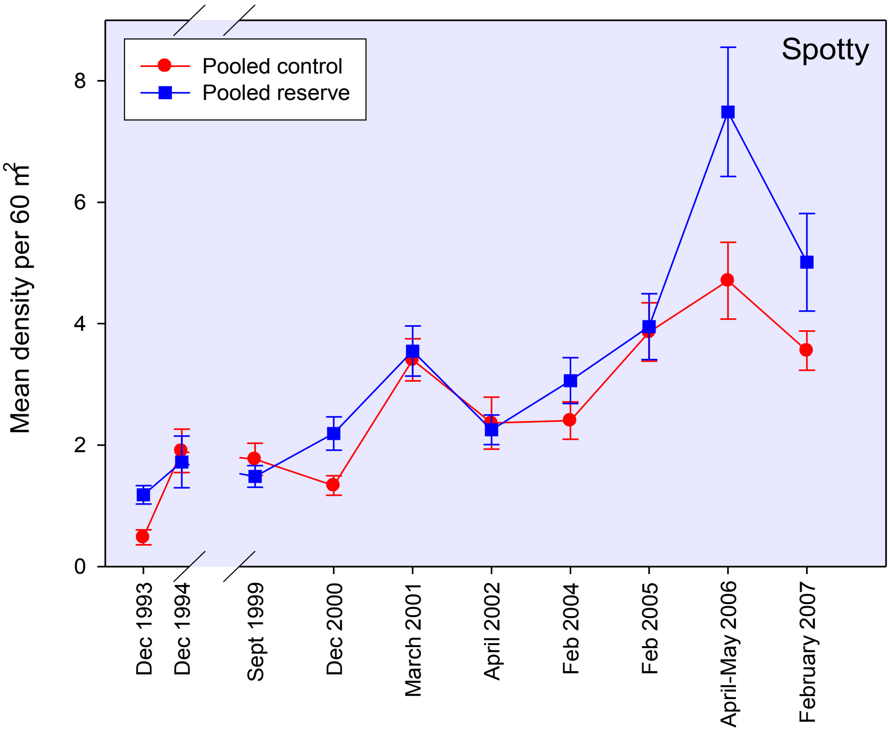
Since December 2000, divers have estimated blue cod length during underwater visual fish counts (Figure 11). Blue cod mean size at pooled reserve sites has gradually climbed over the six year period from an average of 27.06 cm in December 2000 to 31.3 cm in February 2007. The mean size of blue cod from the pooled control treatment remained relatively consistent starting at 22.7 cm and ending at 22.8 cm but with a noticable drop in February 2004. On all sample occasions, the mean size of blue cod was higher from the reserve treatment than the control treatment (Figure 11). Size-frequency histograms of blue cod from pooled reserve and control treatments show that large cod were very noticable in the reserve from April 2002 onwards (Figure 12). These large individuals (>34 cm) were rare at the control sites, with only one > 40 cm cod recorded from a control site (February 2005). The existence of these large individuals in the population at reserve sites and not control sites is probably due to the exclusion of fishing from the marine reserve.

The average size of blue moki for the pooled reserve treatment fluctuated over the sample period, but ended significantly higher in 2007 compared to December 2000 ($P = 0.039$, $df = 96$) (Figure 11). At control sites, the average size of blue moki also increased, but always remained below the mean size recorded from the pooled reserve group. Size-frequency histograms of blue moki from pooled reserve and control treatments show that large moki were much more often encountered in the reserve compared to the control area (Figure 13) with few large individuals > 40 cm encountered from control sites. The existence of these large individuals in the population at reserve sites with less at control sites is probably due to the exclusion of fishing from the marine reserve.

Red moki mean size increased at pooled control and reserve treatments over the period that measurements were collected (2000 to 2007). Apart from March 2001 and February 2007, mean size at control sites was below the mean size recorded from the pooled reserve treatment (Figure 14). In December 2000 and February 2004, red moki size was significantly larger in pooled reserve sites than control sites. In March 2001, February 2005 and February 2007, there was little difference between the pooled reserve and control treatments. Overall there has been an increase in red moki size over the duration of the study but as this trend occurred at both reserve and control treatments there is no evidence to attribute these changes to marine reserve protection.

Most tarakihi at both reserve and control sites fell into two size classes (small 7-14 cm and medium 24-30 cm). Small tarakihi were observed in schools from 4 to 50 individuals at depths of 5-7 m for most years. The number of medium size class individuals, however, fluctuated between years with relatively few being observed by divers in some years. Although data were collected in 2000 to 2002, insufficient numbers were measured to include these data in the graph.

Both pooled reserve and control tarakihi mean lengths followed similar trends (Figure 14). Highest tarakihi densities for both reserve and control treatments were recorded from April-May 2006 and February 2007. A small increase in mean size of tarakihi occurred for both reserve and control treatments between February 2004 and 2007.



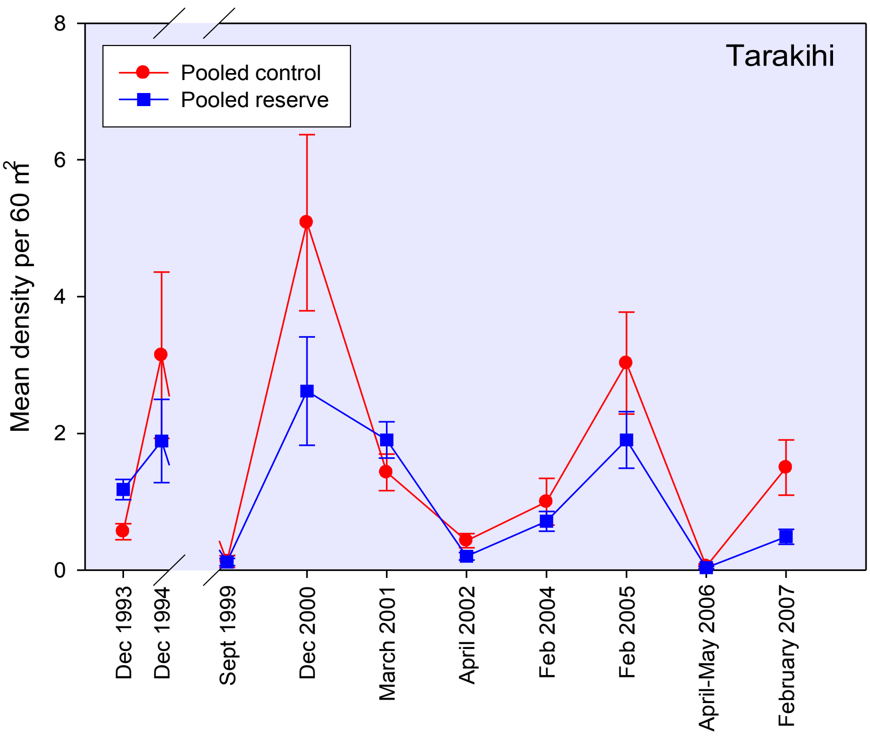


Figure 9. Pooled mean density of spotty and tarakihi from all control and reserve sites sampled from 1993 to 2007. Error bars are +/- 1s.e. Note x-axis time sale is not regular.

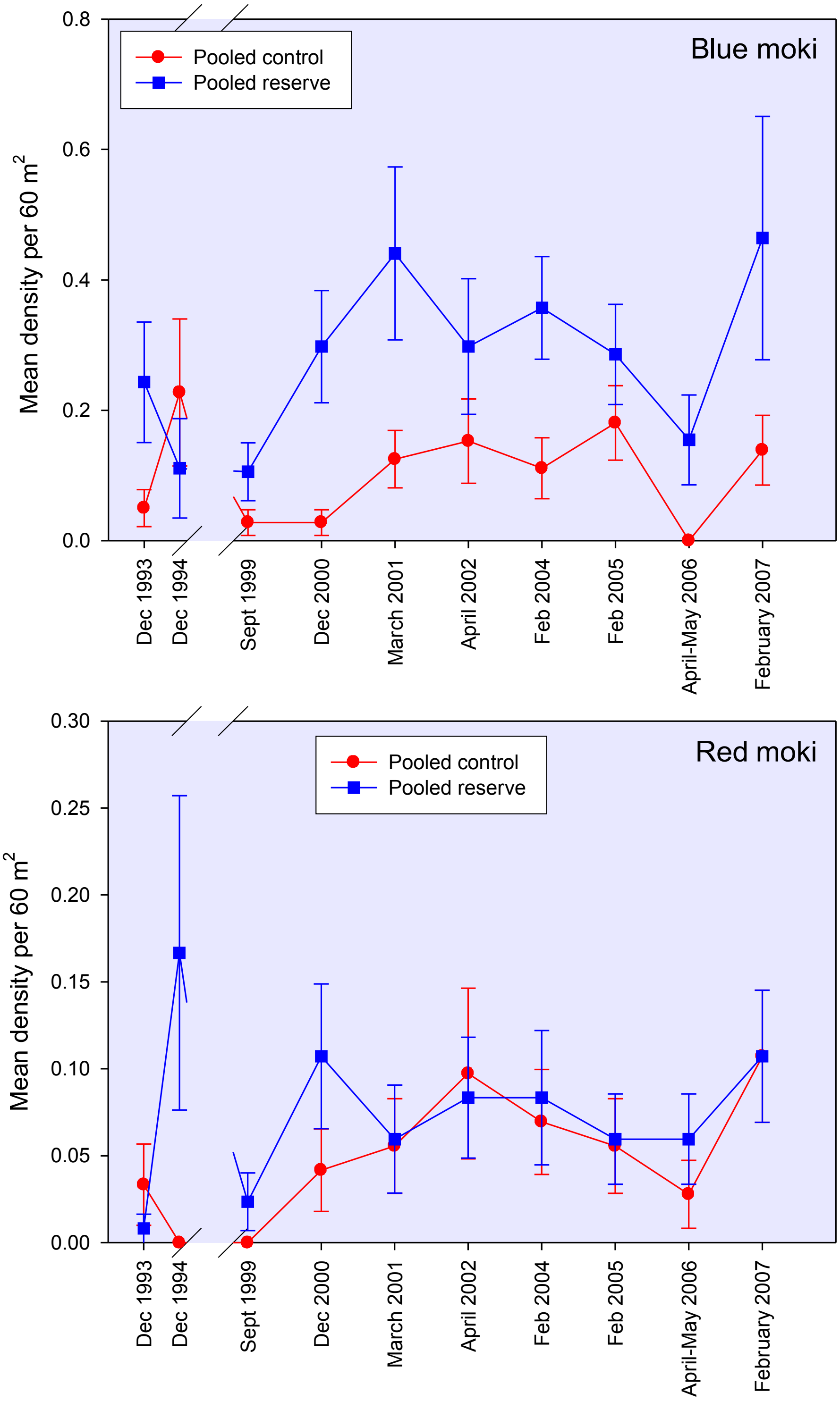


Figure 10. Pooled mean density of blue moki and red moki from all control and reserve sites sampled from 1993 to 2007. Error bars are +/- 1s.e. Note x-axis time sale is not regular.

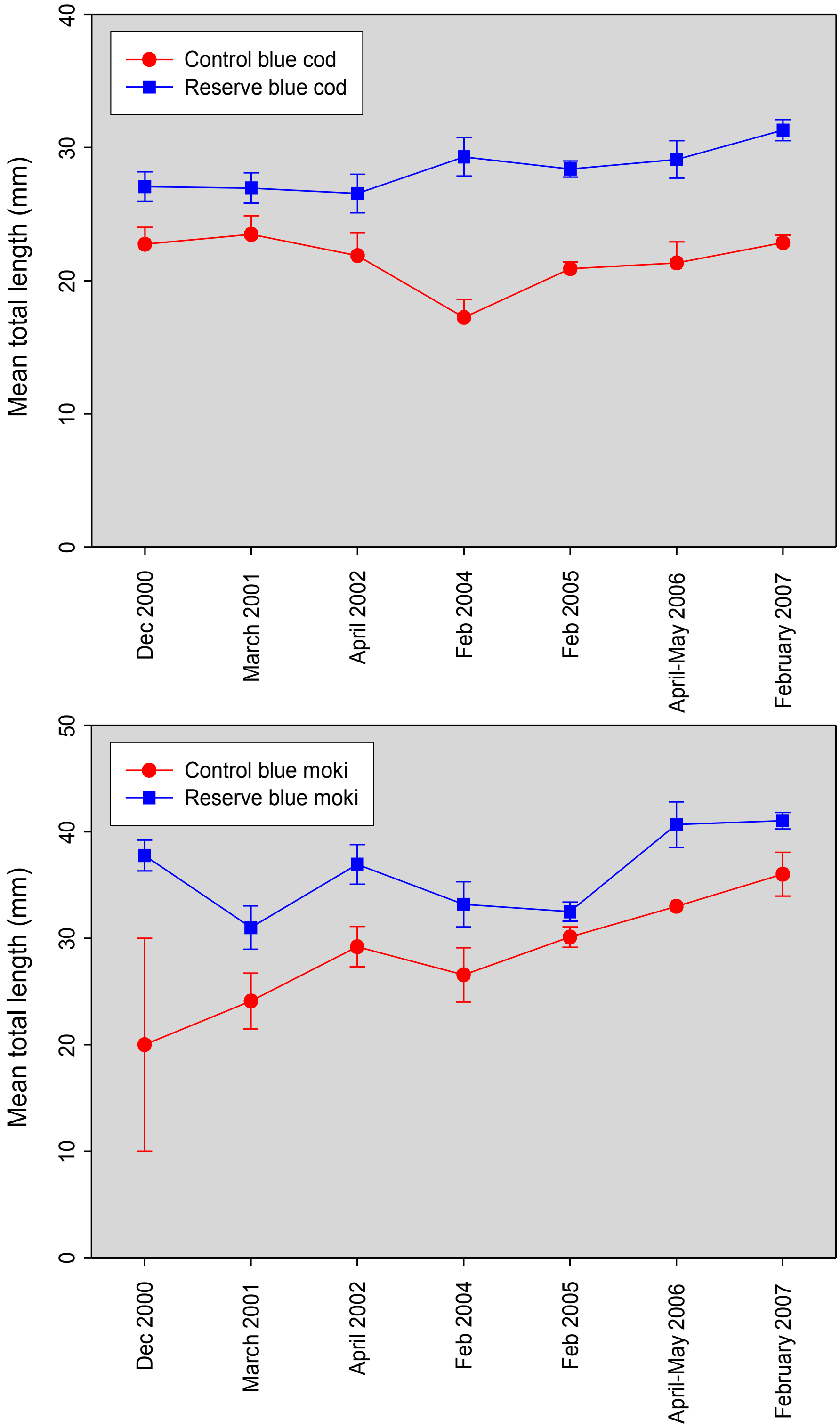


Figure 11. Pooled mean size of blue cod and blue moki from all control and reserve sites sampled from 2000 to 2007. Error bars are +/- 1s.e.

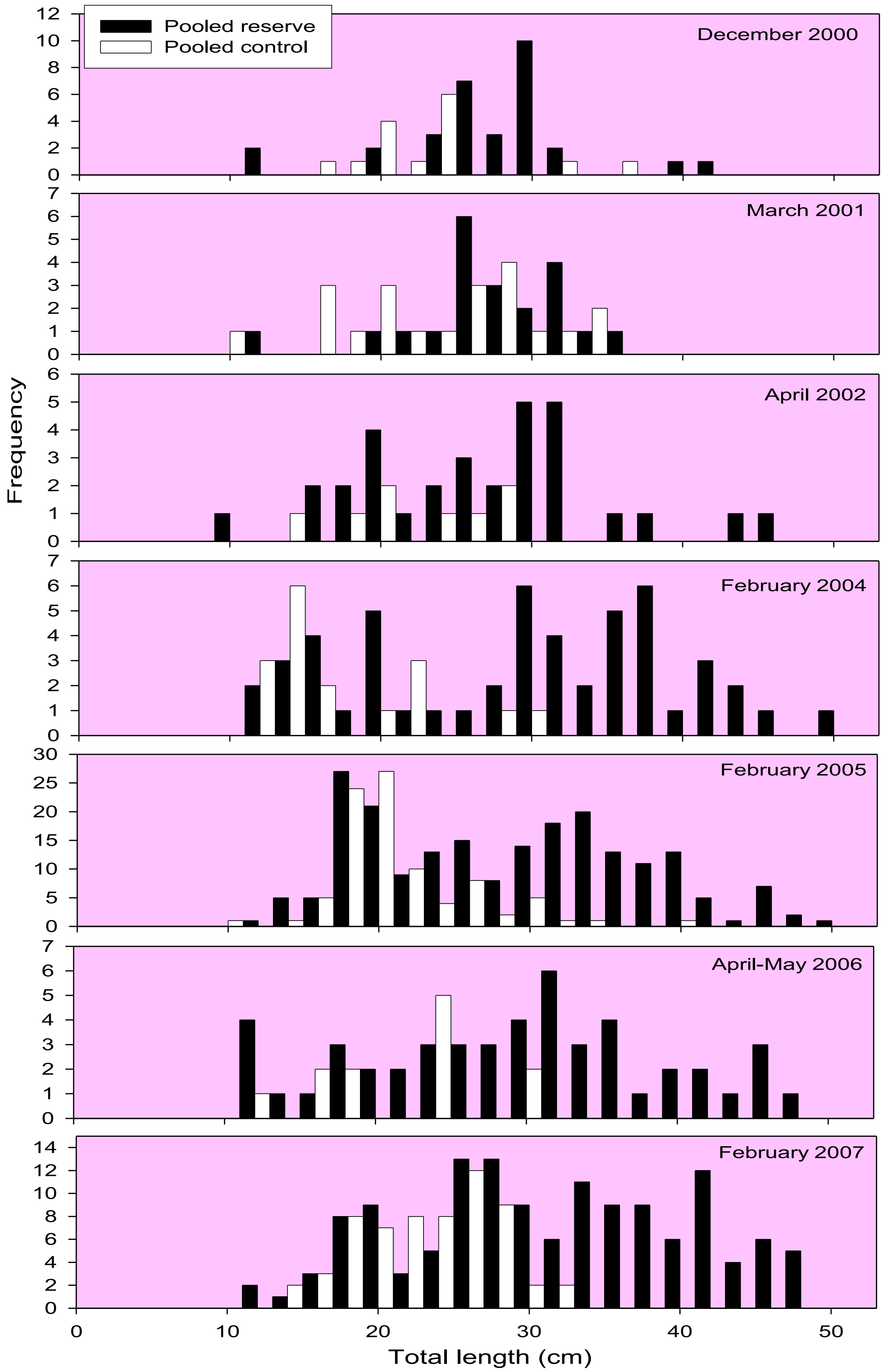


Figure 12. Pooled size frequency of blue cod from pooled control and reserve sites sampled from 2000 to 2007.

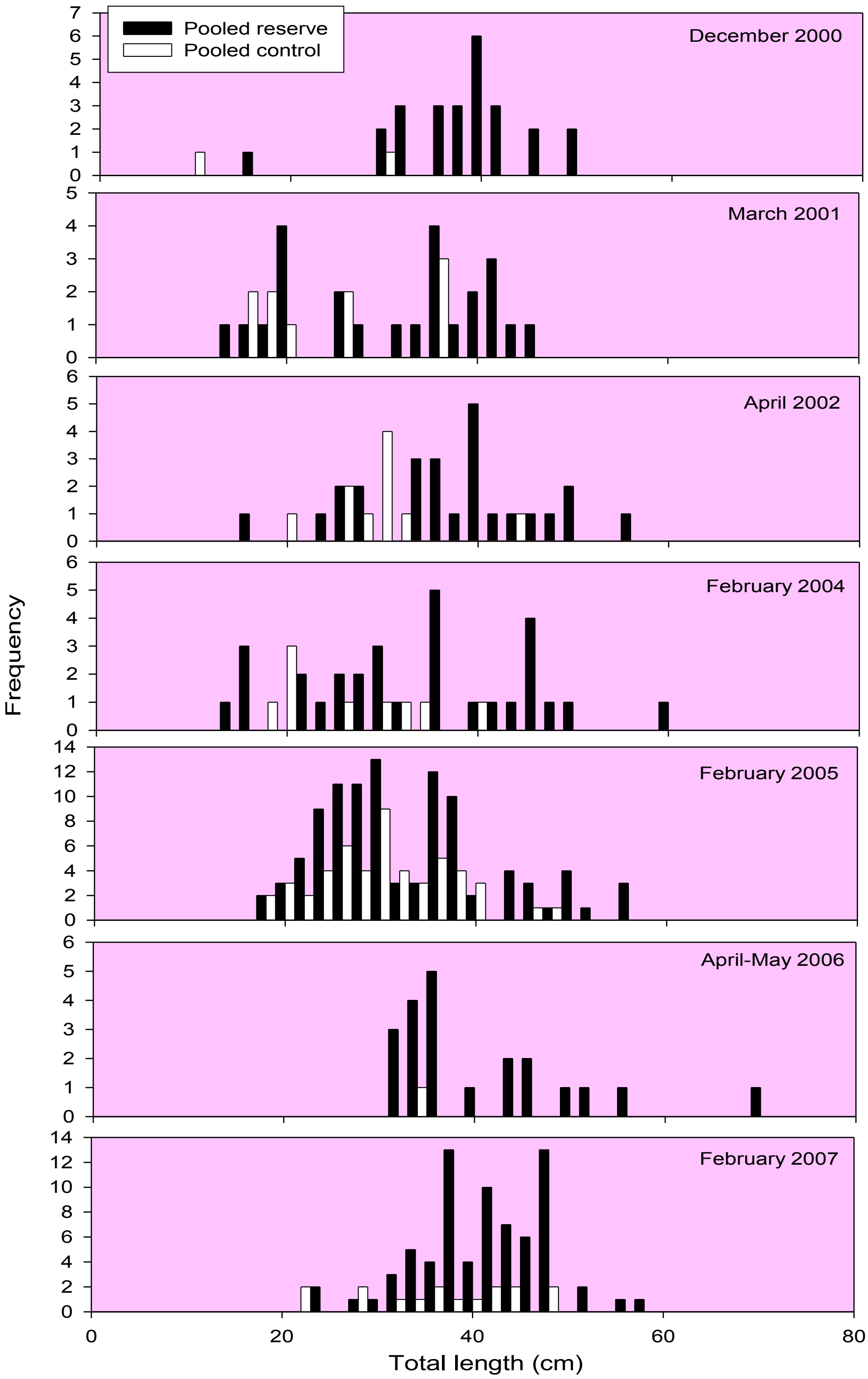
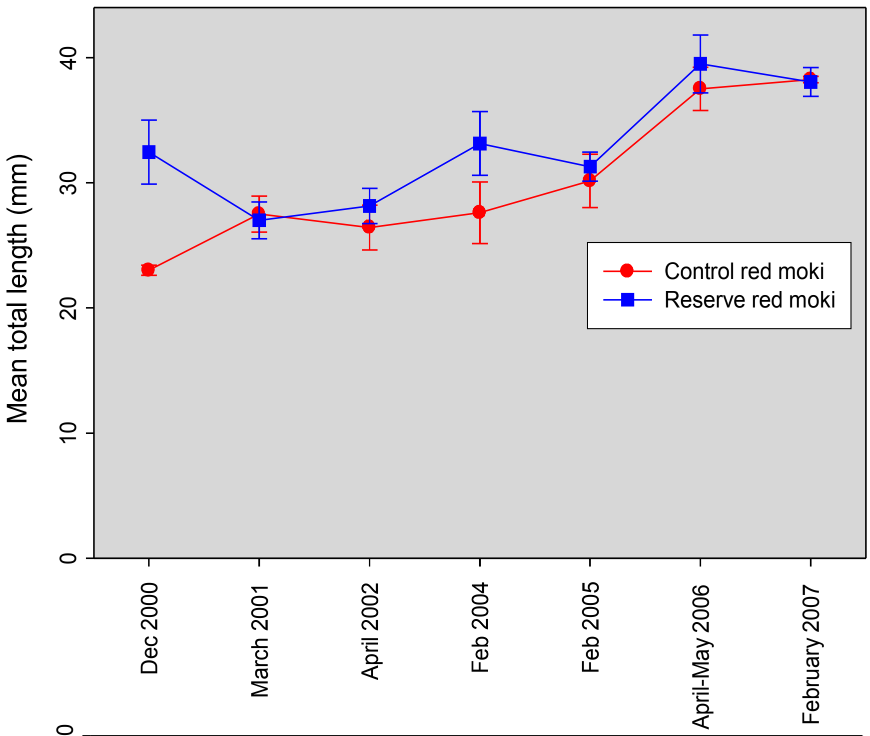


Figure 13. Pooled size frequency of blue moki from pooled control and reserve sites sampled from 2000 to 2007.



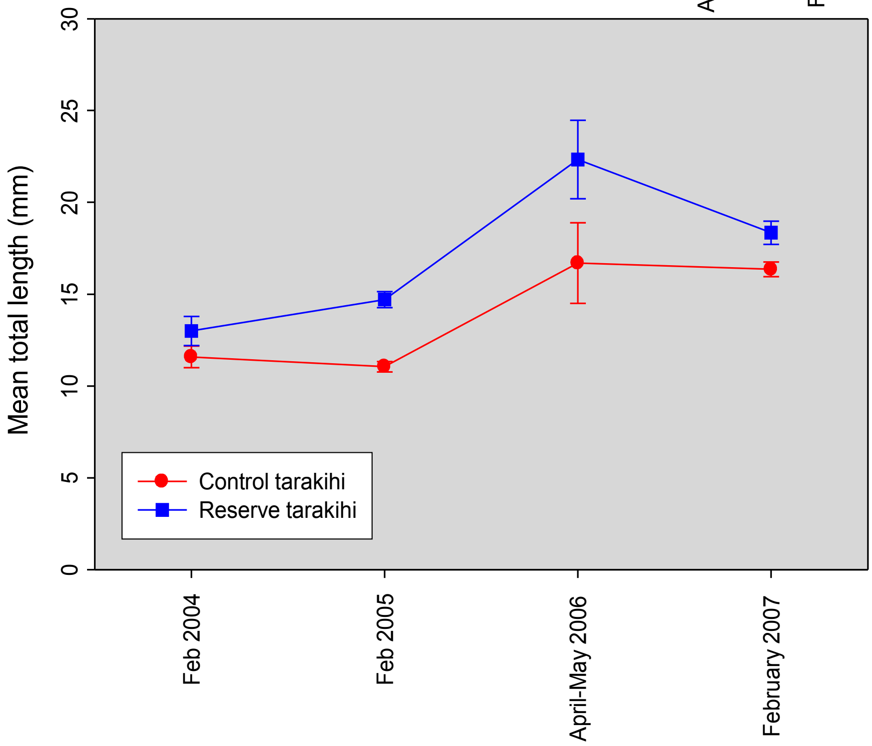


Figure 14. Pooled mean size of red moki and tarakihi from all control and reserve sites sampled from 2000 to 2007 for red moki and 2004 to 2007 for tarakihi. Error bars are +/- 1s.e.

5.2 Spiny lobster density, sex, and size

Lobsters were recorded from boulder or bedrock habitats at reserve and control sites. Rocky habitat was most often located in water < 12 m depth along the length of the Abel Tasman coastline. In some areas, however, rocky substratum ended by < 3 m depth. These very shallow areas were not sampled in the present study due to a lack of suitable lobster habitat.

In shallow quadrats (4-7m), lobster density was consistently higher in the reserve compared to the pooled control sites (Figure 15). Lobster density from the shallow control treatment gradually increased from December 1998, peaking in February 2007. Lobster density from the shallow reserve treatment also increased throughout the study peaking in December 2002 and again in April 2006 (Figure 15).

Similarly, the density of lobsters surveyed from deeper areas (9-11 m) increased in both pooled reserve and control samples from 1994 to 2002. In contrast to the control pooled average densities that declined from December 2002, the average lobster density from the pooled reserve treatment continued to increase to an all time high in February 2007 (Figure 15).

For most lobster size classes a comparison cannot be made between data collected before and after 1998 as the measurement methodology changed from total body length to carapace length. The exception was for juvenile lobsters where the cut-off size for lobster length corresponded to the 85 cm carapace length for juveniles (Figure 16 and Table 5).

The numbers of juvenile lobsters (< 85 cm CL) were comparable for most years between control and reserve treatments (Figure 16). In December 2000 the density of juvenile lobsters peaked in both reserve and control treatments. Juvenile lobsters recorded from this peak grew through to the larger size classes resulting in an increase in mature females and non reproductive males in the reserve from 2004 to 2007 (Figure 16). This increase was also recorded for non reproductive males outside the reserve but was not so pronounced for mature females.

More large reproductive males were recorded in most years from the reserve treatment compared to the control group where they remained relatively uncommon (Figure 16). A dip in the numbers of these large males was recorded from the reserve treatment in November 1999 and December 2002. The reason for this dip is unknown but may be related to movements of large lobsters onshore and offshore. This phenomenon has been recorded for lobsters in other marine reserves in New Zealand (Kelly 2001, Freeman in prep.). Since this dip in numbers, large male lobsters have increased to an all time high in February 2007.

Lobsters > 110 mm CL for 2002, 2004, 2006 and 2007 represented a greater proportion of the population within the reserve compared to the control treatment (Figures 17, 18, 19, 20 and 21). In February 2007, the mean size of lobsters in the pooled reserve group was 18.4 mm larger than the control treatment mean. In 2007, no lobsters > 160 mm CL were recorded from the control treatment. In comparison, lobsters up to 200 mm CL were regularly recorded from the reserve treatment (Figure 21).

Table 5. Sex composition of spiny lobsters sampled in Tonga Island Marine Reserve and control sites (1994 to 2007). Data from quadrats and from additional lobsters observed outside quadrats.

Date	Reserve sites			Control sites		
	Juveniles	Males	Females	Juveniles	Males	Females
	N	N	N	N	N	N
December 1994	26	NA	NA	13	NA	NA
December 1998	14	22	6	0	2	4
February 1999	17	48	26	12	7	4
May 1999	2	39	19	9	2	0
November 1999	23	36	11	15	4	7
March 2000	24	47	40	21	6	3
December 2000	57	37	23	22	11	5
December 2002	83	33	38	51	18	10
February 2004	29	88	36	40	26	13
April 2006	17	137	115	28	33	24
February 2007	41	120	102	20	11	31

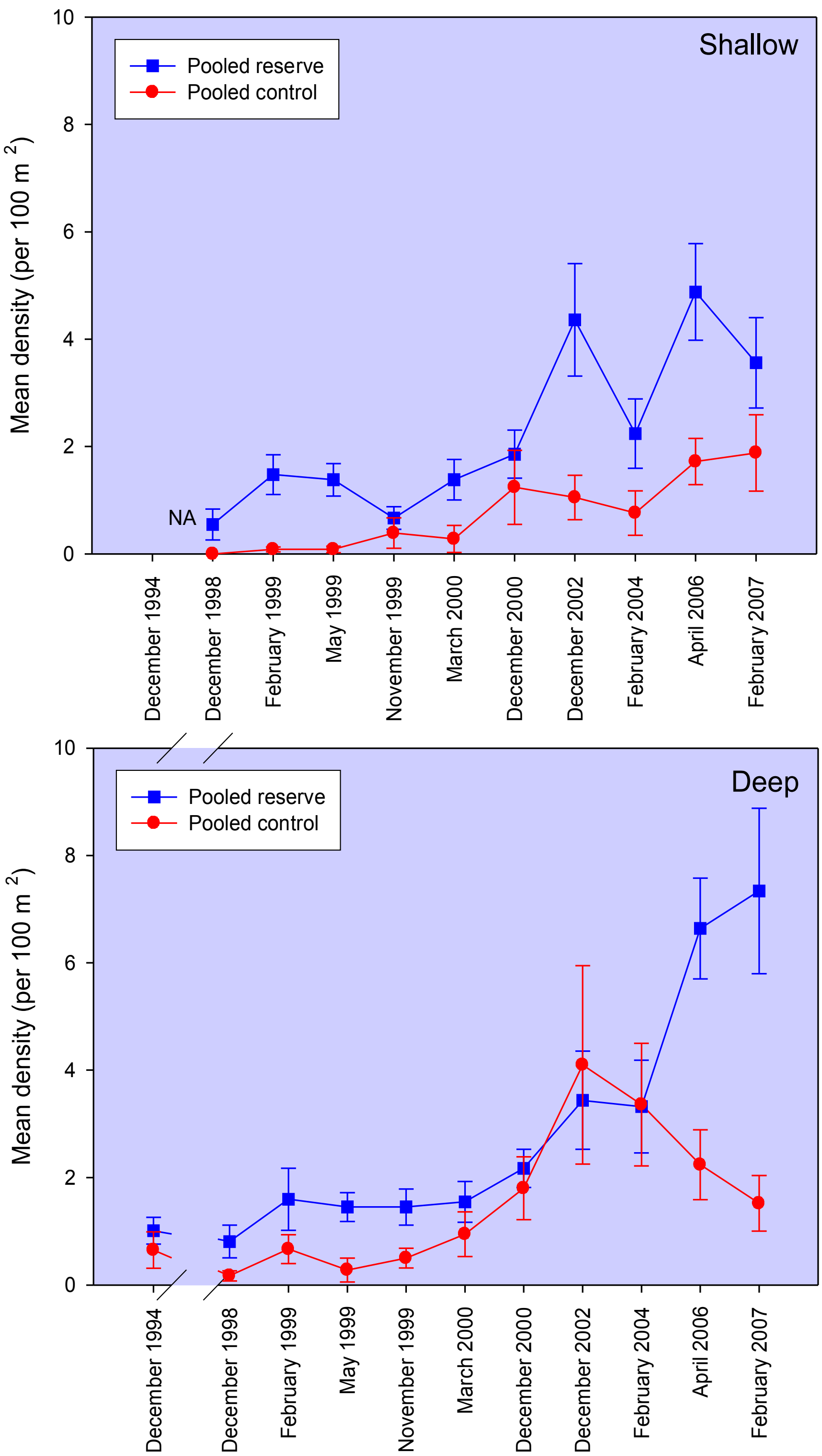


Figure 15. Pooled mean density of lobsters from all control and reserve sites sampled from 1994 to 2007 from deep (10-11m) and shallow (6-7 m) strata. Error bars are +/- 1s.e.

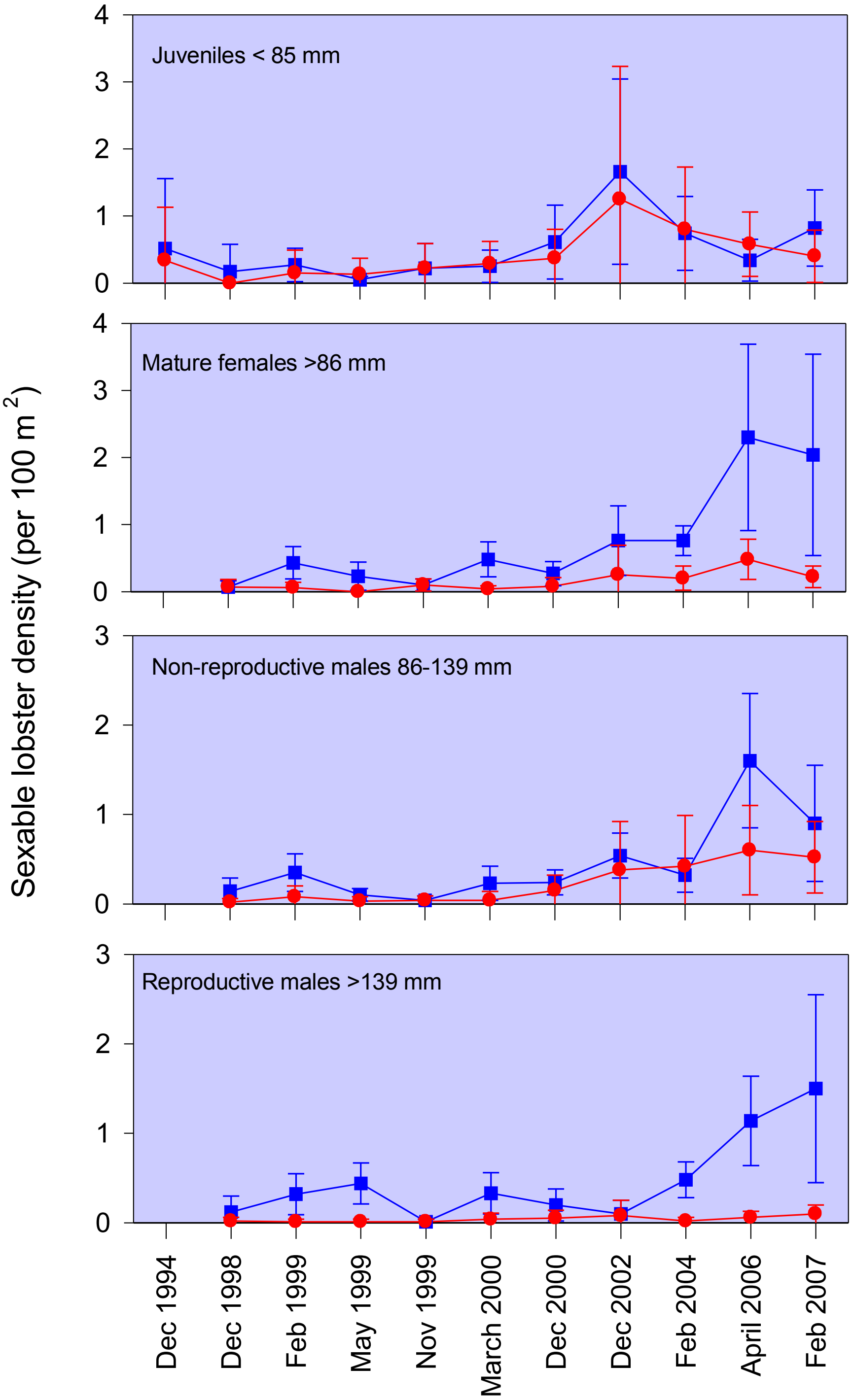


Figure 16. Density of spiny lobster individuals that could be sexed from all control (red circles) and reserve (blue squares) sites sampled from 1994 to 2007. Lobsters have been divided into reproductive classes according to MacDiarmid (1989). Sizes are estimated carapace length (mm).

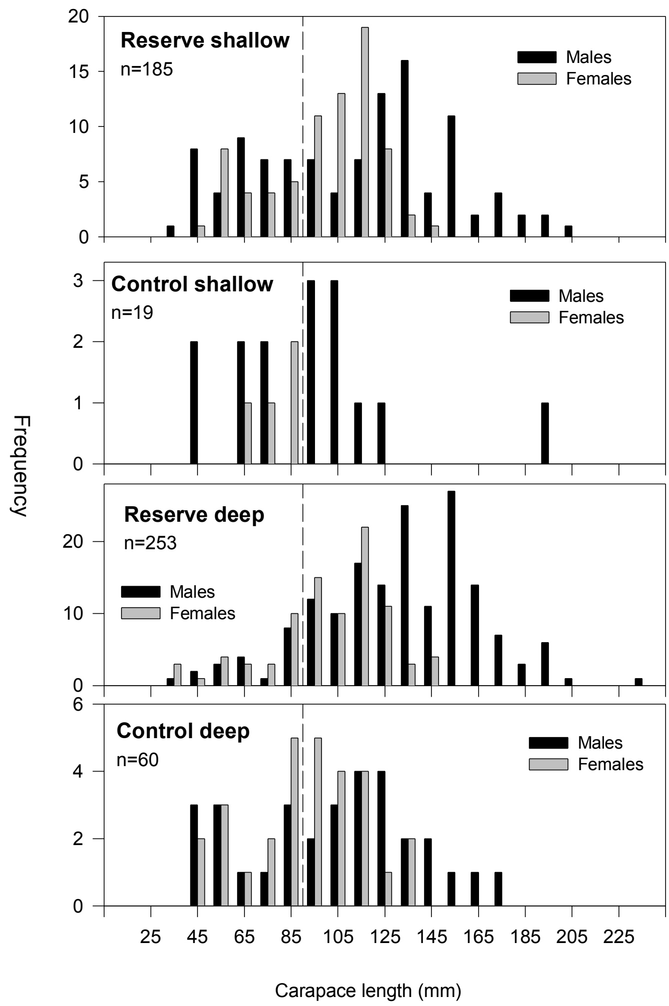


Figure 17. (from Davidson *et al.* 2002) Size-frequency distributions of spiny lobster for shallow and deep quadrats pooled across reserve and control treatments from December 1998 to December 2000. Sizes are estimated carapace length (mm).

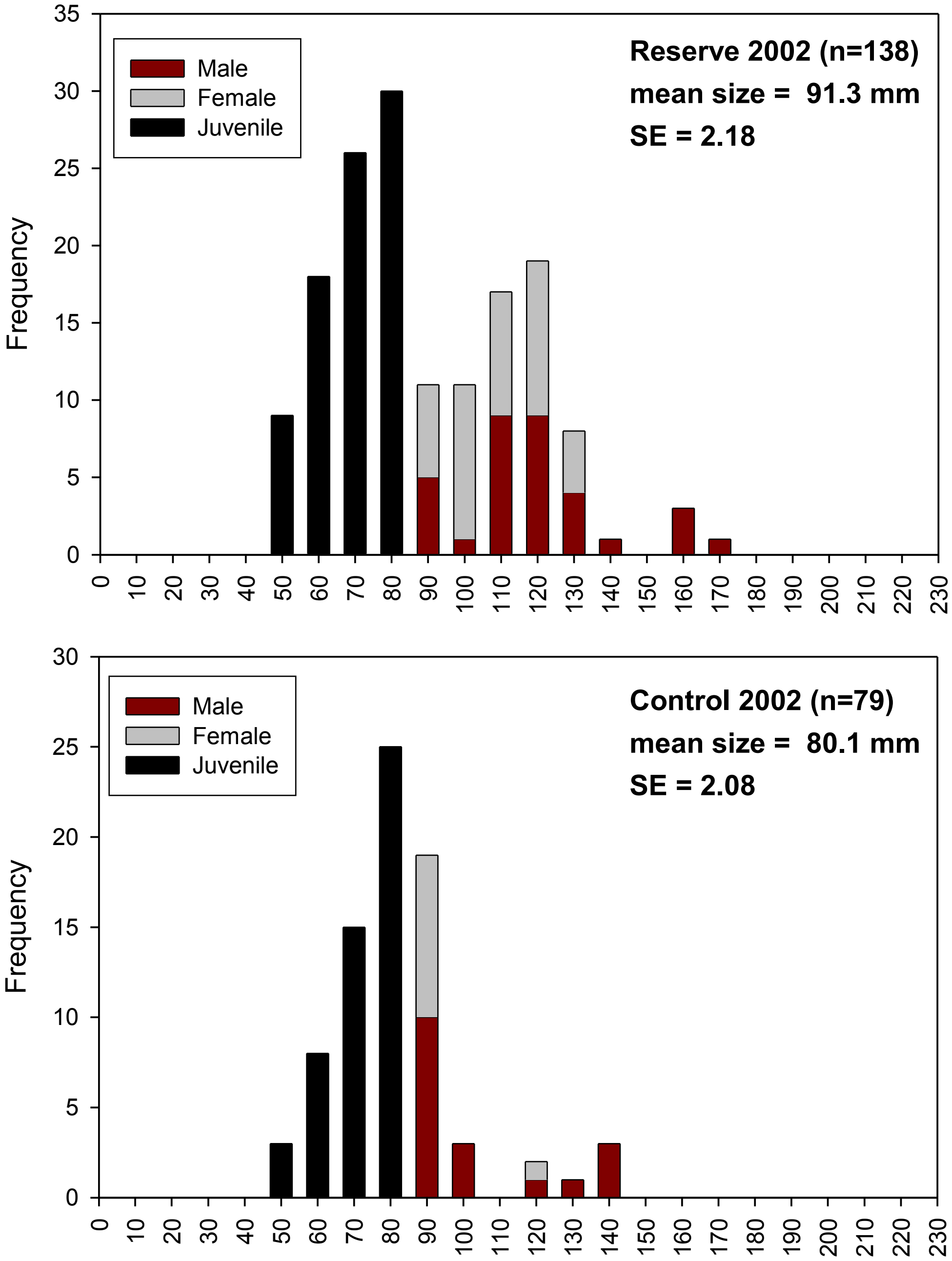
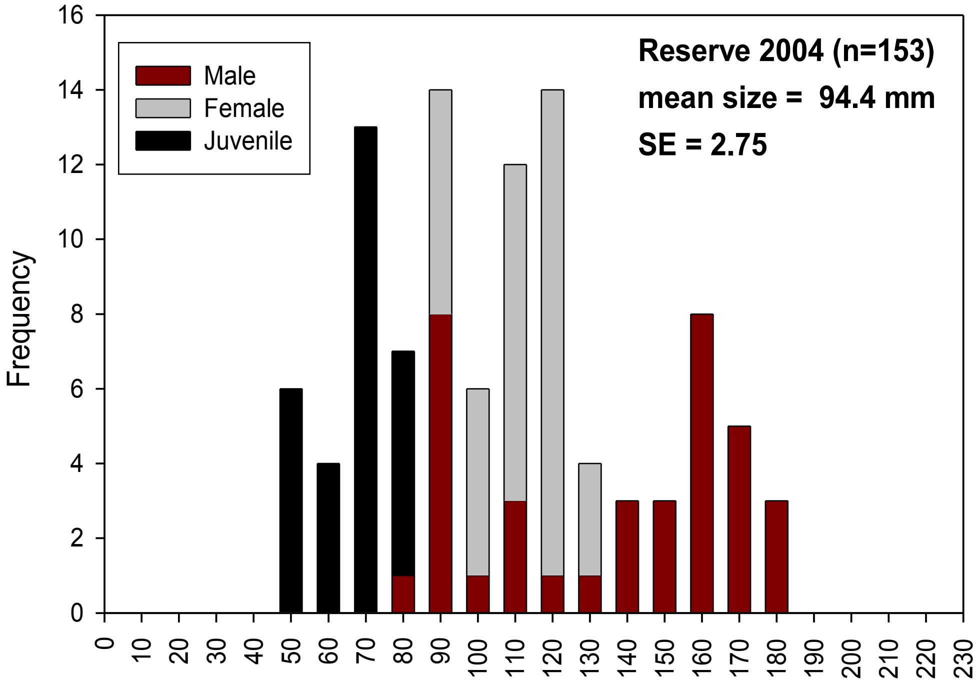


Figure 18. Size-frequency distributions of spiny lobster pooled across reserve and control treatments for December 2002. Sizes are estimated carapace length (mm).



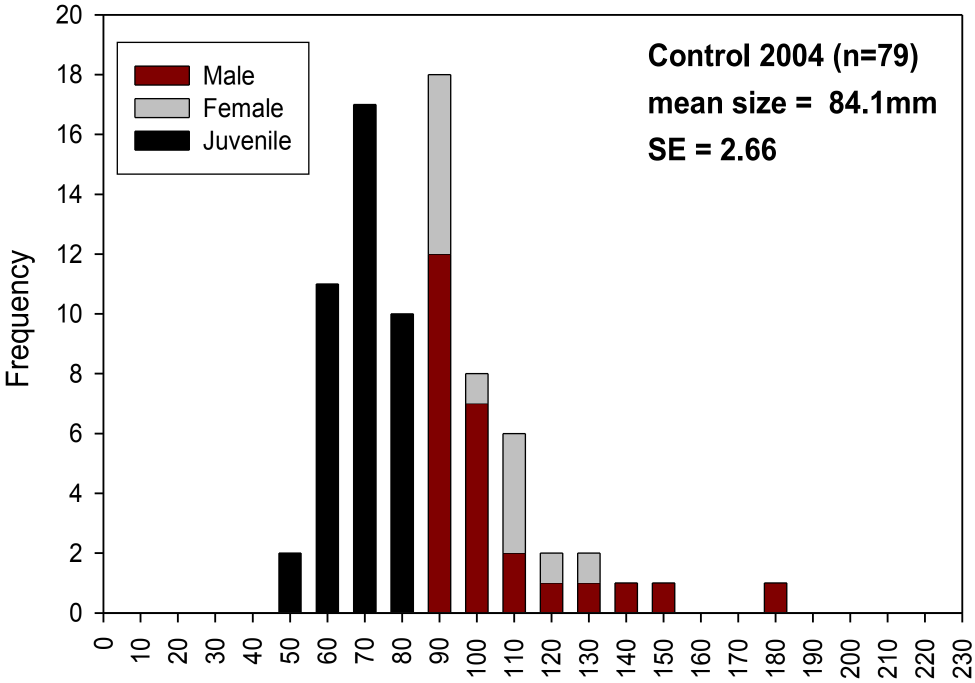
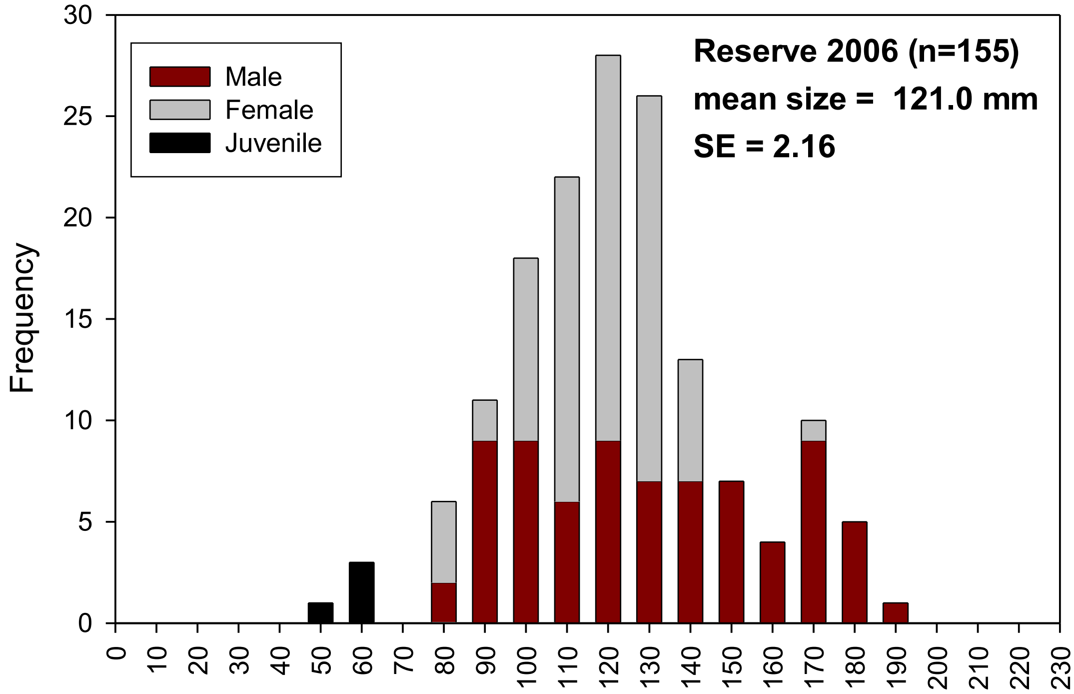


Figure 19. Size-frequency distributions of spiny lobster pooled across reserve and control treatments for February 2004. Sizes are estimated carapace length (mm).



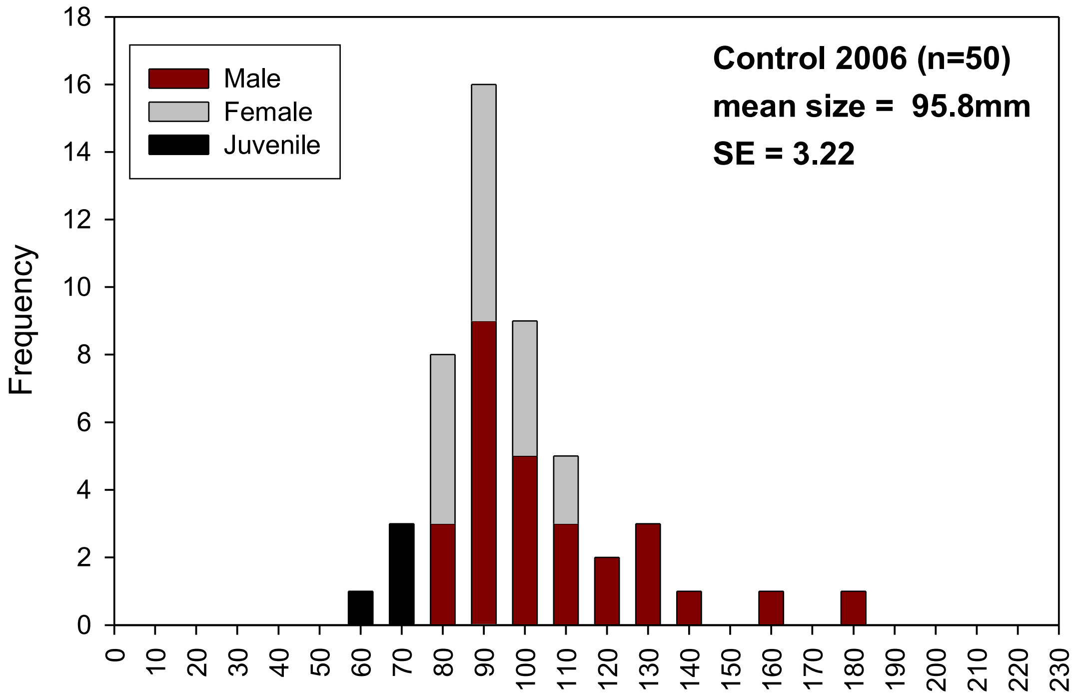
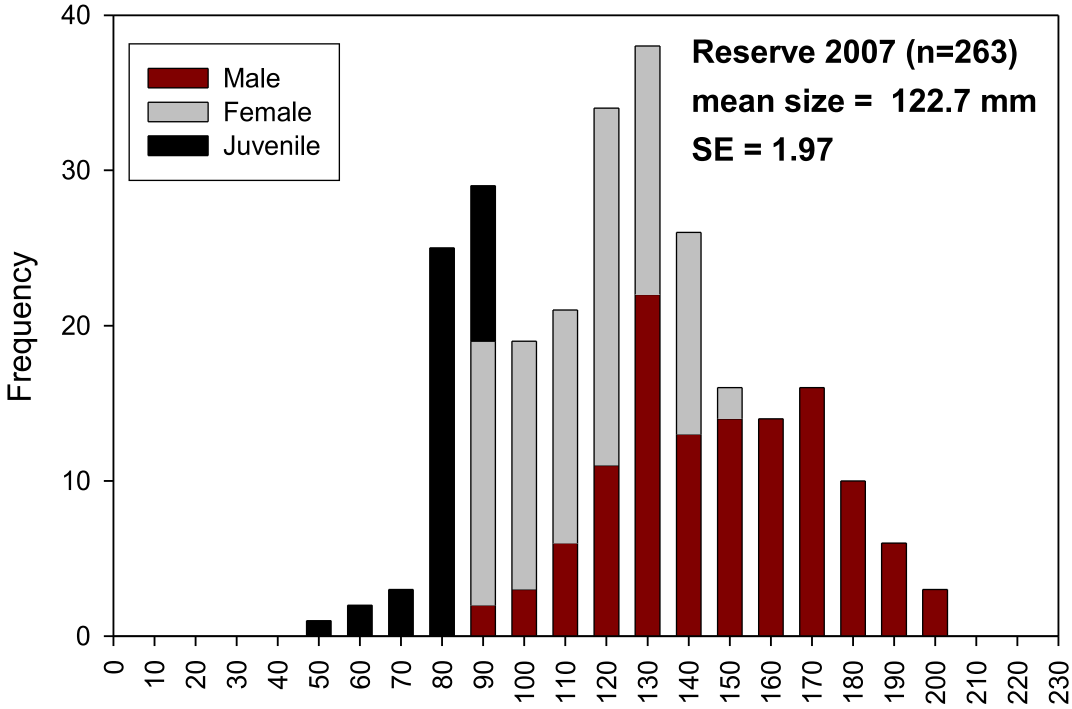


Figure 20. Size-frequency distributions of spiny lobster pooled across reserve and control treatments for April 2006. Sizes are estimated carapace length (mm).



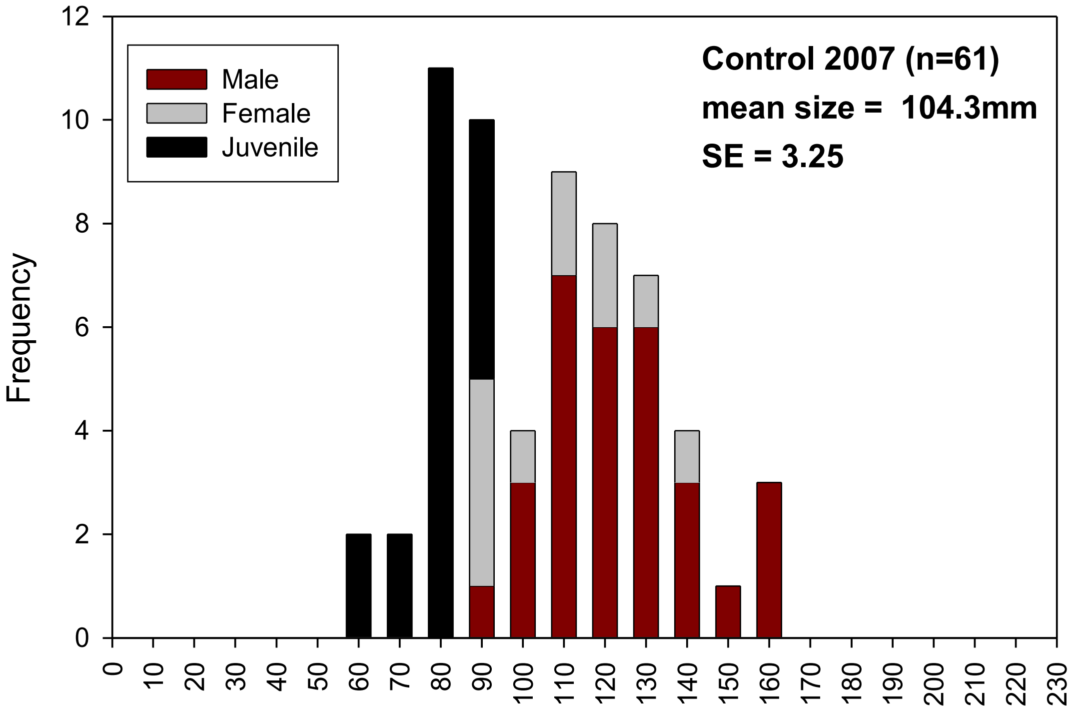


Figure 21. Size-frequency distributions of spiny lobster pooled across reserve and control treatments for February 2007. Sizes are estimated carapace length (mm).

5.3 Shore profiles

Shore profile data was collected from nine sites in March 2001 (Figure 3, Appendix 14). No obvious changes in habitat composition or macroalgae percentage cover were observed between these samples and profiles collected in December 1993.

5.4 Benthic quadrats

Benthic quadrat data were collected in 1993-94 (Davidson, 1999) and in March 2001 (Appendix 15, Figures 22 and 23). In March 2001, a total of nine shallow rocky sites (five reserve and four control) were sampled. Few large scale changes in species abundance were observed between the two sample occasions. The most notable was the anemone, *Culicea rubeola*. In 1993, this species was more abundant at both reserve and control sites than in 2001 (Table 6, Figures 22 and 23). The tubeworm (*Galeolaria hystrix)* also exhibited a decrease similar to *C. rubeola*. Of note, was an increase in the percentage cover and number of stipes of the alga *Carpophyllum flexuosum* in the reserve treatment between 1993 and 2001. Most abundant species at both reserve and control sites were coralline algae, box anemones, limpets, window oyster, top shells, tubeworms, kina, cushion stars and Cook's turban shells.

5.5 Kina density and size

Raw kina density data collected in April 2002 have been presented in Appendix 16, while size data have been presented in Appendix 21. Previous kina density data collected in December 1993 was presented in Davidson (1999).

Kina density declined at the pooled reserve treatment and increased at the control treatment between the two sample occasions (Figure 24). Of the five key rock dwelling invertebrates sampled, this is the only species where the reserve density did not follow the same trend as the control treatment (Figures 24 and 25). The decline in kina density at the reserve site was not large (i.e. 1.57 to 1.36 individuals per m^2) with error bars from each treatment overlapping.

Mean kina size was higher in the reserve compared to the control treatment. Between 1993 and 2002 mean kina size increased slightly in the reserve but declined by a similar margin outside the reserve (Figure 26, Table 7). These differences were, however, relatively small with error bars overlapping between the treatments.

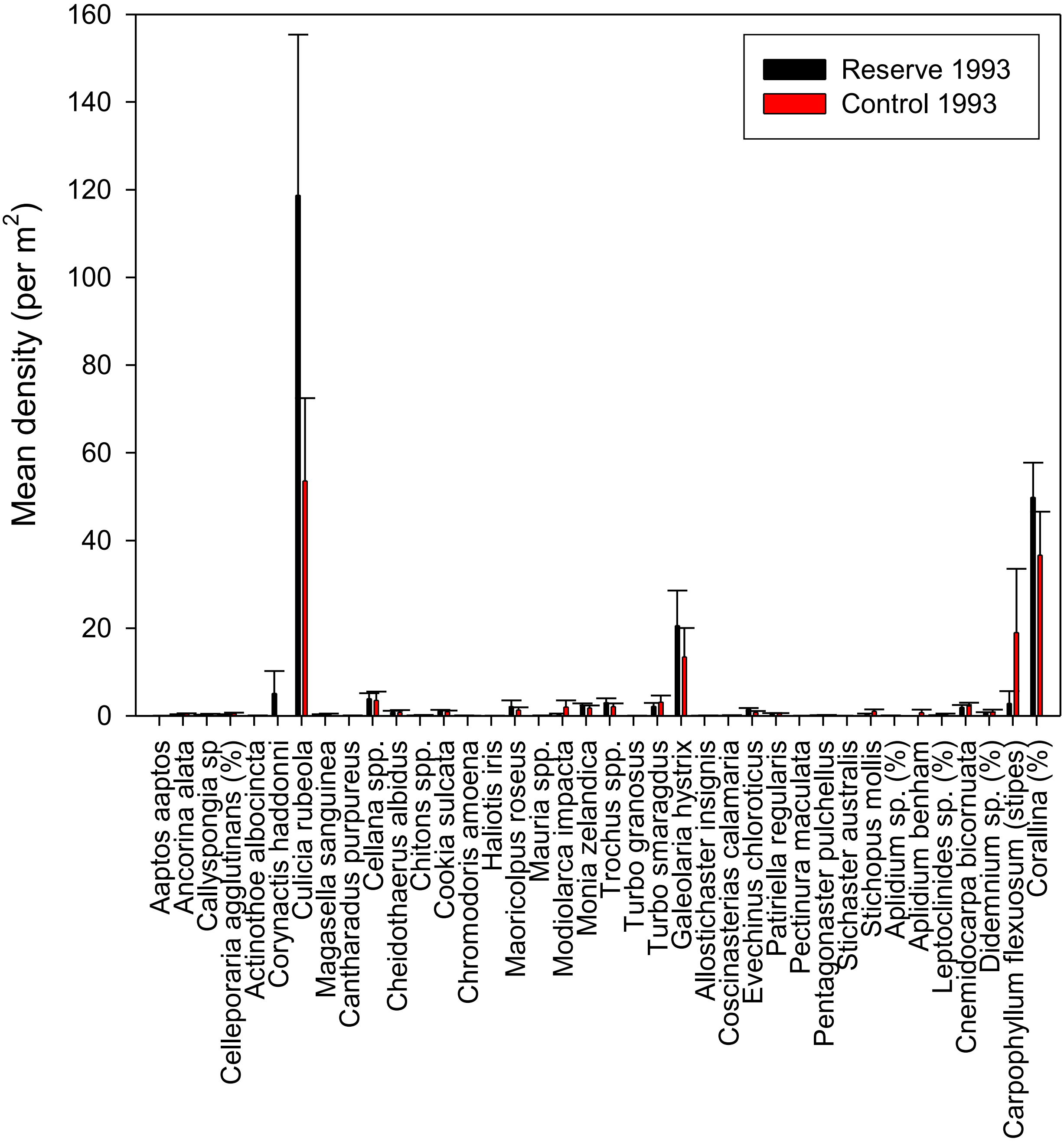


Figure 22. Mean density of benthic invertebrates and algae recorded from pooled reserve and control sites in 1993. Error +/- 1 s.e.

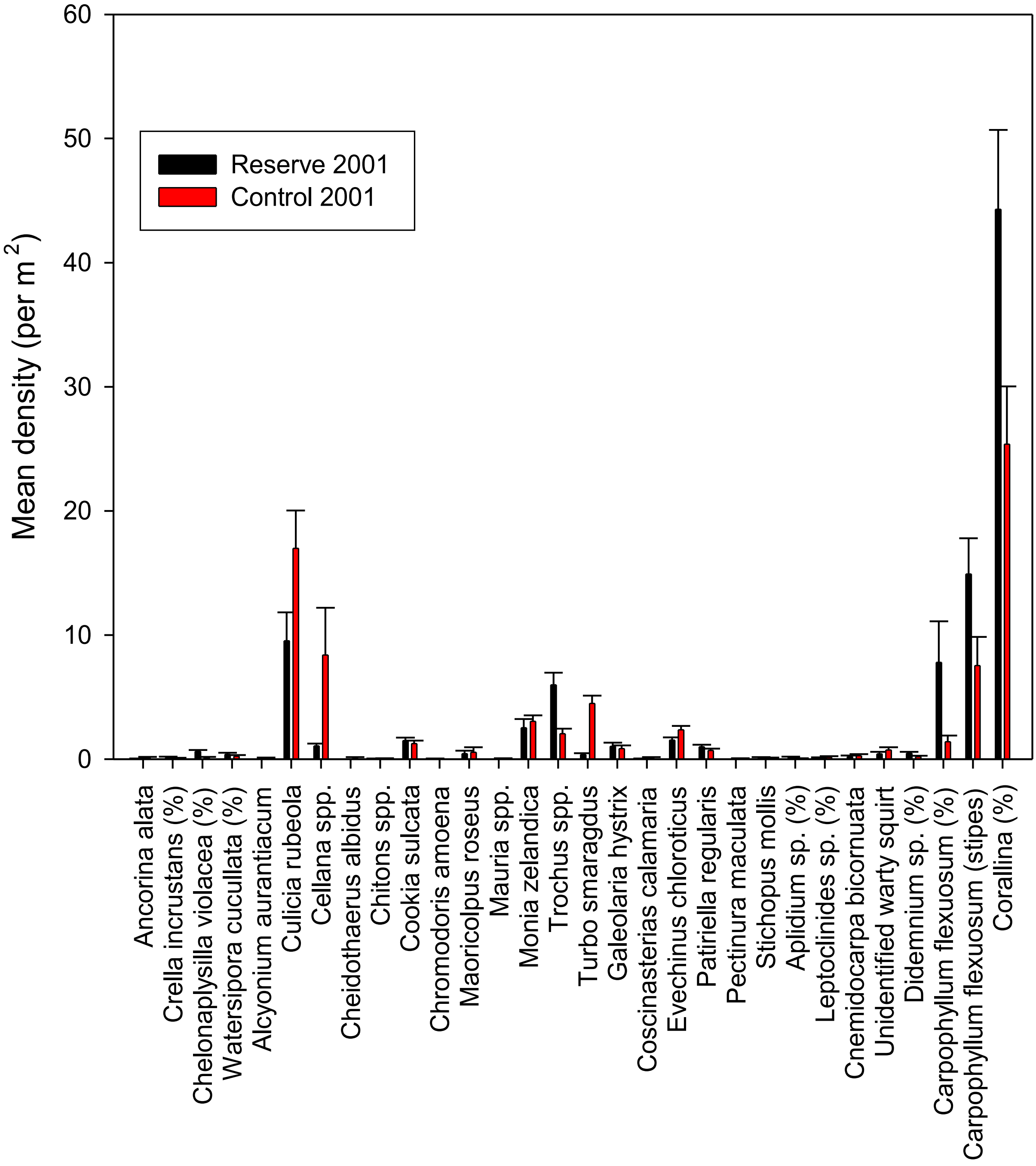


Figure 23. Mean density of benthic invertebrates and algae recorded from pooled reserve and control sites in 2001. Error +/- 1 s.e.

Table 6. Mean densities (per m2) for selected benthic species sampled from pooled rocky reserve and control treatments in 1993 and 2001.

Date Treatment	1993 Reserve Mean	1993 Reserve SD	1993 Reserve SE	1993 Control Mean	1993 Control SD	1993 Control SE	2001 Reserve Mean	2001 Reserve SD	2001 Reserve SE	2001 Control Mean	2001 Control SD	2001 Control SE
Aaptos aaptos	0.00	0.00	0.00	0.02	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Ancorina alata	0.22	0.39	0.11	0.42	0.43	0.14	0.02	0.15	0.02	0.12	0.43	0.08
Crella incrustans (%)	NA	NA	NA	NA	NA	NA	0.13	0.47	0.07	0.07	0.25	0.04
Callyspongia sp	0.14	0.36	0.10	0.23	0.52	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Chelonaplysilla violacea (%)	NA	NA	NA	NA	NA	NA	0.63	0.69	0.11	0.13	0.35	0.06
Celleporaria agglutinans (%)	0.26	0.32	0.09	0.49	0.58	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Watersipora cucullata (%)	NA	NA	NA	NA	NA	NA	0.38	0.91	0.14	0.24	0.58	0.10
Actinothoe albocincta	0.00	0.00	0.00	0.04	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Alcyonium aurantiacum	NA	NA	NA	NA	NA	NA	0.00	0.00	0.00	0.06	0.35	0.06
Corynactis haddonni	5.10	19.08	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Culicia rubeola	118.74	137.15	36.65	53.57	56.69	18.90	9.55	14.78	2.28	17.00	17.12	3.03
Magasella sanguinea	0.21	0.47	0.12	0.26	0.60	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Cantharadus purpureus	0.00	0.00	0.00	0.04	0.11	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Cellana spp.	3.86	4.84	1.29	3.50	6.11	2.04	1.06	1.35	0.21	8.39	21.53	3.81
Cheidothaerus albidus	0.83	1.20	0.32	0.75	1.57	0.52	0.00	0.00	0.00	0.10	0.40	0.07
Chitons spp.	0.04	0.09	0.02	0.10	0.17	0.06	0.02	0.15	0.02	0.03	0.18	0.03
Cookia sulcata	1.07	0.91	0.24	0.91	0.92	0.31	1.50	1.50	0.23	1.27	1.31	0.23
Chromodoris amoena	0.05	0.10	0.03	0.02	0.05	0.02	0.03	0.16	0.03	0.00	0.00	0.00
Haliotis iris	0.00	0.00	0.00	0.02	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Maoricolpus roseus	2.05	5.48	1.47	1.27	1.96	0.65	0.45	1.54	0.24	0.56	2.33	0.41
Mauria spp.	0.00	0.00	0.00	0.03	0.07	0.02	0.00	0.00	0.00	0.03	0.18	0.03
Modiolarca impacta	0.24	0.89	0.24	1.94	4.73	1.58	0.00	0.00	0.00	0.00	0.00	0.00
Monia zelandica	2.13	2.61	0.70	1.73	1.80	0.60	2.53	4.49	0.69	3.05	2.72	0.48
Trochus spp.	2.97	3.83	1.02	2.11	2.09	0.70	6.00	6.24	0.96	2.04	2.37	0.42
Turbo granosus	0.00	0.00	0.00	0.02	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Turbo smaragdus	2.13	2.98	0.80	3.10	4.45	1.48	0.37	0.75	0.12	4.48	3.57	0.63
Galeolaria hystrix	20.55	30.05	8.03	13.41	19.88	6.63	1.03	1.98	0.30	0.85	1.46	0.26
Allostichaster insignis	0.01	0.04	0.01	0.03	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Coscinasterias calamaria	0.01	0.04	0.01	0.06	0.17	0.06	0.03	0.16	0.02	0.10	0.40	0.07
Evechinus chloroticus	1.45	1.26	0.34	0.80	0.74	0.25	1.53	1.46	0.22	2.36	1.84	0.33
Patiriella regularis	0.52	0.40	0.11	0.45	0.51	0.17	1.00	1.12	0.17	0.71	0.86	0.15
Pectinura maculata	0.00	0.00	0.00	0.02	0.06	0.02	0.00	0.00	0.00	0.03	0.18	0.03
Pentagonaster pulchellus	0.07	0.18	0.05	0.11	0.28	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Pseudechinus albocinctus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stichaster australis	0.02	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stichopus mollis	0.37	0.34	0.09	1.04	1.10	0.37	0.11	0.31	0.05	0.07	0.27	0.05
Aplidium sp. (%)	0.04	0.13	0.04	0.00	0.00	0.00	0.15	0.36	0.06	0.03	0.18	0.03
Aplidium benham	0.00	0.00	0.00	0.69	2.07	0.69	0.00	0.00	0.00	0.00	0.00	0.00
Leptoclinides sp. (%)	0.08	0.16	0.04	0.31	0.60	0.20	0.10	0.30	0.05	0.15	0.46	0.08
Cnemidocarpa bicornuata	1.92	2.07	0.55	2.23	2.15	0.72	0.21	0.53	0.08	0.28	0.70	0.12
Unidentified warty squirt	NA	NA	NA	NA	NA	NA	0.41	1.19	0.18	0.73	1.31	0.23
Didemnium sp. (%)	0.66	0.67	0.18	0.85	1.51	0.50	0.48	0.62	0.10	0.21	0.41	0.07
Carpophyllum flexuosum (stipes)	2.82	10.47	2.80	18.93	43.86	14.62	7.81	21.37	3.30	1.41	2.85	0.50
Carpophyllum flexuosum (%)	NA	NA	NA	NA	NA	NA	14.91	18.72	2.89	7.53	13.17	2.33
Corallina (%)	49.82	29.68	7.93	36.67	29.58	9.86	44.31	41.31	6.37	25.38	26.33	4.65

5.6 Cook's turban density and size

Cook's turban density data collected in April 2002 are presented in Appendix 14. Previous Cook's turban density data collected in December 1993 were presented in Davidson (1999). Mean size for pooled reserve and control treatments for 1993 and 2002 are given in Table 7 (see also Appendix 22).

Cook's turban density increased at both pooled reserve and control treatments between the two sample occasions (Figure 24). In 2002, the density of Cook's turban was comparable between control and reserve treatments. Cook's turban size was comparable between pooled reserve and control treatments and varied little between sample occasions (Figure 26, Table 7).

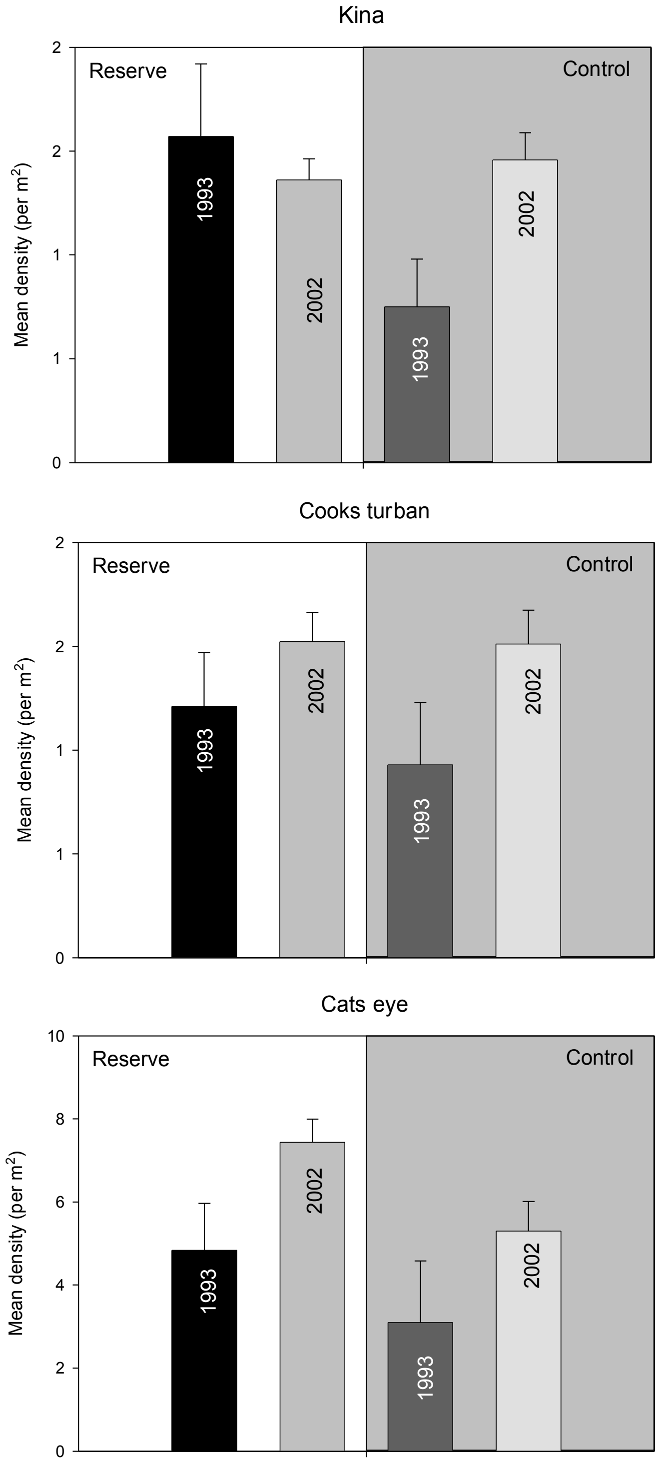


Figure 24. Mean density of kina, Cook's turban and cats-eye from pooled reserve and control sites in 1993 and 2002. Error bars are +/- 1 s.e.

Table 7. Mean size of invertebrates from reserve and control treatments in 1993 and 2002.

	Kina				Cook's Turban				Cats eye	
	1993 Reserve	1993 Control	2002 Reserve	2002 Control	1993 Reserve	1993 Control	2002 Reserve	2002 Control	1993 Reserve	1993 Control
Mean	56.62	53.95	59.80	51.45	42.38	42.80	42.03	42.87	29.90	30.46
SD	6.34	9.60	9.57	8.92	10.60	9.47	9.39	9.44	4.50	3.87
SE	0.34	0.52	0.52	0.48	0.52	0.49	0.39	0.49	0.23	0.19

5.7 Cats-eye snail density

Cats-eye snail raw density data collected in April 2002 are presented in Appendix 18. Previous cats-eye density data collected in December 1993 were presented in Davidson (1999). Mean size for pooled reserve and control treatments for 1993 are given in Table 7. No size data collected in 2002. Cats-eye density increased at both pooled reserve and control treatments between the two sample occasions (Figure 24). In both 1993 and 2002, the pooled density was higher in the reserve treatment compared to the control.

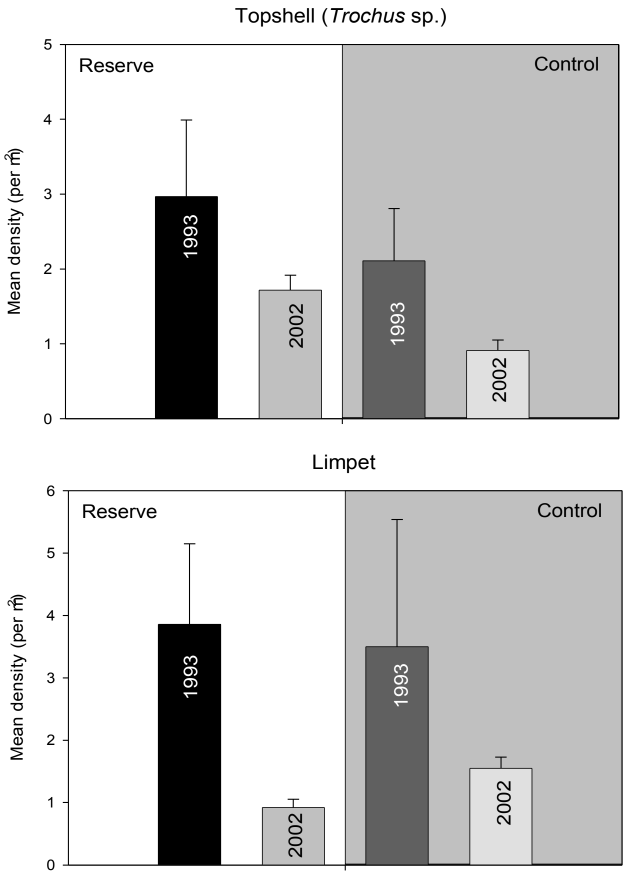


Figure 25. Mean density of topshell and limpet from pooled reserve and control sites in 1993 and 2002. Error bars are +/- 1 s.e.

5.8 Topshell density

Topshell (*Trochus* sp.) raw density data collected in April 2002 are provided in Appendix 19. Previous topshell density data collected in December 1993 were presented in Davidson (1999). Topshell density declined at both pooled reserve and control treatments between the two sample occasions (Figure 25). In both years, the pooled density was higher for the reserve treatment.

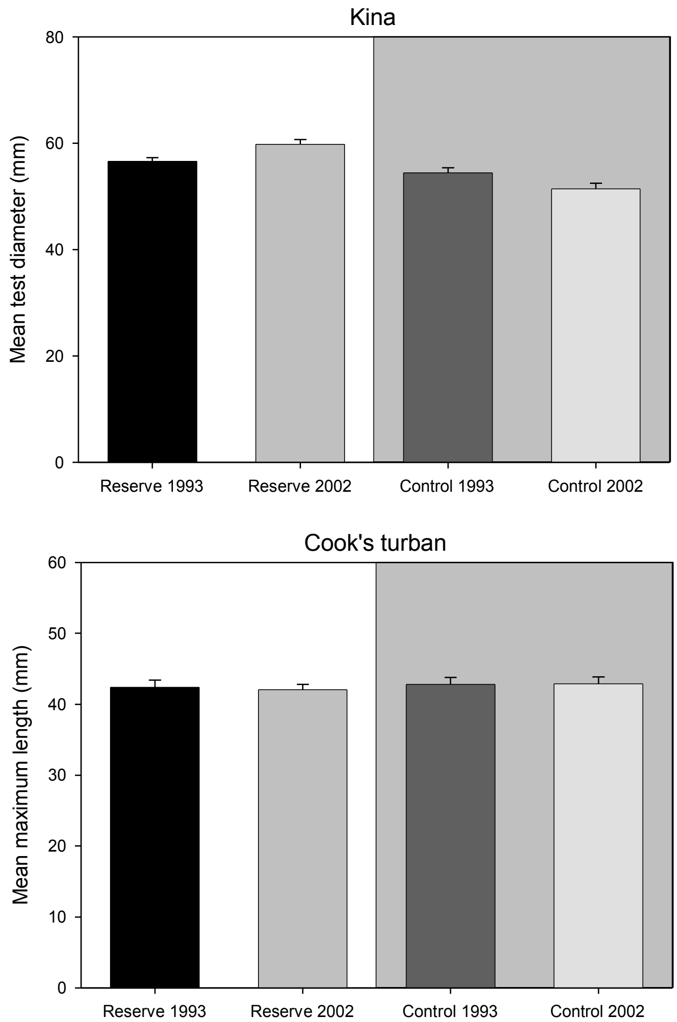


Figure 26. Mean size of kina and Cook's turban from pooled reserve and control sites in 1993 and 2002. Error bars are +/- 95% confidence.

5.9 Limpet density

Limpet (*Cellana* sp.) raw density data collected in April 2002 are given in Appendix 20. Previous limpet density data collected in December 1993 were presented in Davidson (1999). Limpet density declined at both pooled reserve and control treatments between the two sample occasions (Figure 25). The pooled density was higher for the reserve treatment in 1993 but lower in 2002 compared to the control treatment.

5.10 Scallop size and density

Scallop size and density data collected in March 2003 are presented in Appendices 23, 24, 30 and 31. Scallop data collected in 1994 and 1999 were presented in Davidson (1999, 2001).

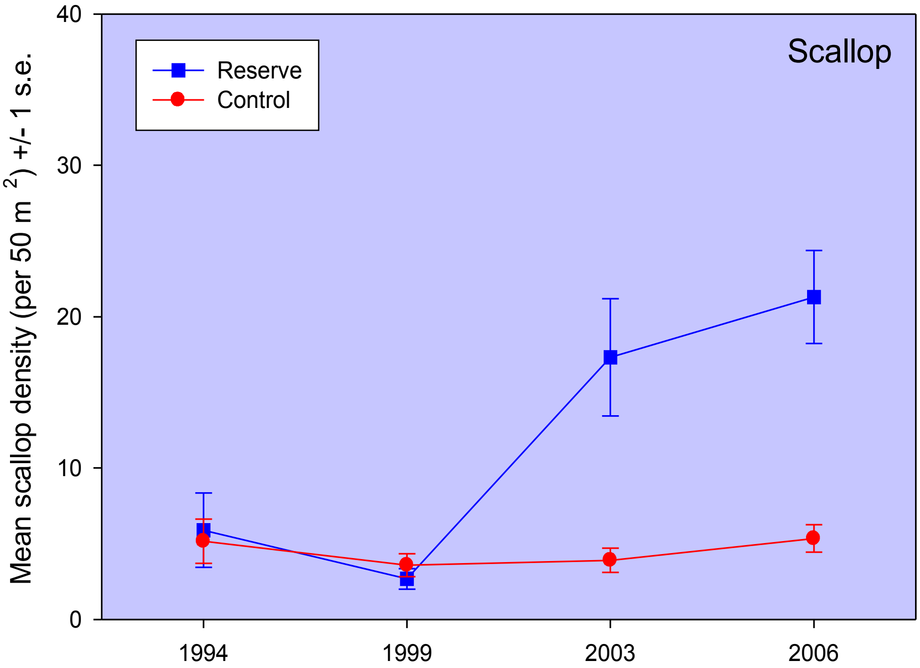
Mean density of scallops in both reserve and control sites were comparable in 1994 and 1999 (Figure 27). In 2003, scallop density increased in the reserve. At control sites, the density of scallops remained relatively stable and significantly lower than at the reserve for the 2003 and 2006 samples (t-test, $P < 0.007$, df 47).

Scallop size showed comparable patterns at both reserve and control treatments over the duration of the study (Figures 28 and 29). To date scallops size data suggest that reservation has little impact on the size of scallops in the population.

5.11 Horse mussel density

Horse mussel density data collected in March 2003 are presented in Appendices 25 and 26. Horse mussel density data collected in 1994 and 1999 were presented in Davidson (1999, 2001).

Mean horse mussels density at both reserve and control sites were very low at the start of the study in 1994 (Figure 27). At control sites, the density of horse mussels increased dramatically in 1999 and 2003, but declined back to low levels in 2006 (Figure 27). At reserve sites, densities were also low at the start of the study in 1994 and 1999, but increased in 2003 and 2006. Reserve densities at the end of the study were significantly higher than horse mussel densities recorded in 1993 (t-test, $P < 0.00001$, df = 36).



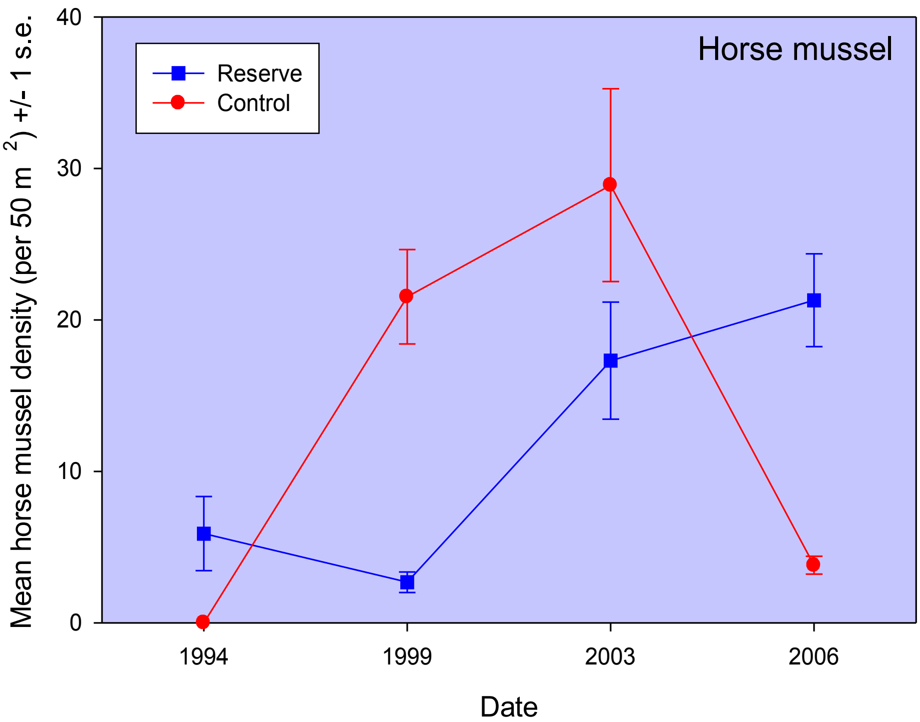


Figure 27. Mean density of scallops and horse mussels from pooled reserve and control sites. Error bars are +/- 1s.e. Note: x axis intervals are unequal time scales.

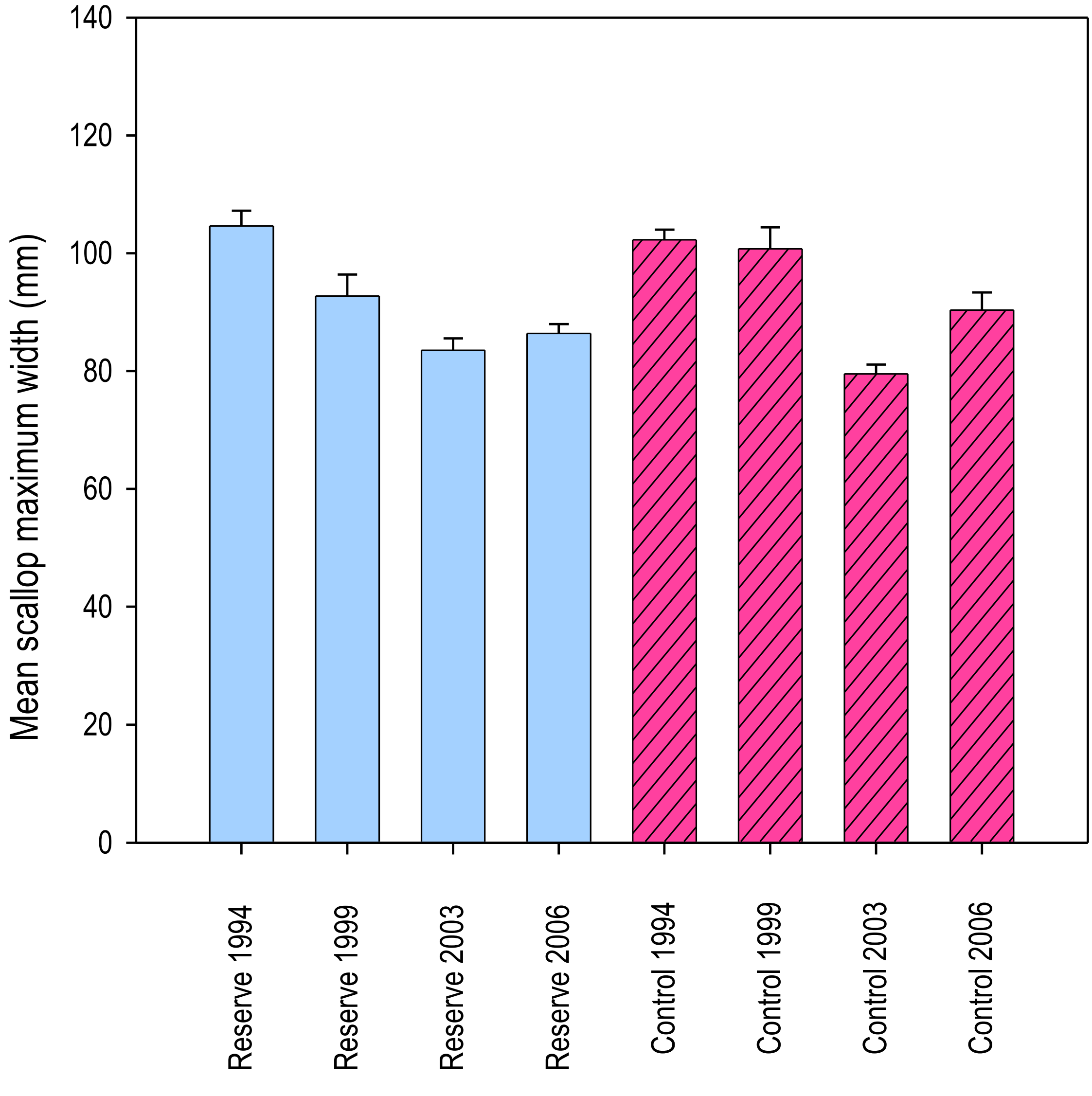


Figure 28. Mean size of scallops from individual reserve and control sites in 1994, 1999, 2003 and 2006. Error bars are 95% confidence. Blue bars = reserve, red hatched bars = control.

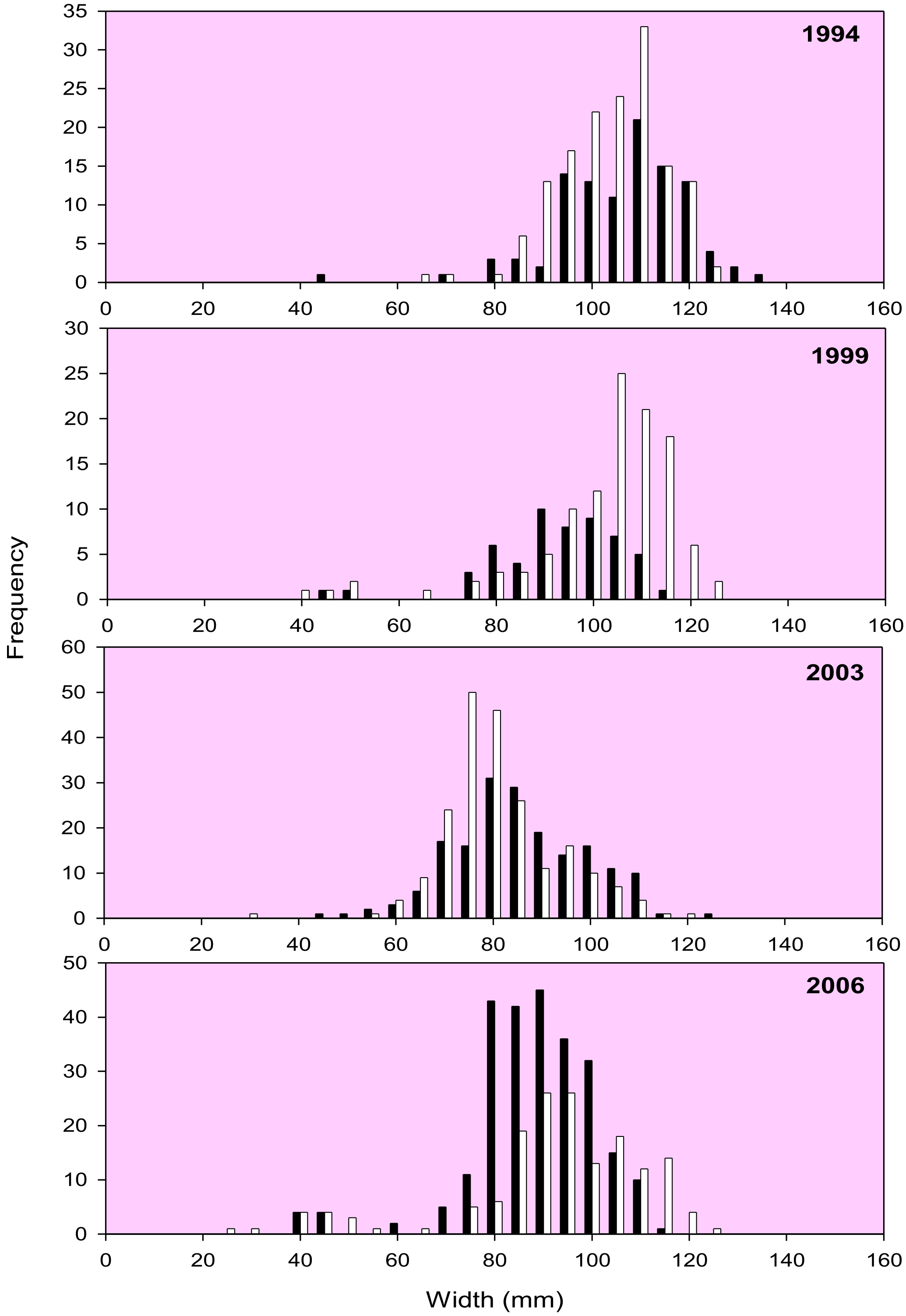


Figure 29. Size-frequency of scallops from pooled reserve (black bars) and control (open bars) treatments for each sample occasion (1994, 1999, 2003 and 2006).

6.0 DISCUSSION AND CONCLUSIONS

This report spans 15 years of monitoring from 1993 to 2007, although no data were collected from 1995 to 1998.

A growing body of studies that have shown changes in marine reserves in New Zealand (McCormick and Choat, 1987; Cole *et al*., 1990; Creese and Jeffs, 1993; Jones *et al*., 1993; MacDiarmid and Breen, 1993; Cole, 1994; Cole and Keuskamp, 1998; Kelly, 1999; Kelly *et al*., 1999; Kelly *et al*., 2000; Willis *et al*., 2000; Cole *et al.,* 2000; Davidson, 2001; Davidson *et al*., 2002, Shears *et al*, 2006). These biological changes have generally been directly attributed to the cessation of fishing.

In general, the changes attributed to reservation have been relatively small and restricted to particular species. For example, Freeman (2005) reported little or no change as a result of reservation for species that had been previously harvested such as snapper, tarakihi, blue cod and blue moki in Te Tapuwae o Rongokako Marine Reserve, on the North Island's East Coast (2000 to 2004). Relatively few fish species within the Tonga Island Marine Reserve have increased in size or abundance since reservation, a period of 15 years. With the exception of blue cod and blue moki, no other reef fish appear to have responded to the exclusion of fishing. The increase in size and abundance of blue cod and blue moki has been relatively slow with few changes recorded prior to 2002. It is probable that this slow response to reservation at Tonga Island Marine Reserve is due to a variety of factors including:

- The biology of particular reef fish species (e.g. tarakihi being migratory),
- Heavy fishing pressure and low stocks prior to reservation,
- High levels of continued fishing pressure on the adjacent coast,
- Illegal fishing within the reserve,
- The isolation of the reef habitats of Abel Tasman coastline within Tasman and Golden Bays potentially limiting recruitment through migration from adjacent areas,
- The low energy and low productivity coastline (see Davidson and Chadderton 1994), and
- The relatively low fertility of adjacent the catchments.

It is possible that recovery of many species within the Tonga Island Marine Reserve will take a relatively long period compared to many marine reserves around New Zealand. It's sheltered, low productivity and isolated situation may mean that some changes will be difficult to detect and may occur over a very long period.

6.1 Reef fish

Most New Zealand studies that have investigated the impact of reservation on reef fishes have adopted traditional diver strip counts to determine fish abundance (e.g. McCormick and Choat 1987, Cole *et al*., 1992, Cole 1994, Cole *et al*. 2000, Davidson 2001, Freeman 2005). Willis *et al*. (2000), however, questioned the reliability of this method and reported that other methods such as baited video stations may be a more reliable method for determining fish abundance. The development of such new methods may thus be an important consideration for present and future marine reserve monitoring. For example, in areas subjected to consistently poor water visibility, alternative methods to diver visual counts will require development and testing.

The present study adopted traditional visual transect methodology to estimate fish density for a variety of reasons. Water visibility in this area was often unsuitable (i.e. < 4 m), however, on occasions was adequate for this method (i.e. > 4.5 m horizontal distance). The habitat was relatively homogeneous and the target species were relatively diver-neutral, providing divers did not disturb the benthos. As a precautionary approach, a large number of replicates (n = 12 per site) were collected at each site.

The present study demonstrated that the exclusion of fishing resulted in direct changes to particular species of reef fish in the Tonga Island Marine Reserve, especially blue cod. Blue cod population size structure, abundance and behaviour in the reserve all exhibited change. For example, in February 2005, large blue cod (> 300 mm TL) in the reserve represented 43.5% of the population compared to three individuals out of 90 blue cod (< 3.3%) from all control sites. Davidson and Richards (2004) measured blue cod using baited underwater methodology (BUV) in the Tonga Island Marine Reserve. The authors also reported that blue cod were larger from the marine reserve compared to the adjacent control sites. Cole *et al.* (2000) suggested that even relatively small marine reserves would protect blue cod as a proportion of the population would remain in the same physical area for long periods (i.e. several years).

Using BUV methods, Davidson and Richards (2004) reported that mean length values for blue cod were generally greater at Tonga Island Marine Reserve sites (i.e. often ≥ 300 mm mean length) compared to Long Island-Kokomohua Reserve sites (i.e. usually < 300 mm mean length). Results collected during the present study have used underwater visual census methods (UVC) that are not directly comparable to size data collected using BUV methods due to differences in the methodology and diver estimate error. Regardless of these considerations blue cod were larger inside the both reserves compared to outside regardless of the methodology used.

At Long Island-Kokomohua Marine Reserve the proportion of very large blue cod > 330 mm in length, peaked in the reserve in April 1999 at 38.5% compared to the lowest value of < 1% for April 2000 at control sites (Davidson 2001). In the present study, large blue cod (> 330 mm TL) represented 46% of the total reserve population in the Tonga Island Marine Reserve compared to 0% for the control treatment. These proportions at Tonga Island Marine Reserve represented a dramatic difference between inside and outside the reserve.

The total abundance of blue cod has increased at both of the Nelson-Marlborough marine reserves but this increase has been more rapid and total abundance has reached higher levels at Long Island-Kokomohua Marine Reserve (Davidson 2004, Davidson and Richards 2004). For example, the mean density of all blue cod at Long Island has consistently been over six individuals per 60 m^2 since April 1999. In comparison, blue cod density for Tonga Island Marine Reserve has not risen above 1.2 individuals per 60 m^2 over the duration of the study. The dramatic difference in abundance between the two reserves is probably related to various factors including the proximity of Long Island to large areas of blue cod habitat in the Marlborough Sounds and Cook Strait. It is probable that recruitment into the reserve from movement and larval settlement is considerably higher at Long Island than for the Abel Tasman coast. Differences in the environmental variables operating at each marine reserve will also be important factors. It is unknown what density blue cod will reach in the Tonga Island Marine Reserve, however, it is certain that the abundance of this species has been on the rise.

Other reef fish species have also been slow to increase in abundance and size in Tonga Island Marine Reserve. Blue moki has shown relatively small but positive changes in the reserve. It is probable that blue moki recovery will occur over a relatively long time scale due to the isolation of the Abel Tasman coast from other reef habitats.Tarakihi numbers overall do not appear to be influenced by the absence of fishing. Tarakihi can be highly migratory and this will influence what changes occur in a marine reserve. Schools of very small individuals (6-14 cm) are regularly observed feeding on rock surfaces in the reserve and control areas, but large individuals > 30 cm are rare in both reserve and control areas.

Snapper were recorded from BUV stations located within the reserve but not outside the reserve by Davidson and Richards (2004). During the present study, snapper were not recorded from any transects, however, occasional individuals and one school of small snapper have been observed in the reserve since 2002 by divers. No snapper have been observed by divers outside the reserve during the study. As snapper usually avoid divers it is probable that their abundance has been underestimated using UVC methods.

6.2 Spiny lobsters

Spiny lobsters are intensively fished in many areas of New Zealand (Lipcius and Cobb, 1994). Several studies have shown abundance and size of spiny lobsters to be greater in protected areas than in nearby fished areas (e.g. MacDiarmid and Breen, 1993; Edgar and Barrett, 1999**;** Kelly *et al.*, 1999, 2000; Davidson *et al*., 2002, Davidson 2004, Haggitt and Kelly 2004, Shears *et al*., 2006). Those findings suggest that some lobsters remain within non-fished areas, but there is also evidence of movement across reserve borders with some lobsters leaving reserves making them susceptible to capture (e.g. Kelly *et al.*, 2000; Kelly, 2001, Freeman in prep.). There is also evidence that egg production may be limited in intensively-fished populations that lack large males (MacDiarmid and Butler, 1999).

Kelly *et al*. (2000) estimated the increase in population abundance of spiny lobsters in northern marine reserves to be about 9% per year. Davidson (2004) reported that lobster abundance increased in the Long Island-Kokomohua Marine Reserve from 1.9 individuals per 100 m^2 in 1992 to 7.5 individuals per 100 m^2 in 2003 representing an increase in abundance of approximately 22% per year. Davidson *et al.* (2002) estimated a 4.4% per year increase for combined deep and shallow samples from Tonga Island Marine Reserve based on two sets of abundance data collected from 1994 and 1999.

Declines in lobster abundance has also been documented for marine reserve areas. Haggitt and Kelly (2003, 2004b) investigated the recovery of lobsters following a 80 % reduction in their abundance from Cape Rodney to Okakari Point Marine Reserve between 1995 ans 2001. In Te Whanganui a Hei Marine Reserve Marine Reserve, Haggitt and Kelly (2004a) reported a 24% decline in lobster abundance between 2003 and 2004. The authors stated that this decline was largely due to the loss of legal-sized lobsters within the reserve from intense fishing along the reserve boundaries.

Increased abundance and size of spiny lobster lobsters were the first documented biological change due to the cessation of fishing in the Tonga Island Marine Reserve. Over the life of the reserve, lobster densities have fluctuated between sample occasions but overall their density and size have increased compared to control areas. For example, lobster abundance doubled for deeper reserve samples from 1.01 individuals per 100 m^2 in 1994 to 2.17 individuals per 100 m^2 in 2000. From 2000 to 2007, the population increased more rapidly from 2.17 individuals per 100 m^2 to 7.3 individuals per 100 m^2. Similarly lobster density also increased in the shallow reserve sites over the same period, but this increase was less pronounced (0.55 individuals per 100 m^2 in 1994 to 3.56 individuals per 100 m^2 in 2007).

An increase in deep lobster density from 0.65 individuals per 100 m^2 in 1994 to 4.1 individuals per 100 m^2 in 2002 also occurred for the pooled control treatment. This increase was primarily due to the increase in abundance of lobsters at one control site (Separation Point). This natural increase in lobster abundance outside the reserve was also recorded by Davidson (2004) over the same period in the outer Queen Charlotte Sound, and was probably due to high natural settlement and subsequent growth of lobsters on the reef. This increase in lobster density was, however, reversed in subsequent years with numbers at Separation Point dropping dramatically after the peak in 2002 to the most recent sample in 2007.

It is unlikely that the changes in lobster methodology between samples collected in 1994 and those collected from 1998 onwards (i.e. a reduction in the sample area and increase in the number of replicates) would be responsible for changes in detected densities of lobsters in the Tonga Island Marine Reserve. MacDiarmid (1991) compared the precision of three different transect sizes (10 m x 10 m (n=20), 25 m x

10 m (n=8) and 50 m x 10 m (n=4) each covering a total areas of 2000 m2. MacDiarmid (1991) found that all transects provided a similar level of precision.

The density of lobsters recorded from the deep zone in Tonga Island Marine Reserve in 2007 some 15 years after reserve establishment was 7.3 individuals per 100 m^2. This density was comparable to that found at Long Island-Kokomohua Marine Reserve after only seven years following that reserves establishment in 1993 I(i.e. approximately 7-10 individuals per 100m^2). Densities of lobsters at Long Island have continued to increase reaching a mean of 13 individuals per 100 m^2 in 2007 (Davidson unpublished data).

The abundance of the different lobster size classes in Tonga Island Marine Reserve (i.e. juveniles, mature females, non-reproductive males and reproductive males) varied both over time and between and within reserve and control treatments. It should be noted that sex-size class densities represent underestimates of the real population as not all lobsters observed in quadrats could be both sexed and measured due to the habitat complexity.

The abundance of juveniles (< 85 mm CL) remained comparable between reserve and control treatments with a peak in December 2002 for both treatments. The similarity in the abundance of juveniles between reserve and control treatments was not unexpected as this size class is well below the legal size limit for lobsters and should not be removed from the control reefs by fishers. For the other size and sex classes the abundance remained relatively stable for the control treatment over the duration of the study. In contrast the removal of fishing from the reserve has resulted in an increase in the abundance of the larger male and female size classes. This was particularly obvious for mature females (> 86 mm CL) and reproductive males (> 139 mm CL) since 2004.

Davidson *et al.* (2002) estimated that approximately nine times as many eggs would be produced from females in the Tonga Island Marine Reserve compared to the equivalent length of non reserve coast. This estimate was based on the mean size of reproductive female lobsters, their density and known egg production. Since that time, the abundance of reproductive females has more then doubled in the reserve ensuring that egg production from the reserve will be dramatically higher when compared to the adjacent fished coast. Large male abundance in the Tonga Island Marine Reserve has increased over three-fold since Davidson *et al.* (2002) sampled lobsters. High numbers of large males (>139 mm CL) helps ensure high fertilisation rates compared to control areas where large males are relatively rare.

6.3 Scallops and horse mussels

Between 1994 and 2006 horse mussel density at the control site increased dramatically and then declined. In contrast, the abundance of horse mussels from the reserve sites was initially low (1994-1999) but increased in subsequent samples (2003 and 2006).

Changes in horse mussel densities in the reserve and control treatments could be due to a variety of reasons including natural recruitment and mortality patterns as well as the effects of dredging. Further monitoring of the reserve and control sites may shed light in this issue.

Scallop density remained relatively low at the control treatment throughout the study, but increased at the reserve treatment in 2003 and again in 2006, relative to densities recorded in the first two samples. In contrast scallop mean size data showed no differences between reserve and control treatments. These data suggest that the exclusion of dredging from the reserve has allowed their abundance to increase.

6.4 Other species

Occasional monitoring of shore profiles and various benthic rocky species occurs as part of the present monitoring programme. These data have been collected in order to detect long term community changes and to assess effects on non-harvested species. For most of these species, monitoring has occurred on only two occasions, once in 1993 and once several years after reservation. At this stage insufficient temporal data exists to draw any conclusions regarding the impact of reservation on these species or community structure.

7.0 FUTURE BIOLOGICAL MONITORING

The current monitoring programme funded by the Department of Conservation, Nelson is carried out by Davidson Environmental Ltd. with assistance from Department staff of the Motueka Area. This study has spanned a period of 15 years and has detected changes that can be attributed to the establishment of the marine reserve (i.e. increased abundance and size). Some species, however, have shown no detectable response to reservation. It is important that the monitoring programme be continued in order to detect changes as they occur. Longer term monitoring will also detect community level changes that may take many more years to occur. Based on results collected as part of the present study and the sampling protocol produced by Davidson (2001), the following monitoring is recommended over the next three to four years.

Spiny lobsters

Lobsters should be counted, sexed and sized annually from reef sites outlined by Davidson (2001). Two additional sites to those outlined in Davidson (2001) have been monitored during this study (i.e. a reserve site located at Mosquito Reef and a new reserve site at Totara Rock). It is recommended that these sites continue to be monitored as part of the annual lobster programme.

Fish

Fish densities using traditional visual underwater count methodology (UVC) should be collected annually from reef sites as outlined by Davidson (2001).

Macro-invertebrates

Kina size and density should be investigated every fifth year as outlined by Davidson (2001). Other key invertebrate densities should be sampled every fifth year as outlined by Davidson (2001).

Shore profiles

Particular shore profiles should be re-sampled once before 2010.

Scallops and horse mussels

Scallops and horse mussels should be sampled once every third year as outlined by Davidson (2001). The next sample is due in the summer of 2008-2009.

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Appendix 1 Visual fish data collected in December 2000 from Tonga Island Marine Reserve and control sites.

Species	Common Name	Site B1											
Parapercis colias	blue cod < 10 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod 10-30 cm	0	1	0	0	0	4	0	0	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	1	2	0	0	0	1	1	0	0	1	4
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	2	1	1	1	0	2	0
Caesioperca lepidoptera	Butterfly perch	1	0	1	1	1	5	5	4	9	3	0	0
Pseudolabrus miles	Scarlet wrasse	1	1	3	0	0	3	3	4	2	2	3	3
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	1	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	1	0	0	13	0	0	0	0	0	1
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	1	1
Aplodactylus arctidens	Marblefish	0	1	0	0	1	2	0	0	0	0	0	1
Scorpis lineolatus	Sweep	0	0	12	0	0	14	32	20	0	37	21	15
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	1	0	0	0	0	0	0	0	0	1	0
Habitat		**Boulder**											
Depth (m)		**8**	**7**	**7**	**6**	**6**	**6**	**8.5**	**10**	**10**	**6**	**7**	**6**

Species	Common Name	Site B2											
Parapercis colias	blue cod < 10 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod 10-30 cm	0	0	0	0	0	0	1	0	0	3	0	1
Parapercis colias	blue cod > 30 cm	0	0	0	1	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	1	3	2	4	1	0		1	0	0	1
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	3	0	0	0	1	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	1	30	0	1	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	3	0	0	0	0	0	0	0	0
Habitat		**Bedrock**											
Depth (m)		**6**	**7**	**7**	**8**	**7**	**6**	**5**	**6**	**7**	**5**	**5**	**7**

Species	Common Name	Site B3											
Parapercis colias	blue cod < 10 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod 10-30 cm	0	0	1	0	0	0	0	1	0	0	0	1
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	4	1	1	3	5	3	3	2	1	3	1	0
Notolabrus fucicola	Banded wrasse	0	0	0	1	0	0	2	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	1	0	0	0	0	0	0	0	0	0	1	1
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	1	1	0	0	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	1	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Bedrock**											
Depth (m)		**9**	**10**	**11**	**6**	**6**	**7**	**6**	**9**	**8**	**9**	**7**	**10**

Species	Common Name	Site B4										
Parapercis colias	blue cod < 10 cm	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod 10-30 cm	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	2	1	0	0	1	0	0	0	0	3	
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	1	0	0	0	0	1
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	52	4	14	37	14	15	0	0	0	21	12
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	3	0	1	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	3	0	1	1	0	0	0	0	0	2	5
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Boulder**										
Depth (m)		**10**	**10**	**9**	**7**	**7**	**7**	**10**	**10**	**9**	**6**	**6**

Appendix 1 Visual fish data collected in December 2000 from Tonga Island Marine Reserve and control sites.

Site B5											
0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	1	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
2	6	3	5	2	2	2	4	5	0	1	2
0	0	0	0	0	0	0	1	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	1	0	0	0	0	4
1	0	2	15	37	34	2	1	3	5	2	0
0	0	0	0	0	1	1	0	0	0	0	0
0	2	1	0	0	0	3	0	0	0	0	0
0	1	0	0	2	0	1	25	0	0	1	14
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
11	**11**	**10**	**6**	**5**	**8**	**10**	**8**	**8**	**6**	**6**	**6**

Site B6											
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0		0	1	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
3	0	2	4	1	2	2	2	0	1	2	0
0	0	0	0	1	0	0	0	0	0	0	0
2	0	1	0	1	0	4	0	0	0	0	0
0	0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0
1	2	0	0	0	0	0	4	0	0	0	0
1	0	0	2	18	0	0	0	0	0	2	0
0	0	0	0	0	0	1	2	1	0	0	0
0	1	1	0	0	0	1	0	0	0	0	0
1	2	1	0	0	0	1	1	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
Bed/boulder											
10	**13**	**11**	**6**	**8**	**8**	**9**	**9**	**9**	**6**	**6**	**6**

Site B8											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	2	2	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	1	2	1	0	2	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	2	5	0	2	0	0	0	0	0	3
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**10**	**10**	**6**	**7**	**7**	**10**	**10**	**10**	**6**	**7**	**7**

Site B10											
0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	1	1	0	0	0	0	0
0	1	0	0	0	0	0	0	0	5	0	0
4	3	4	5	0	1	11	14	8	8	4	5
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	1	2	0	0	0
0	5	0		1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock											
8	**7**	**9**	**7**	**6**	**6**	**7**	**6**	**6**	**7**	**9**	**6**

Site B12										
0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
1	0	1	2	0	1	1	3	0	4	6
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	1	0	0	0	2
0	0	0	0	1	0	0	2	0	1	5
0	0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	1	2	2	2
0	0	1	0		1	0	0	1	1	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0
Boulder										
10	**10**	**9**	**6**	**6**	**6**	**10**	**10**	**10**	**7**	**7**

Appendix 1 Visual fish data collected in December 2000 from Tonga Island Marine Reserve and control sites.

Site B14											
0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	1	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	0	0	0
1	3	5	1	7	1	1	0	0	1	0	1
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	2	0	2	0	2	6	36	2	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	3	0	0	0	0	0
Boulder/algae											
11	**10**	**10**	**7**	**8**	**8**	**10**	**11**	**11**	**7**	**8**	**8**

Site B15											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0	0
0	2	1	1	4	1	2	0	1	1	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	1	0	0	1	0
0	0	0	0	0	1	3	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	2	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**11**	**11**	**8**	**8**	**8**	**10**	**13**	**13**	**7**	**7**	**7**

Site B16											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	4	4	1	0	3	1	1	3
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1	0	0	1	0
0	0	0	0	0	0	0	1	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0
1	6	1	1	51	17	10	0	2	1	20	2
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	1	0
0	0	0	0	3	5	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**10**	**10**	**6**	**6**	**6**	**10**	**10**	**10**	**7**	**7**	**6**

Site B17											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	4	2	0	0	0	2	2	3	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	4	0	0	1	0	9	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
7	**8**	**10**	**6**	**6**	**7**	**5**	**4**	**6**	**4**	**6**	**6**

Appendix 2 Visual fish data collected in March 2001 from boulder substrata from the Abel Tasman.

Species	Common Name	Site B1												Site B2											
Parapercis colias	blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	0	0	0	0	0	3	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Notolabrus celidotus	Spotty	5	16	6	1	1	2	3	7	9	4	8	6	4	2	5	4	5	7	1	1	0	3	2	1
Notolabrus fucicola	Banded wrasse	0	0	0	0		0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	2	1	0	0	0	2	6	3	5	5	2	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	2	3	3	2	0	1	4	3	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	1	1	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	2	7	1	0	2	3	2	4	3	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	4	4	6	1	1	1	1	3	1	8	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	20	0	0	0	0	1	0	0	4
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	2	0	0	0	0	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Boulder**												**Bedrock**											
Depth (m)		**9**	**8**	**8**	**6**	**6**	**5**	**9**	**11**	**11**	**7**	**6**	**6**	**7**	**6**	**6**	**7**	**5**	**4**	**9**	**10**	**8**	**9**	**17**	**6**

Species	Common Name	Site B3												Site B4											
Parapercis colias	blue cod < 30 cm	0	0	0	0	0	2	0	0	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	4	1	5	2	1	0	5	6	3	2	4	3	2	3	1	2	0	3	2	2	2	0	2
Notolabrus fucicola	Banded wrasse	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	4	3	2	0	2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	1	0	0	0	1	0	0	0	0	1	2	3	4	3	4	3	0	0	4	15	3	1	1	4
Cheilodactylus spectabilis	Red moki	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0
Scorpis lineolatus	Sweep	4	11	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	11	0	1	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Habitat		**Bedrock**												**Boulder**											
Depth (m)		**6.5**	**8**	**8**	**7**	**7**	**7**	**6**	**9**	**8**	**8**	**8**	**8**	**5**	**6**	**7**	**8**	**9**	**9**	**11**	**11**	**10**	**7**	**7**	**6**

Appendix 2 Visual fish data collected in March 2001 from boulder substrata from the Abel Tasman.

Site B5											
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	1	5	2	4	1	2	2	7	3	1	3
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	14	10	2	3	1	1	3	2	3	1	3
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
8.6	**9**	**10**	**6**	**7**	**7**	**9**	**9**	**9**	**7**	**7**	**7**

Site B6											
1	0	1	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
4	5	8	3	3	4	3	2	4	1	4	2
1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
9	0	1	0	1	0	0	0	4	0	0	0
1	4	1	1	1	3	6	6	4	2	4	3
0	0	0	0	0	0	0	0	2	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0
5	1	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock/boulder											
10	**9**	**10**	**6**	**6**	**7**	**9**	**8**	**10**	**8**	**7**	**6**

Site B8											
0	1	0	0	0	1	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	4	0	1	3	1	1	6	0	4	12
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	1	2	2	1	0	2	2	1	0	3	1
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	1	0	0	6
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**10**	**9**	**7**	**6**	**7**	**11**	**11**	**11**	**7**	**8**	**7**

Site B10											
1	1	0	0	0	0	1	0	0	2	0	0
1	1	0	0	0	0	0	0	0	0	0	0
24	15	3	2	11	6	2	1	2	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	3	3	2	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	2	0	0	2	0	0	0	1	0	0	0
Bedrock											
8	**8**	**8**	**5**	**6**	**6**	**8**	**6**	**4**	**6**	**5**	**5**

Site B12											
0	0	0	0	0	0	0	0	0	2	0	0
0	0	0	0	0	0	0	0	0	1	0	0
3	2	3	1	3	2	2	2	1	1	1	0
0	0	0	0	0	0	0	1	0	1	0	0
0	1	0	0	0	0	0	0	4	0	2	2
3	0	1	0	0	0	0	1	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	1	1	0	0	0	0
0	1	4	1	1	0	3	1	3	0	1	0
1	0	0	0	0	0	0	0	0	0	0	0
0	0	1	1	1	0	0	0	0	0	1	1
0	1	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
8	**10**	**9**	**6**	**6**	**7**	**9**	**10**	**11**	**7**	**7**	**6**

Appendix 2 Visual fish data collected in March 2001 from boulder substrata from the Abel Tasman.

Site B14											
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	1	12	3	8	5	4	2	6	14	6	4
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	1	0
3	1	1	0	0	0	10	4	3	1	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	1	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	17	2	33	37	0	0	0	0	10	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0
Boulder/algae											
9	**10**	**9**	**6**	**7**	**7**	**10**	**9**	**10**	**6**	**5**	**5**

Site B15											
0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	1
1	4	0	2	7	3	4	2	0	4	0	4
0	1	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	2	0	4	0	0	0
0	1	0	0	1	1	3	5	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	2	1	0	1
0	0	2	1	3	2	7	3	3	2	4	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	5	3	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
11	**10**	**10**	**7**	**7**	**6**	**10**	**10**	**11**	**7**	**7**	**6**

Site B16											
0	0	0	0	1	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
3	0	3	1	4	0	3	3	4	0	5	2
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	1	1	0	1	4	0
0	1	0	1	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
1	1	2	0	1	0	1	1	2	3	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	1	0	0
0	4	1	0	0	0	4	0	1	0	1	0
0	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
11	**11**	**11**	**7**	**7**	**7**	**11**	**11**	**11**	**7**	**7**	**7**

Site B17											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
5	1	3	5	1	0	2	7	12	10	7	5
1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	6	0	0	0	0	3	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	1	2	0
2	0	2	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
7	**10**	**9**	**6**	**6**	**6**	**7**	**6**	**4**	**6**	**4**	**3**

Appendix 3 Visual fish data collected in April 2002 from boulder substrata from the Abel Tasman.

Species	Common Name	Site B1												Site B2											
Parapercis colias	blue cod < 30 cm	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	0	0	0	1	0	4	3	5	4	0	3	5	5	4	1	2	1	27	4	1	2	2	0	2
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	5	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	2	1	0	1	0	3	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	4	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	10	1	0	2	0	0	1	1	2	1	1	5	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Habitat		**Boulder**												**Bedrock**											
Depth (m)		**8**	**8**	**7**	**6**	**5**	**7**	**8**	**7**	**8**	**6**	**5**	**6**	**6**	**4**	**4**	**7**	**7**	**7**	**7**	**9**	**9**	**7**	**7**	**6**

Species	Common Name	Site B3												Site B4											
Parapercis colias	blue cod < 30 cm	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	8	5	5	3	1	4	2	1	6	3	1	0	0	2	0	0	0	0	1	1	1	2	1
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	2	0	2	0	0	2	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	2	0	0	2	2	1	2
Cheilodactylus spectabilis	Red moki	0	0	0	2	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	1	1	0	0	2	0	1	1
Parika scaber	Leatherjacket	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hippocampus abdominalis	Seahorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Bedrock**												**Boulder**											
Depth (m)		**8**	**8**	**9**	**6**	**7**	**6**	**9**	**8**	**7**	**6**	**6**	**7**	**8**	**9**	**9**	**6**	**7**	**6**	**10**	**9**	**8**	**7**	**7**	**6**

Appendix 3 Visual fish data collected in April 2002 from boulder substrata from the Abel Tasman.

Site B5											
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	2	0	1	3	0	1	1	3	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	1	0	0	0	1	0	0	3	0	0	3
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**9**	**8**	**7**	**7**	**6**	**7**	**7**	**6**	**8**	**8**	**7**

Site B6											
0	0	1	0	1	0	0	0	0	0	1	0
0	17	0	0	0	1	1	0	0	0	0	0
0	1	2	1	1	4	1	1	0	3	3	5
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	0	1	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock/boulder											
9	**9**	**8**	**8**	**8**	**7**	**9**	**10**	**11**	**7**	**10**	**8**

Site B8											
0	0	0	0	0	0	0	0	1	0	0	1
1	0	0	0	0	0	0	0	0	0	0	0
1	2	4	2	5	2	1	1	0	2	0	2
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
8	**10**	**11**	**6**	**7**	**7**	**10**	**9**	**8**	**7**	**7**	

Site B10											
0	2	0	0	1	1	0	1	1	0	0	0
0	1	0	0	0	2	0	1	0	0	0	1
3	12	6	6	6	7	2	2	9	0	4	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
4	0	1	1	0	0	1	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock											
5	**8**	**7**	**5**	**5**	**5**	**8**	**6**	**5**	**6**	**6**	**5**

Site B12											
1	0	0	0	0	0	0	0	1	0	0	0
1	2	0	0	0	1	0	0	0	0	0	0
0	1	2	0	0	0	0	1	0	0	0	1
0	0	0	0	2	0	0	0	0	0	0	0
0	1	2	0	4	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	1	2	0	0
0	0	0	0	1	0	1	0	0	0	0	0
0	0	0	0	0	0	12	0	5	6	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
7	**8**	**9**	**6**	**6**	**6**	**10**	**9**	**8**	**6**	**6**	**6**

Appendix 3 Visual fish data collected in April 2002 from boulder substrata from the Abel Tasman.

Site B14

	0	0	0	0	0	0	1	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
	3	2	0	0	0	1	1	2	4	4	5	2
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	2	0	0
	0	0	0	0	0	0	1	2	2	0	0	2
	0	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
Boulder/algae												
	9	**9**	**8**	**6**	**6**	**7**	**7.7**	**9.4**	**9.7**	**6**	**7.3**	**6.8**

Site B15

	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0	0
	3	5	2	5	3	2	1	4	5	4	2	3
	0	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	21	0	0	0	0
	0	0	0	0	0	0	1	0	0	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	6	1	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
Boulder												
	8.8	**9.4**	**11**	**6.1**	**7.3**	**7.7**	**7**	**8**	**6**	**9**	**10**	**11**

Site B16

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	1	3	1	1	1
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	2	0	0	3	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	3	0	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
Boulder												
	7	**8**	**7**	**5**	**6**	**6**	**5**	**8**	**8**	**6**	**9**	**9**

Site B17

	0	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	7	8	5	7	5	1	2	0	0	0	0	2
	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	3	1	2	0	1	0	0	0	4	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	5.8	**5.9**	**7.1**	**4.8**	**5.1**	**6.5**	**6**	**9**	**9**	**5**	**7**	**7**

Appendix 4. Visual fish data collected in February-March 2004 from boulder substrata from the Abel Tasman.

Species	Common Name	Site B1											
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	2	2	1	6	1	1	1	0	2	0	3	2
Notolabrus fucicola	Banded wrasse	0	0	0	0	1	0	0	0	1	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	1	2	0	0	0	0	0	0	11	0	0
Pseudolabrus miles	Scarlet wrasse	3	1	2	0	0	0	0	0	0	0	1	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	2	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	1	0	0	0	0	3	1	0	0	4	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	1	0	0	1	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	1	1	0	0	1	0	0	0	0	0	0	3
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0	0
	Jack mackerel	0	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Boulder**											
Depth (m)		**7**	**10**	**8**	**5**	**5**	**5**	**5**	**4**	**5**	**6**	**8**	**7**

Species	Common Name	Site B2											
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	2	0	3	0	6	0	6	0	4	0	0
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	1	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	1	0	1	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	1	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	2	0	0	0	1	1	0	0	0
	Jack mackerel	0	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Bedrock**											
Depth (m)		**7**	**5**	**4**	**8**	**6**	**3**	**9**	**11**	**10**	**6**	**7**	**8**

Species	Common Name	Site B3											
Parapercis colias	Blue cod < 30 cm	0	0	1	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	2	5	3	1	1	3	0	0	1	2	3
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	1	1	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	1	0	0	0	0
Nemadactylus macropterus	Tarakihi	1	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	1	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	2	0	0	0	0	0	0	0	0	1
	Jack mackerel	0	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Bedrock**											
Depth (m)		**8**	**9.5**	**9**	**8**	**8**	**8**	**7**	**9**	**10**	**11**	**9**	**9**

Species	Common Name	Site B4										
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	1	0	0	0	0	0	2	3	0	0	2
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	1	0	1	0	0	0	2	3	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	2	1	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	19	2	3	1	1	0	2	1	2	1	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes monopterygius	Opal fish	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0
	Jack mackerel	0	0	0	0	0	0	0	0	0	0	0
Habitat		**Boulder**										
Depth (m)		**8**	**8**	**9**	**8**	**9**	**8**	**11**	**10**	**10**	**11**	**13**

Appendix 4. Visual fish data collected in February-March 2004 from boulder substrata from the Abel Tasman.

Site B5

1	0	0	0	0	1	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0	0
5	2	3	0	0	0	0	3	1	0	1	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	9	0	1	2	0
0	0	0	0	1	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0	0	0	0
4	0	0	1	0	0	1	4	3	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	3
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	6	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
10	**9**	**7**	**7**	**6**	**5**	**11**	**11**	**12**	**7**	**7**	**7**

Site B6

0	0	0	0	0	0	2	1	0	0	0	0
0	0	0	0	0	0	0	1	2	0	1	1
1	1	2	0	0	1	0	3	3	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	5	0	0
0	0	0	0	0	0	1	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock/boulder											
5	**6**	**5**	**6**	**7**	**7**	**8**	**9**	**11**	**7**	**8**	**9**

Site B8

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	1	1	0	8	2	2	2	5	12
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	2	0	0	0	0	3	0	0	2	1	1
0	0	0	0	0	0	1	1	0	0	1	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
11	**10**	**9**	**8**	**8**	**7**	**9**	**9**	**9**	**7**	**7**	**7**

Site B10

0	2	2	0	1	1	2	1	1	0	0	1
0	1	1	0	0	0	0	2	0	1	0	2
18	2	8	4	5	3	9	4	9	1	0	7
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	1	0
1	0	0	1	0	0	2	0	0	0	0	5
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
10	4	1	4	1	0	2	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock											
8	**9**	**9**	**9**	**9**	**9**	**7**	**4**	**5**	**7**	**6**	**5**

Site B12

0	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	3	1	0	0	0	0	0	0
5	4	0	1	6	1	1	2	2	0	6	0
0	1	0	0	0	0	1	0	0	0	0	0
0	0	0	3	7	0	0	5	1	0	7	0
0	1	0	0	0	1	0	1	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	0	0	1	0	0	3
0	0	1	1	6	1	0	0	0	0	4	0
0	1	0	0	2	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	3	0	0	0	0	0	2	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	2	0	0	0	0	1	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
9	**10**	**10**	**9**	**10**	**11**	**7**	**7**	**7**	**7**	**7**	**7**

Appendix 4 Visual fish data collected in February-March 2004 from boulder substrata from the Abel Tasman.

Site B14

0	0	0	0	0	1	0	1	0	0	0	0
0	0	0	1	0	0	0	1	1	0	0	1
8	2	4	3	5	3	1	0	3	3	0	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	4	1	0	2	0	0	1	1	2	0	2
0	0	0	1	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder/algae											
7	**7**	**7**	**7**	**7**	**7**	**7**	**8**	**8**	**6**	**7**	**7**

Site B15

0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0
1	1	0	0	8	10	10	1	4	6	11	7
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	0	0	0
0	0	1	2	0	0	0	0	2	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	3	0	2	0	0	0	0	0
0	0	0	0	0	0	0	2	0	1	4	0
0	0	0	0	0	0	0	2	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1	0	0	0	0
0	0	1000	0	100	0	0	0	0	0	0	0
Boulder											
8	**8**	**8.5**	**6**	**6.3**	**6**	**6**	**7**	**9**	**6**	**6**	**5**

Site B16

0	1	4	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
7	5	13	10	2	1	4	3	3	3	2	9
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	6	10	1	0
0	0	1	0	0	0	1	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	3	0	3	15	0	2
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	1	8	5	1	0	8	4	5	1	1	2
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
9	**9**	**8**	**7**	**6**	**5**	**10**	**12**	**10**	**6**	**6**	**6**

Site B17

0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
3	5	5	3	8	3	1	0	1	5	2	2
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	2	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	2	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
5	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**8**	**5**	**5**	**6**

Appendix 5 Visual fish data collected in February 2005 from boulder substrata from the Abel Tasman.

Species	Common Name	Site B1												Site B2												Site B3												Site B4											
Parapercis colias	blue cod < 30 cm	0	0	5	0	0	0	1	4	0	0	2	4	0	1	0	2	0	0	0	0	1	1	1	0	0	0	1	1	2	0	0	0	1	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	blue cod > 30 cm	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	5	3	3	3	0	9	7	6	0	0	5	3	3	3	3	5	4	3	3	1	9	1	4	2	3	7	5	3	4	5	5	3	6	7	4	23	2	0	1	1	2	0	1	1	1	1	0	3
Notolabrus fucicola	Banded wrasse	0	0	0	1	1	0	2	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	3	12	0	1	7	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	5	7	0	1	3	1	3	6	4	2	3	2	0	0	0	0	0	0	0	0	0	0	1	0	4	1	3	0	2	0	3	0	0	1	0	0	0	2	0	0	1	1	0	1	0	0	2	1
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	8	10	4	0	1	19	0	19	1	0	0	0	0	0	0	0	1	0	3	2	1	1	0	0	1	2	0	0	23	0	0	0	0	0	0	0	4	2	0	0	2	2	0	1	1	2	2	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicolenus percoides	Sea perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	2	1	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	4	6	5	3	2	2	1	1	1	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0
	Habitat	**Boulder**												**Bedrock**												**Bedrock**												**Boulder**											
	Depth (m)	**6 - 12.5**												**5.5 - 10**												**8 - 10.5**												**8 - 12**											

Appendix 5 Visual fish data collected in February 2005 from boulder substrata from the Abel Tasman.

Site B5												Site B6												Site B8												Site B10												Site B12											
0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	3	4	1	3	5	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	2	2	0	0	0	2	1	2	0	0	0	2	2	2	2	1	1	0	2	4	0	0	3	1	0	1	0	0	0	0	1	0	0	0	1
3	1	0	2	3	2	5	3	12	0	0	1	0	2	1	0	1	0	2	1	0	0	3	2	26	1	1	1	1	1	2	0	1	0	1	0	20	13	7	4	24	8	6	9	8	1	10	9	3	4	14	8	2	1	5	4	1	1	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	2	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	19	10	0	0	1	0	0	0	0	0	0
0	0	0	0	1	0	3	3	4	0	0	1	1	0	0	0	1	0	3	1	0	1	0	1	0	1	0	0	0	0	0	0	2	2	2	0	0	0	0	1	0	1	0	0	0	1	1	0	0	2	8	0	0	3	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	1	1	1	1	0	0	0	1	0	0	2	0	0
2	0	0	0	2	1	6	16	0	0	0	0	1	0	1	5	0	1	1	3	3	25	3	0	2	0	1	1	0	1	0	8	3	1	0	0	1	0	0	1	1	3	1	0	0	1	0	8	2	1	13	0	0	1	3	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0
1	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	26	0	1	2	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	7	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Boulder												**Bedrock/boulder**												**Boulder**												**Bedrock**												**Boulder**											
7.5 - 12												**8 - 13**												**8 - 15**												**4 - 8**												**8 - 13**											

Appendix 5 Visual fish data collected in February 2005 from boulder substrata from the Abel Tasman.

Site B14											
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
0	7	1	6	7	4	4	7	7	3	6	4
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	2	0	1	0
0	0	0	1	0	0	1	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	5	0
9	7	1	0	0	4	0	4	2	1	2	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	2	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
9	4	0	0	0	0	0	13	1	0	2	9
Boulder/algae											
6.5 - 11											

Site B15											
0	0	1	0	0	0	2	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	6	7	5	3	5	1	0	3	1	2
0	2	1	0	0	2	0	0	0	0	0	0
0	0	0	0	1	2	0	0	0	0	0	0
0	6	3	5	2	3	0	2	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	2	0	2	1	0	1	0	1	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0
1	1	0	0	0	0	1	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	3	0	0	1	0	0
Boulder											
6.5 - 12											

Site B16											
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	3	0	4	4	1	2	5	6	4	16
0	0	0	0	0	0	0	0	0	0	0	0
0	5	0	0	1	7	0	0	2	0	0	8
1	0	0	0	0	4	0	0	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	2	0	13
2	1	6	6	0	10	1	40	5	1	2	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	3	1	0	4
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	3	0	0	1	0	0	0	2	0	0
Boulder											
8 - 12											

Site B17											
1	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
15	12	14	4	0	1	0	4	2	3	2	2
0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	1	1	0	0	0	0	0	0
3	7	11	0	2	0	0	4	2	0	3	0
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
5	4	8	0	0	0	0	0	1	0	0	0
Boulder											
5 - 8											

Appendix 5. Visual fish data collected in April-May 2006 from boulder substrata from the Abel Tasman.

Species	Common Name	Site B1											
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	4	0	4	9	12	6	2	4	1	1	4	5
Notolabrus fucicola	Banded wrasse	0	0	2	3	0	2	1	0	1	0	0	1
Caesioperca lepidoptera	Butterfly perch	0	2	0	0	0	0	0	0	5	1	2	4
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	0	1	0	0	1	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	1	0	0	1	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	2	1	1	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0
Helicolenus percoides	Sea perch	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	0	0	0	0	0	0	0
	Habitat	**Boulder**											
	Depth (m)	**6 - 12.5**											

Species	Common Name	Site B2											
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	4	7	4	1	0	3	10	2	0	2	10	1
Notolabrus fucicola	Banded wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	0	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	1	0
Helicolenus percoides	Sea perch	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	0	0	0	0	0	1	0	0	1	0	1	0
	Habitat	**Bedrock**											
	Depth (m)	**5.5 - 10**											

Appendix 6 Visual fish data collected in April-May 2006.

Site B3											
1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0
3	3	4	1	3	3	6	2	4	5	3	2
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock											
8 - 10.5											

Site B4											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
5	3	3	4	6	25	2	2	1	3	1	6
0	0	0	0	0	1	0	0	0	0	0	1
1	0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	3	1	2	2	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	2	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	2	0	0	0	0	0
Boulder											
7 - 12											

Site B5											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1	0	0	0
2	0	6	50	16	5	4	2	7	3	1	1
0	0	0	0	0	0	0	0	0	0	0	0
11	8	2	2	6	0	0	0	0	0	0	0
1	2	0	1	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	1	1	0	0	0	0	0
5	6	30	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
6 - 11											

Appendix 6 Visual fish data collected in April-May 2006.

Site B6											
1	1	0	0	0	0	0	0	0	1	1	3
0	0	0	4	0	0	0	0	0	0	1	2
2	2	4	2	7	5	2	1	1	8	12	7
0	2	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	1	0	0
1	1	0	0	0	3	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
Bedrock/boulder											
7 - 12											

Site B7											
0	0	0	0	0	1	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	3	6	1	9	3	4	9	9	1
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	5	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Boulder											
8 - 15											

Site B8											
3	3	0	0	0	0	0	0	3	0	0	0
0	0	1	0	0	0	3	0	0	0	0	0
20	17	38	20	19	23	4	31	46	14	6	13
0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0
Bedrock											
4 - 8											

Site B9												Site B10												Site B11											
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	6	0	1	3	0	2	2	1	1	4	13	6	24	15	7	3	9	9	15	3	5	21	1	0	1	0	0	2	4	5	3	7	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	5	2	0	0	0	2	6	2	1	1	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3	4	0	0	0	0	0	0	0	0	0	2	2	0
Boulder												**Boulder/algae**												**Boulder**											
8 - 13												**6.5 - 11**												**6.5 - 12**											

Appendix 6 Visual fish data collected in April-May 2006.

Site B12												Site B13											
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	2	5	1	2	3	1	1	0	3	2	0	28	9	2	4	2	1	13	14	11	23	7	6
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	1	2	0	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	1	0	0
Boulder 8 - 12												**Boulder 5 - 8**											

Appendix 7. Visual fish data collected in February 2007 from boulder substrata from the Abel Tasman.

Species	Common Name	Site 1 Separation Point												Site 2 Totaranui north											
Parapercis colias	Blue cod < 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Parapercis colias	Blue cod = 30 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus celidotus	Spotty	2	1	1	0	0	2	0	3	4	0	4	5	2	4	3	2	3	3	2	2	7	3	6	6
Notolabrus fucicola	Banded wrasse	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caesioperca lepidoptera	Butterfly perch	1	10	0	2	9	21	4	6	19	4	2	15	0	0	0	0	0	0	0	0	0	0	0	0
Pseudolabrus miles	Scarlet wrasse	5	3	1	3	2	4	1	1	0	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0
Odax pullus	Butterfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilodactylus nigripes	Magpie moki	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latridopsis ciliaris	Blue moki	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemadactylus macropterus	Tarakihi	0	0	0	0	0	20	1	0	15	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Cheilodactylus spectabilis	Red moki	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aplodactylus arctidens	Marblefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scorpis lineolatus	Sweep	0	0	0	0	2	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Parika scaber	Leatherjacket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicolenus percoides	Sea perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upeneichthys lineatus	Goatfish	1	1	0	0	2	2	0	2	1	0	0	0	0	2	0	0	5	3	0	0	0	0	0	0
	Habitat	**Boulder**												**Bedrock**											
	Depth (m)	**6 - 12.5**												**6 - 10**											

Appendix 7. Visual fish data collected in February 2007 from boulder substrata from the Abel Tasman.

Site 3 Totaranui Reef												Site 4 Awaroa Head												Site 5 Canoe Bay											
0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5	8	6	7	9	12	9	7	7	8	3	4	1	3	3	5	4	2	3	3	4	6	2	0	1	0	0	2	11	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	4	1	0	0	0	0
2	2	2	0	1	0	2	1	2	0	1	0	0	1	0	0	0	0	1	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	2	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
1	1	0	5	0	0	0	0	1	1	4	0	1	0	1	0	1	0	2	2	1	0	9	0	0	1	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2	0	0	1	0	0	0	1	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	4	0	4	2	0	0	1	1	1	3	2	0	0	0	0	1	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Bedrock												**Boulder**												**Boulder**											
7 - 12												**7 - 12**												**7 - 12**											

Appendix 7. Visual fish data collected in February 2007 from boulder substrata from the Abel Tasman.

Site 6 Abel Head											
0	0	0	1	0	1	0	0	0	0	0	1
0	0	0	0	0	2	1	1	1	0	0	1
5	6	5	5	10	8	4	2	3	5	2	26
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	1	4	0	0	0	2	0	2	2	1	3
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	1	0	0
0	0	0	2	1	7	1	1	0	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0	1	0	0
Bedrock/boulder											
9 - 12											

Site 7 Cottage Loaf											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	6	0	0
1	2	3	1	5	2	0	5	3	3	1	2
0	0	0	0	0	0	0	0	0	0	0	0
0	0	9	0	0	0	0	1	1	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
Bedrock											
7 - 12											

Site 8 Reef Point											
0	0	2	0	2	0	0	0	0	0	2	1
1	1	1	0	2	0	1	2	2	0	0	1
0	52	26	6	7	4	1	1	5	1	2	5
0	0	0	0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	3	0	0	0
0	0	0	0	4	0	0	2	1	0	0	2
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	1	0	0	0
Boulder/algae											
6.5 - 10											

Appendix 7. Visual fish data collected in February 2007 from boulder substrata from the Abel Tasman.

Site 9 Tonga Island east											
0	2	0	0	1	0	1	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0	0
2	2	1	2	4	3	5	7	2	14	3	1
0	0	0	0	0	0	1	2	0	0	0	0
0	2	2	3	2	12	0	0	0	10	2	0
0	1	2	0	2	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
1	2	1	0	0	0	0	0	0	1	0	0
0	1	1	0	1	0	0	1	1	0	1	0
0	0	0	0	0	0	0	1	0	0	0	0
0	2	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	5	0	0	0	0	0	2	0	0	0	0
Boulder											
7.5 - 12											

Site 10 Foul Point											
0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	1	0	0	2	0	0	0	0	0
10	5	5	2	7	1	22	6	14	4	4	8
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	15	1	0	0	2	0	1	0	0
0	1	0	1	1	0	0	1	1	0	0	1
0	0	0	1	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
1	2	2	0	0	1	5	6	6	0	7	0
Boulder											
6 - 9.5											

Site 11 Whale Rock											
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	1	1	1	1	12	4	0	0	9	13	9
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	2	0	1	0	0	0	0
0	2	2	0	0	3	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	2
0	1	0	0	0	0	0	0	0	0	2	0
0	0	0	0	0	1	0	0	0	1	2	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
2	3	1	0	0	0	0	0	0	0	0	0
Boulder											
4 - 11											

Appendix 7. Visual fish data collected in February 2007 from boulder substrata from the Abel Tasman.

Site 12 Bark Bay Reef												Site 13 Totara Rock											
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	10	1	4	3	5	2	6	1	3	0	1	3	1	2	5	4	1	10	3	2
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	1	2	2	3	0	1	4	0	0	0	0	7	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	1	5	0	2	4	0	0	2	0	0	0	12	2	4	1	1	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2	1	0	1	0	1	0	2	0
Boulder 7 - 12												**Boulder 4 - 8**											

Appendix 8. Lobster sizes from December 2002.

Shallow

Sample site	Treatment	Number	Depth	1	2	3	4	5	Total Reserve	Total Control	Total All sites
Separation Point	Control	1	7	3	0	1	1	3		8	8
Awaroa Head	Control	2	7	0	0	0	0	7		7	7
Cottage Loaf	Reserve	3	7	0	0	2	3	7	12		12
Tonga Island	Reserve	4	7	1	0	0	4	2	7		7
Foul Point	Reserve	5	6	26	8	5	4	13	56		56
Whale Rock	Reserve	6	7	0	0	0	1	3	4		4
Mosquito Bay	Reserve	7	7	3	6	9	5	7	30		30
Bark Bay Reef	Control	8	7	0	0	0	0	0		0	0
Pitt Head	Control	10	7	3	0	3	0	0		6	6
									109	21	130

Deep

Sample site	Treatment	Number	Depth	1	2	3	4	5	Total Reserve	Total Control	Total All sites
Separation Point	Control	1	10	0	13	20	31	9		73	73
Awaroa Head	Control	2	11	0	0	1	0	0		1	1
Cottage Loaf	Reserve	3	11	3	0	0	3	9	15		15
Tonga Island	Reserve	4	10	7	3	1	7	11	29		29
Foul Point	Reserve	5	10	3	11	0	0	2	16		16
Whale Rock	Reserve	6	10	0	0	1	0	3	4		4
Mosquito Bay	Reserve	7	9	13	0	0	1	8	22		22
Bark Bay Reef	Control	8	11	0	0	1	0	3		4	4
Pitt Head	Control	10	10	0	0	3	1	0		4	4
									86	82	168

Appendix 9. Lobster sizes from February 2004.

Shallow

Sample site	Treatment	Number	1	2	3	4	5	Total Reserve	Total Control	Total All sites
Separation Point	Control	1	1	0	0	0	8		9	9
Awaroa Head	Control	2	0	0	1	0	1		2	2
Cottage Loaf	Reserve	3	0	0	0	3	4	7		7
Tonga Island	Reserve	4	0	0	1	1	5	7		7
Foul Point	Reserve	5	1	12	2	0	0	15		15
Whale Rock	Reserve	6	3	0	0	4	0	7		7
Mosquito Bay	Reserve	7	0	2	3	4	11	20		20
Bark Bay Reef	Control	8	0	0	0	0	0		0	0
Totara Rock	Control	9	0	2	0	0	0		2	2
Pitt Head	Control	10	3	0	0	3	0		6	6
								56	19	75

Deep

Sample site	Treatment	Number	1	2	3	4	5	Total Reserve	Total Control	Total All sites
Separation Point	Control	1	23	15	12	6	6		62	62
Awaroa Head	Control	2	0	1	0	1	1		3	3
Cottage Loaf	Reserve	3	0	0	0	1	16	17		17
Tonga Island	Reserve	4	1	0	7	7	2	17		17
Foul Point	Reserve	5	12	9	0	0	0	21		21
Whale Rock	Reserve	6	1	3	0	3	1	8		8
Mosquito Bay	Reserve	7	2	7	0	7	4	20		20
Bark Bay Reef	Control	8	0	0	1	3	1		5	5
Totara Rock	Control	9	8	4	0	0	0		12	12
Pitt Head	Control	10	0	0	2	0	0		2	2
								83	84	167

Appendix 10. Lobster sizes and density from shallow quadrats in April 2006.

Site name	Site no.	Treatment	N quadrats	Depth (m)	Habitat	Number per quadrat					Total n	Sex (includes extras outside quadrats)				Density ($100m^2$)	SD	SE
SHALLOW						1	2	3	4	5		Male	Female	Juvenile	Unknown			
Cottage Loaf	RL1	Reserve	10	5-7 m	Boulder	2	0	6	7	0	15	11	3	1	0	3.00	3.32	1.05
Tonga Island	RL2	Reserve	10	5-7 m	Boulder	9	6	2	5	1	23	16	5	1	1	4.60	3.21	1.01
Foul Point	RL3	Reserve	10	5-6 m	Boulder	9	4	9	4		26	10	8	6	2	6.50	2.89	0.91
Whale Rock	RL4	Reserve	10	5-7 m	Boulder	18	12	8	3	6	47	24	21	2	0	9.40	5.81	1.84
Mosquito Bay	RL5	Reserve	10	7-6 m	Boulder	1	5	0	0	0	6	3	3	0	0	1.20	2.17	0.69
Separation Point	CL1	Control	10	5-6 m	Boulder	4	2	2	10	3	21	9	4	3	5	4.20	3.35	1.06
Awaroa Head	CL2	Control	10	5-7 m	Boulder	0	3	2	0	0	5	0	3	1	1	1.00	1.41	0.45
Bark Bay Reef	CL3	Control	10	5-7 m	Boulder	0	1	2	0	0	3	1	0	2	0	0.60	0.89	0.28
Totara Rock	CL4	Control	10	5-6 m	Boulder	2	1	3	1	3	10	1	3	4	2	2.00	1.00	0.32
Pitt Head	CL5	Control	10	5-6 m	Boulder	0	0	2	0	2	4	2	2	0	0	0.80	1.10	0.35

Shallow		Number	Density ($100m^2$)	SD	SE
ALL	RESERVE	117	4.88	4.48	0.90
ALL	CONTROL	43	1.72	2.13	0.43

Appendix 11. Lobster sizes and density from deep quadrats in April 2006.

Site name	Site no.	Treatment	N quadrats	Depth (m)	Habitat	Number per quadrat					Total n	Sex (includes extras outside quadrats)				Density (100m^2)	SD	SE
DEEP						1	2	3	4	5		Male	Female	Juvenile	Unknown			
Cottage Loaf	RL1	Reserve	10	5-7 m	Boulder	1	1	2	4	2	10	8	2	0	0	2.00	1.22	0.39
Tonga Island	RL2	Reserve	10	5-7 m	Boulder	10	3	3	6	15	37	16	17	2	2	7.40	5.13	1.62
Foul Point	RL3	Reserve	10	5-6 m	Boulder	4	8	11	9	8	40	20	12	5	3	8.00	2.55	0.81
Whale Rock	RL4	Reserve	10	5-7 m	Boulder	10	4	8	3	11	36	23	11	0	2	7.20	3.56	1.13
Mosquito Bay	RL5	Reserve	10	7-6 m	Boulder	10	12	18	3	0	43	6	33	0	4	8.60	7.20	2.28
Separation Point	CL1	Control	10	5-6 m	Boulder	6	8	8	0	13	35	11	7	12	5	7.00	4.69	1.48
Awaroa Head	CL2	Control	10	5-7 m	Boulder	0	0	1	1	1	3	2	0	1	0	0.60	0.55	0.17
Bark Bay Reef	CL3	Control	10	5-7 m	Boulder	1	3	1	0	0	5	2	1	2	0	1.00	1.22	0.39
Totara Rock	CL4	Control	10	5-6 m	Boulder	0	0	2	4	1	7	2	3	2	0	1.40	1.67	0.53
Pitt Head	CL5	Control	10	5-6 m	Boulder	1	0	3	2	0	6	3	1	1	1	1.20	1.30	0.41

Deep		Number	Density (100m^2)	SD	SE
ALL	RESERVE	166	6.64	4.72	0.94
ALL	CONTROL	56	2.24	3.27	0.65

Appendix 12. Lobster sizes and density from shallow quadrats in February 2007.

Site name	Site no.	Treatment	N quadrats	Depth (m)	Habitat	Number per quadrat					Total n	Sex (includes extras outside quadrats)				Density ($100m^2$)	SD	SE
SHALLOW						1	2	3	4	5		Male	Female	Juvenile	Unknown			
Cottage Loaf	RL1	Reserve	10	5-7 m	Boulder	4	2	2	1	0	9	3	5	1	0	1.80	1.48	0.47
Tonga Island	RL2	Reserve	10	5-7 m	Boulder	4	7	1	3	3	18	9	7	1	1	3.60	2.19	0.69
Foul Point	RL3	Reserve	10	5-6 m	Boulder	3	2	0	0	4	9	6	2	3	1	1.80	1.79	0.57
Whale Rock	RL4	Reserve	10	5-7 m	Boulder	1	0	0	1	1	3	1	1	1	0	0.60	0.55	0.17
Mosquito Bay	RL5	Reserve	10	7-6 m	Boulder	4	6	10	14	16	50	13	18	12	8	10.00	5.10	1.61
Separation Point	CL1	Control	10	5-6 m	Boulder	3	1	0	17	6	27	6	2	7	12	5.40	6.88	2.17
Awaroa Head	CL2	Control	10	5-7 m	Boulder	1	0	0	1	1	3	1	0	0	2	0.60	0.55	0.17
Bark Bay Reef	CL3	Control	10	5-7 m	Boulder	0	0	0	0	4	4	1	0	1	2	0.80	1.79	0.57
Totara Rock	CL4	Control	10	5-6 m	Boulder	4	2	0	2	1	9	6	1	1	1	1.80	1.48	0.47
Pitt Head	CL5	Control	10	5-6 m	Boulder	0	4	0	0	0	4	0	2	0	2	0.80	1.79	0.57

Shallow		Number	Density ($100m^2$)	SD	SE
ALL	RESERVE	89	3.56	4.22	0.84
ALL	CONTROL	47	1.88	3.57	0.71

Appendix 13. Lobster sizes and density from deep quadrats in February 2007.

Site name	Site no.	Treatment	N quadrats	Depth (m)	Habitat	Number per quadrat					Total n	Sex (includes extras outside quadrats)				Density (100m^2)	SD	SE
DEEP						1	2	3	4	5		Male	Female	Juvenile	Unknown			
Cottage Loaf	RL1	Reserve	10	5-7 m	Boulder	4	2	3	4	0	13	9	2	2	0	2.60	1.67	0.53
Tonga Island	RL2	Reserve	10	5-7 m	Boulder	0	23	15	3	13	54	25	26	3	0	10.80	9.34	2.95
Foul Point	RL3	Reserve	10	5-6 m	Boulder	0	0	2	16	0	18	5	3	9	1	3.60	6.99	2.21
Whale Rock	RL4	Reserve	10	5-7 m	Boulder	3	2	3	4	12	24	14	8	1	1	4.80	4.09	1.29
Mosquito Bay	RL5	Reserve	10	7-6 m	Boulder	5	23	11	12	23	74	35	30	8	1	14.80	7.95	2.51
Separation Point	CL1	Control	10	5-6 m	Boulder	0	2	10	9	0	21	9	3	7	2	4.20	4.92	1.56
Awaroa Head	CL2	Control	10	5-7 m	Boulder	0	0	2	0	3	5	2	2	0	1	1.00	1.41	0.45
Bark Bay Reef	CL3	Control	10	5-7 m	Boulder	0	0	1	1	0	2	1	0	1	0	0.40	0.55	0.17
Totara Rock	CL4	Control	10	5-6 m	Boulder	2	1	2	1	3	9	4	1	3	1	1.80	0.84	0.26
Pitt Head	CL5	Control	10	5-6 m	Boulder	0	0	1	0	0	1	1	0	0	0	0.20	0.45	0.14

Deep		Number	Density (100m^2)	SD	SE
ALL	RESERVE	183	7.32	7.71	1.54
ALL	CONTROL	38	1.52	2.60	0.52

Appendix 14 Shore profile data for ATNP, March 2001.

SITE	1	1	1	2	2	2	3	3	3
Distance (m)	Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% algae
0	0	bedrock	0	0		*2% C.maschalocarpum*	0	bedrock	0
5	0.1	bedrock	0	0.2	boulder	*3% C.maschalocarpum*	1.4	bedrock	0
10	1.6	bedrock	*2 % C. maschalocarpum*	0.3	boulder	*1% C.maschalocarpum*	3.9	bedrock/sand	0
15	3.5	boulder	0	1.4	boulder	0	3.7	boulder/cobble	0
20	3.9	boulder	0	1.4	boulder	*5% C.flexuosum*	3.7	bedrock/cobble	0
25	4.9	boulder/sand	0	2.1	boulder	0	4	bedrock/sand	0
30	4.8	boulder/cobble	0	2.8	boulder	0	4.1	bedrock/sand	0
35	5.4	boulder	0	3.2	boulder	0	4.5	bedrock/sand	0
40	5.5	boulder/bedrock	0	3.6	boulder/gravel	0	4.7	bedrock/sand	0
45	5.8	boulder/bedrock	0	4	boulder/cobble	0	4.7	bedrock/sand	0
50	6.8	boulder/bedrock	0	4.2	boulder/cobble	0	5	bedrock/sand	0
55	7.9	bedrock/sand	0	4.2	boulder/cobble	0	5.3	bedrock/sand	0
60	8.2	boulder/sand	0	4.6	boulder/cobble	*1% C.maschalocarpum*	5.3	bedrock/boulder	0
65	8.5	boulder	0	5.3	boulder/cobble	*10% C.maschalocarpum*	6.3	bedrock/boulder	0
70	9.7	boulder/sand	0	6.6	boulder	*5% C.maschalocarpum*	6.6	bedrock/boulder	0
75	10.6	boulder/sand	0	8.5	boulder	0	7.3	boulder/sand	0
80	11.6	boulder	0	10.8	boulder	0	7.5	boulder/sand	0
85	12.9	boulder/sand	0	12.2	sand/shell		8	sand/cobble	0
90	14.6	boulder/sand	0	12.6	sand/shell		8.3	sand/shell	0
95	15.7	shell/sand	0	12.7	sand/shell		8.3	sand/shell	0
100	15.8	shell/sand	0	12.7	sand/shell		8.5	sand/shell	0
105				12.9	sand/shell				
110				13.1	sand/shell				
115				13.3	sand/shell				
120				13.6	sand/shell				
125				13.9	sand/shell				
130				14.2	sand/shell				
135				14.5	sand/shell				
140				14.7	sand/shell				
145				14.9	sand/shell				
150				15.2	sand/shell				

Appendix 14 (continued). Shore profile data for ATNP, March 2001.

4	4	4	5	5	5	6	6	6
Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% cover algae
0	bedrock/boulder	*50% C.flexuosum*	0	boulder/gravel	*5% Cystophora sp. 5% C.flexuosum*	0	boulder	*10% C.maschalocarpum*
2.8	bedrock/boulder	*60% C.flexuosum*	0.7	boulder/sand	*2% C.flexuosum*	1.3	boulder/cobble	*5% C.flexuosum*
5	boulder/sand	*40% C.flexuosum*	1.3	boulder/sand	*1% C.flexuosum*	2.3	boulder/bedrock	*5% C.flexuosum*
4.5	boulder/sand	*40% C.flexuosum*	1.8	boulder/sand	*0.5% C.flexuosum*	3.4	boulder	0
5	boulder/silt	*30% C.flexuosum*	2	boulder/sand	*0*	3.7	boulder	0
5.4	boulder/silt/shell	*0*	2.3	sand/shell	0	5.7	boulder	0
5.1	boulder/silt/shell	0	2.4	boulder/shell	0	7.9	boulder/sand	0
6.5	boulder/silt/shell	0	0.2	boulder	0	8.5	sand/shell	0
6.7	boulder/silt/shell	0	1.6	boulder/sand	0	8.8	sand/shell	0
7	boulder/sand/shell	0	2.5	bedrock	0	9.3	sand/boulder	0
7.2	boulder/sand/shell	0	4.4	bedrock/boulder	0	8.2	boulder	0
8.2	boulder/sand/shell	0	6	gravel/sand	0	10.9	sand/shell	0
8.2	sand/shell	0	6.7	cobble/sand	0	11.4	sand/shell	0
8.2	sand/shell	0	7.5	sand/silt	0	11.8	silt/shell	0
8.3	sand/shell	0	7.8	sand/shell	0	12.1	silt/shell	0
8.4	sand/shell	0	8	sand/shell	0	12.3	silt/shell	0
8.5	sand/shell	0	8.1	sand/shell	0	12.7	silt/shell	0
8.5	sand/shell	0	8.4	sand/shell	0	13.1	silt/shell	0
8.6	sand/shell	0	8.6	sand/shell	0	13.7	shell/sand	0
8.6	sand/shell	0	8.8	sand/shell	0	14.1	shell/sand	0
8.8	sand/shell	0	9	sand/shell	0	14.3	shell/sand	0
8.9	sand/shell	0	9.2	sand/shell	0	15.3	shell/sand	0
9	sand/shell	0	9.5	sand/shell	0	15.7	shell/sand	0
9	sand/shell	0	9.6	sand/shell	0	15.9	shell/sand	0
9	sand/shell	0	9.8	sand/shell	0	16.2	shell/sand	0
9.1	sand/shell	0	10	shell/silt	0	17.1	shell/sand	0
9.1	sand/shell	0	10.2	shell/silt	0	17.3	shell/sand	0
9.1	sand/shell	0	10.3	shell/silt	0	17.5	shell/sand	0
9.2	sand/shell	0	10.4	shell/silt	0	17.7	shell/sand	0
9.2	sand/shell	0	10.5	shell/silt	0	17.9	shell/sand	0
9.2	sand/shell	0	10.6	shell/silt	0	18	shell/sand	0

Appendix 14 (continued). Shore profile data for ATNP, March 2001.

7	7	7	8	8	8	9	9	9
Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% cover algae	Depth (m)	Substratum	% cover algae
0	boulder/sand	*10% C.mascholocarpum/2% Cystophora*	0	bedrock/boulder	*60% C.maschalocarpum*	0	boulder/bedrock	10% C.flexuosum
0	boulder/sand	*5% C.maschalocarpum/10% Cystophora*	2.6	bedrock/boulder	0	3.2	boulder	0
0.3	boulder/sand	*8% C.maschalocarpum/6% Cystophora*	4.7	bedrock/boulder	0	2.8	boulder	0
0.5	sand	0	5.9	bedrock/boulder	0	3.1	boulder	0
0.5	sand	0	7.1	bedrock/boulder	0	2.9	boulder	0
0.8	sand	0	7.1	bedrock/boulder	0	3.7	boulder	0
1.1	sand/shell	0	8.5	bedrock/boulder	0	3.9	boulder	0
1.3	sand/boulder	0	9.5	bedrock/boulder	0	5	boulder	2% C.flexuosum
1.5	sand/boulder	0	10.4	bedrock/boulder	0	5.4	boulder	1% C.flexuosum
0.6	sand/boulder	0	11.3	bedrock/boulder	0	5.8	boulder	1% C.flexuosum
1.7	sand	0	13	bedrock/boulder	0	7.1	boulder	2% C.flexuosum
2	sand	0	13.7	sand/shell	0	8.1	boulder	2% C.flexuosum
2.2	sand	0	13.8	sand/shell	0	9.4	boulder	0
2.4	sand	0	13.7	sand/shell	0	10.5	boulder/bedrock	0
2.7	sand	0	13.9	sand/shell	0	12	boulder/silt	0
2.9	sand	0	14	sand/shell	0	12.7	boulder/silt	0
3	sand	0	14.1	sand/shell	0	13.6	boulder/silt	0
3.1	sand	0	14.3	sand/shell	0	14.6	boulder/silt	0
3.3	sand	0	14.4	sand/shell	0	15.1	silt/shell	0
3.5	sand	0	14.5	sand/shell	0	15.4	silt/shell	0
3.6	sand	0	14.6	sand/shell	0	15.8	silt/shell	0
3.9	sand	0	14.7	shell/silt	0	16.3	silt/shell	0
4	sand	0	14.9	shell/silt	0	16.7	silt/shell	0
4.1	sand	0	15	shell/silt	0	17.2	silt/shell	0
4.2	sand	0	15.2	shell/silt	0	17.5	silt/shell	0
4.3	sand	0	15.3	shell/silt	0	17.9	silt/shell	0
4.5	sand	0	15.4	shell/silt	0	18.3	silt/shell	0
4.6	sand	0	15.4	shell/silt	0	18.5	silt/shell	0
4.8	sand	0	15.5	shell/silt	0	18.9	silt/shell	0
4.8	sand	0	15.6	shell/silt	0	19.1	silt/shell	0
5	sand	0	15.7	shell/silt	0	19.3	silt/shell	0

Appendix 15. Raw benthic quadrat data collected in March 2001 from the ATNP coastline.

SITES	1								2							
Species	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Aaptos aaptos																
Ancorina alata						2		1								
Aplysilla sulphurea (%)																
Crella incrustans (%)											1					
Callyspongia sp																
Chelonaplysilla violacea (%)			1	1												
Celleporaria agglutinans (%)																
Watersipora cucullata (%)				2	2											
Actinothoe albocincta																
Alcyonium aurantiacum								2								
Corynactis haddonni																
Culicia rubeola					35		55	3				15			15	
Magasella sanguinea																
Cantharadus purpureus																
Cellana spp.								1	16	115	12		2	3	12	4
Cheidothaerus albidus		1	2													
Chitons spp.																
Cookia sulcata			2	2		3	1			1	3	2	1	4	4	
Chromodoris amoena																
Haustorum haustorium																
Haliotis iris																
Maoricolpus roseus													1			
Mauria spp.								1								
Modiolarca impacta																
Monia zelandica						2	3			1		4			2	1
Pecten novaezelandiae																
Trochus spp.		1	5	9		2		2		1	1		2		2	8
Unidentified whelk	1	1		2	1				1							
Turbo granosus																
Turbo smaragdus	2								3	7		11	12	11	3	7
Galeolaria hystrix										1	6			1	3	
Allostichaster insignis																
Coscinasterias calamaria																
Evechinus chloroticus	4			1				2	4	5		1	6	6	2	4
Patiriella regularis									1	1		1	1	1		
Pectinura maculata																
Pentagonaster pulchellus																
Pseudechinus albocinctus																
Stichaster australis																
Stichopus mollis												1				
Aplidium sp. (%)																
Aplidium benham																
Leptoclinides sp. (%)																
Cnemidocarpa bicornuata	3	1				1	2									
Unidentified warty squirt	1			1	1	4	3	5								
Didemnium sp. (%)			1	1	1	1		1								
Carpophyllum flexuosum (%)	1	1	2	1	5	2	2	1								
Carpophyllum flexuosum (stipes)	45	47	7	1	12	13	22	4								
Corallina (%)	3	25	35	4	35	15	15	2	25	75	7	75	8	6	85	8

Appendix 15 (continued). Raw benthic quadrat data collected in March 2001 from the ATNP.

3								4								5							
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
																				2	2		
	2	1	2				1			1		1							1	1		2	
						1								1	1		1						
5	15	5	1			55	1	3	2	4	35	2	22	8		15	4	3	1	1	4	35	8
		2	2			1		4		5	1	3	3	1	2		2	3		2		1	2
3	1	1			7			3		1	1	1		3	1					1	1		
				1																			
8	5		1				2																
2		1	2	2	14	2	1	3	4			5	21			1							
2	8	1	8		8	3	4	18	18	25	13	9		3	14		1		1	2	1	12	7
	2											3			3	1				1			
	1	1			1			2	5	4					2	4		3	1		9	1	
2	3	1	1		1	1	1		5			3	1		1		1	1	2	3	2	1	1
				1	2	2						1		1		3	4			1	1	1	
								1					1			1							
																1		1		1	1	1	1
1																							1
	1		2			1																	
			1	1	1	1	1	1	2	1	1	2		1					1	1			1
2				1	75		8							1	1								
13				45	48		28							4	1								
9	9	85	92	85	75	94	6	8	7	8	95	85	7	92	9	95	98	97	9	85	98	95	9

Appendix 15 (continued). Raw benthic quadrat data collected in March 2001 from the ATNP.

6										7								8							
1	2	3	4	5	6	7	8	9	1	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
								1																	
																1									
	1			1	1		1	1																	1
										1	5	1	1		1		2	1							1
				35						5	45	13	2	4	1	45	3	15	8	35	3	45	5	25	
			1														1	2		2			2	1	1
											1														
2	1	3	4	1	1	3	2		2		2	2				1		1	1			3	2		
														1					2						
		1			3			1		2	1			7		1	2	8	2			2	1	2	1
1	2	18	4	2	3	6	5	5	7		1		4						1	2	3	1			
													1	1					1		3			18	3
	1	1			2		2	3	1			2			1	1		7	1	5	4	4	4	1	5
																				3					
												1													
			1									1	5	5	1		2	2		1	3				1
						3	1		1		1	1		1	3			1		3			3		1
	1																								
						1				1									2			1			1
				2	1					1															1
										3	4			1	5		3					1	1	3	1
																		1							
8	6	35	95	6	1	1	1	5	2					1	1			2	1	5	1	1	15	4	1
56	31	38	48	38	35	27	32	15	13					2	3			15	4	24	1	1	35	4	6
7	9	8	9	92	95	9	8	9	9	1	3	55	8	8	85	85	9	7	8	5	45	8	55	58	6

Appendix 15 (continued). Raw benthic quadrat data collected in March 2001 from the ATNP.

SITES	9								Mean	SD
Species	1	2	3	4	5	6	7	8		
Aaptos aaptos									0.00	0.00
Ancorina alata									1.33	0.58
Aplysilla sulphurea (%)									0.00	0.00
Crella incrustans (%)	1								1.40	0.55
Callyspongia sp									0.00	0.00
Chelonaplysilla violacea (%)					1				1.17	0.38
Celleporaria agglutinans (%)									0.00	0.00
Watersipora cucullata (%)			1						1.47	1.06
Actinothoe albocincta									0.00	0.00
Alcyonium aurantiacum									2.00	0.00
Corynactis haddonni									0.00	0.00
Culicia rubeola			25		1	35	3		15.33	16.42
Magasella sanguinea									0.00	0.00
Cantharadus purpureus									0.00	0.00
Cellana spp.	6	11	3	5	9	5	4	19	7.13	18.49
Cheidothaerus albidus									1.50	0.71
Chitons spp.								1	1.00	0.00
Cookia sulcata						1		2	2.03	1.27
Chromodoris amoena									1.00	0.00
Haustorum haustorium									0.00	0.00
Haliotis iris									0.00	0.00
Maoricolpus roseus				12					4.00	4.07
Mauria spp.									1.00	0.00
Modiolarca impacta									0.00	0.00
Monia zelandica	11	3	4		1	3	3	7	3.51	4.04
Pecten novaezelandiae									0.00	0.00
Trochus spp.				1	2	4		2	5.30	5.50
Unidentified whelk							1		2.59	4.06
Turbo granosus									0.00	0.00
Turbo smaragdus	5	8	5	8	7	7	5	7	4.64	3.17
Galeolaria hystrix		1	1	2		2	3		2.59	2.04
Allostichaster insignis									0.00	0.00
Coscinasterias calamaria		1	2						1.33	0.58
Evechinus chloroticus			2	1	3	3		1	2.28	1.56
Patiriella regularis	1		1			1	1		1.50	0.90
Pectinura maculata	1								1.00	0.00
Pentagonaster pulchellus									0.00	0.00
Pseudechinus albocinctus									0.00	0.00
Stichaster australis									0.00	0.00
Stichopus mollis			1						1.00	0.00
Aplidium sp. (%)								1	1.00	0.00
Aplidium benham									0.00	0.00
Leptoclinides sp. (%)									1.14	0.38
Cnemidocarpa bicornuata									1.45	0.69
Unidentified warty squirt	1								2.38	1.54
Didemnium sp. (%)									1.10	0.31
Carpophyllum flexuosum (%)									8.68	20.50
Carpophyllum flexuosum (stipes)									21.12	17.41
Corallina (%)	6	65	45	3	3	4	6	65	36.12	36.63

Appendix 16. Kina (*E. chloroticus*) densities collected from 1m^2 quadrats (April 2002). 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Depth	1	Depth	2	Depth	3	Depth	4	Depth	5	Depth	6	Depth	7
6	2	7	2	5.5	0	6	3	6.5	0	6	5	4.5	5
6	1	7	0	7	1	6.5	2	6.5	1	6.5	4	4.5	1
6	4	7.5	3	9	2	6	3	7.5	1	8.5	0	4.5	2
5.5	0	7.5	0	10	2	6	10	6.5	1	8.5	1	5	2
5.5	0	8	2	10	1	6	1	7	0	8	2	5	0
6	5	8	8	10	0	5.5	6	7.5	0	9	2	5	0
6.5	5	7.5	0	10	1	6	2	7.5	2	9.5	1	5	0
6.5	2	7	2	7.5	1	6.5	2	7	2	10	3	5	0
7	2	7	2	7	0	6	6	8.5	1	10	4	5	3
7.5	0	9	1	6.5	1	6	0	8.5	1	9.5	0	5	2
9.5	1	9	0	6.5	0	6	1	8	3	8.5	1	5	2
10	0	9	1	6	0	6	2	8.5	0	9	1	4	3
10	0	9	0	6	0	5.5	2	9	4	8	0	4	1
10	0	11	0	5	0	5.5	0	9.5	4	7	0	4	2
10	2	11	0	5.5	0	5.5	0	10	1	6.5	0	4	3
10	0	11	1	6.5	0	5	1	10	1	6.5	0	4	0
9.5	0	12	2	7	0	5.5	1	10	2	5.5	4	4	8
9.5	0	13	1	12.5	0	6	1	10	0	5	3	4	4
6	0	13	0	11	0	6	2	10	0	5.5	3	4	0
7.5	1	12	0	12	0	6	2	7	1	5	0	3.5	2
8	0	11	0	10.5	0	6	0	5.5	4	6.5	3	4	4
8	0	9.5	0	10.5	0	6	0	5	1	7	3	4	0
9.5	0	10	1	10	0	6	3	5.5	3	7	1	4	1
9.5	0	9	0	10	3	5.5	0	6	1	7.5	1	5	3
7	0	10	1	8	0	6.5	0	7.5	0	8	1	5	2
5.5	0	10	1	5	2	6.5	0	8	0	8	1	6	4
5	5	9	1	6	0	6.5	0	8	1	10	1	6	2
5	2	9	1	6	0	6.5	0	8.5	2	10	0	6	4
5	2	9.5	0	6.5	1	6	0	8	3	8.5	0	6	0
5	0	8.2	0	8	2	5.5	0	8	2	9	4	6	1
6.9	2	8	1	5	0	5	0	6.9	0	9	0	3.7	4
6.7	0	8.9	3	5.5	1	5	1	6.5	0	10	1	3.6	0
6.5	4	9.4	0	6	2	5	0	7	0	9	0	3.4	4
6.8	6	9.1	0	6.1	2	6	2	7.1	0	9	1	4.3	1
6.9	4	10.6	2	5.9	2	6	4	7.3	4	9	2	4.3	4
6.8	1	10.2	2	5.6	0	6	0	6.9	1	9	0	4.5	2
7	1	10.2	0	6.8	0	6	0	8.2	3	9	1	4.6	4
7	0	10.9	0	6.5	1	6	0	8.3	5	9	2	4.7	0
7.2	6	10.6	0	7.9	2	6	4	9.9	2	8	0	4.2	5
7.4	4	9.7	1	8.8	0	6	5	9.9	1	7	1	4.3	2
7.5	2	11.2	1	9.5	2	6	1	9.8	5	7	3	4.3	0
7.1	4	12.1	1	10	0	5	0	9.2	2	7	2	4.2	4
7.1	2	12.6	0	9.8	2	3	0	10.1	1	8	1	4.5	2
7.3	0	11.9	1	9.9	3	6	0	10.4	1	7	1	4.5	6
7.5	0	12.8	0	9.3	2	5	3	8.7	4	7	1	4.3	1
8.9	0	13	1	9.3	1	5	0	8.3	2	6	1	4.4	2
9.5	1	11.2	0	9.1	2	5	1	7.6	0	6	2	4.7	3
10.3	0	11.1	1	8.5	4	5	1	7.5	0	6	2	4.6	0
140.2	0	10.9	0	7.5	1	6	2	7.7	0	7	0	5.3	3
10	0	10.9	0	7.7	0	6	2	7.7	4	6	3	5.5	8
9.4	0	9.9	0	6.6	0	6	1	7	1	7	1	5.4	2
8	1	9.8	2	5.8	0	6	2	6.4	0	7	1	5.5	2
7.9	0	9.8	0	5.7	2	5	0	5.2	0	5	3	5.6	2
7	0	8.9	2	5.9	0	5	6	5	1	6	3	5.7	1
6.5	3	8.3	1	5.2	6	5	0	6.6	0	5	2	5.3	1
6.4	2	7.5	0	5	0	5	0	7.2	0	5	1	5.3	3
6.3	1	7	0	5	1	5	2	7.3	1	5	7	5.4	2
5.5	0	7	0	5.2	0	5	1	7.4	2	5	1	5.8	0
6	0	7	0	5.6	0	5	1	6.9	0	6	5	5.4	1
5.9	3			5.6	0	5	1	6.1	0	5	4	4.6	1
						5	2						

Appendix 17. Cook's turban (*Cookia sulcata*) densities collected in April 2002. 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Depth	1	Depth	2	Depth	3	Depth	4	Depth	5	Depth	6	Depth	7
6	3	7	17	5.5	1	6	0	6.5	4	6	0	4.5	0
6	1	7	3	7	4	6.5	0	6.5	0	6.5	2	4.5	1
6	2	7.5	4	9	6	6	0	7.5	1	8.5	0	4.5	0
5.5	0	7.5	8	10	3	6	0	6.5	0	8.5	0	5	0
5.5	1	8	1	10	1	6	0	7	1	8	0	5	4
6	1	8	1	10	0	5.5	1	7.5	1	9	2	5	0
6.5	3	7.5	3	10	0	6	1	7.5	1	9.5	0	5	0
6.5	3	7	4	7.5	2	6.5	0	7	0	10	1	5	2
7	4	7	4	7	2	6	1	8.5	0	10	0	5	0
7.5	1	9	2	6.5	4	6	0	8.5	9	9.5	1	5	2
9.5	2	9	3	6.5	3	6	2	8	4	8.5	3	5	0
10	1	9	1	6	10	6	0	8.5	2	9	0	4	2
10	3	9	2	6	7	5.5	0	9	0	8	3	4	1
10	1	11	1	5	9	5.5	0	9.5	0	7	5	4	0
10	0	11	1	5.5	5	5.5	0	10	2	6.5	2	4	3
10	0	11	4	6.5	11	5	1	10	0	6.5	7	4	0
9.5	1	12	0	7	0	5.5	0	10	0	5.5	0	4	0
9.5	5	13	0	12.5	0	6	0	10	7	5	0	4	4
6	4	13	0	11	0	6	0	10	1	5.5	0	4	0
7.5	3	12	0	12	0	6	0	7	7	5	0	3.5	0
8	3	11	0	10.5	1	6	0	5.5	3	6.5	1	4	0
8	6	9.5	1	10.5	2	6	1	5	5	7	8	4	0
9.5	7	10	0	10	0	6	1	5.5	2	7	5	4	0
9.5	5	9	1	10	0	5.5	2	6	10	7.5	2	5	0
7	0	10	0	8	1	6.5	3	7.5	4	8	0	5	0
5.5	2	10	1	5	2	6.5	2	8	0	8	1	6	0
5	0	9	0	6	0	6.5	0	8	0	10	0	6	0
5	0	9	0	6	1	6.5	2	8.5	1	10	0	6	4
5	0	9.5	1	6.5	3	6	3	8	0	8.5	3	6	0
5	1	8.2	6	8	4	5.5	0	8	2	9	0	6	0
6.9	2	8	2	5	1	5	9	6.9	1	9	1	3.7	0
6.7	0	8.9	1	5.5	2	5	1	6.5	6	10	1	3.6	1
6.5	4	9.4	1	6	0	5	1	7	2	9	1	3.4	0
6.8	6	9.1	7	6.1	0	6	3	7.1	0	9	0	4.3	1
6.9	4	10.6	0	5.9	1	6	0	7.3	2	9	0	4.3	0
6.8	1	10.2	1	5.6	7	6	1	6.9	0	9	0	4.5	0
7	1	10.2	3	6.8	1	6	4	8.2	0	9	0	4.6	0
7	0	10.9	2	6.5	1	6	1	8.3	0	9	2	4.7	0
7.2	6	10.6	1	7.9	0	6	1	9.9	2	8	1	4.2	0
7.4	4	9.7	6	8.8	3	6	0	9.9	0	7	3	4.3	2
7.5	2	11.2	0	9.5	2	6	1	9.8	2	7	0	4.3	0
7.1	4	12.1	0	10	1	5	1	9.2	3	7	1	4.2	0
7.1	2	12.6	0	9.8	1	3	9	10.1	1	8	0	4.5	0
7.3	0	11.9	0	9.9	0	6	0	10.4	0	7	1	4.5	0
7.5	0	12.8	1	9.3	1	5	0	8.7	0	7	0	4.3	3
8.9	0	13	0	9.3	0	5	1	8.3	0	6	0	4.4	8
9.5	1	11.2	4	9.1	5	5	0	7.6	1	6	0	4.7	1
10.3	0	11.1	3	8.5	1	5	0	7.5	2	6	2	4.6	1
140.2	0	10.9	0	7.5	3	6	0	7.7	2	7	7	5.3	0
10	0	10.9	1	7.7	3	6	2	7.7	3	6	0	5.5	1
9.4	0	9.9	2	6.6	1	6	3	7	0	7	0	5.4	0
8	1	9.8	0	5.8	1	6	0	6.4	1	7	3	5.5	0
7.9	0	9.8	4	5.7	0	5	0	5.2	1	5	2	5.6	1
7	0	8.9	2	5.9	0	5	0	5	0	6	1	5.7	0
6.5	3	8.3	2	5.2	0	5	2	6.6	0	5	1	5.3	0
6.4	2	7.5	4	5	0	5	3	7.2	3	5	0	5.3	0
6.3	1	7	0	5	0	5	0	7.3	0	5	3	5.4	0
5.5	0	7	0	5.2	0	5	4	7.4	1	5	2	5.8	0
6	0	7	4	5.6	0	5	0	6.9	1	6	0	5.4	0
5.9	3	0	0	5.6	0	5	4	6.1	0	5	0	4.6	0
						5	0						

Appendix 18. Density data for topshell (*Trochus* sp.) collected in April 2002. 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Depth	1	Depth	2	Depth	3	Depth	4	Depth	5	Depth	6	Depth	7
6	1	7	2	5.5	13	6	0	6.5	0	4.5	0	6	0
6	0	7	0	7	7	6.5	0	6.5	0	4.5	1	6.5	0
6	0	7.5	2	9	7	6	0	7.5	0	4.5	1	8.5	0
5.5	0	7.5	3	10	6	6	0	6.5	0	5	0	8.5	0
5.5	0	8	4	10	0	6	7	7	0	5	3	8	0
6	0	8	0	10	0	5.5	2	7.5	0	5	0	9	0
6.5	0	7.5	5	10	5	6	1	7.5	2	5	0	9.5	0
6.5	0	7	9	7.5	2	6.5	2	7	3	5	0	10	0
7	2	7	3	7	6	6	0	8.5	4	5	0	10	0
7.5	0	9	0	6.5	1	6	0	8.5	2	5	0	9.5	0
9.5	0	9	0	6.5	8	6	2	8	0	5	0	8.5	0
10	0	9	0	6	12	6	14	8.5	1	4	0	9	0
10	0	9	8	6	0	5.5	4	9	0	4	0	8	3
10	0	11	1	5	5	5.5	2	9.5	1	4	0	7	0
10	0	11	4	5.5	6	5.5	3	10	3	4	0	6.5	0
10	0	11	5	6.5	5	5	1	10	0	4	0	6.5	0
9.5	1	12	2	7	1	5.5	3	10	0	4	0	5.5	0
9.5	0	13	1	12.5	0	6	0	10	2	4	0	5	0
6	0	13	0	11	0	6	0	10	0	4	0	5.5	0
7.5	0	12	0	12	0	6	4	7	0	3.5	0	5	0
8	0	11	0	10.5	0	6	0	5.5	0	4	0	6.5	0
8	3	9.5	2	10.5	0	6	0	5	1	4	0	7	0
9.5	6	10	0	10	1	6	10	5.5	0	4	0	7	0
9.5	1	9	3	10	3	5.5	5	6	1	5	0	7.5	0
7	0	10	0	8	0	6.5	2	7.5	6	5	0	8	0
5.5	2	10	1	5	3	6.5	2	8	0	6	0	8	0
5	1	9	0	6	0	6.5	1	8	2	6	0	10	0
5	0	9	1	6	11	6.5	2	8.5	16	6	0	10	0
5	2	9.5	0	6.5	12	6	2	8	0	6	0	8.5	0
5	1	8.2	3	8	12	5.5	4	8	0	6	0	9	0
6.9	1	8	0	5	1	5	1	6.9	1	3.7	0	9	0
6.7	0	8.9	1	5.5	1	5	0	6.5	2	3.6	0	10	0
6.5	1	9.4	2	6	2	5	0	7	0	3.4	0	9	0
6.8	1	9.1	0	6.1	0	6	0	7.1	0	4.3	0	9	0
6.9	0	10.6	4	5.9	0	6	0	7.3	0	4.3	0	9	0
6.8	0	10.2	2	5.6	1	6	7	6.9	0	4.5	0	9	0
7	0	10.2	2	6.8	0	6	0	8.2	1	4.6	0	9	0
7	0	10.9	4	6.5	1	6	1	8.3	12	4.7	0	9	0
7.2	0	10.6	1	7.9	4	6	0	9.9	17	4.2	0	8	0
7.4	0	9.7	8	8.8	5	6	0	9.9	6	4.3	0	7	0
7.5	2	11.2	1	9.5	2	6	4	9.8	7	4.3	0	7	0
7.1	0	12.1	0	10	4	5	0	9.2	4	4.2	0	7	0
7.1	1	12.6	0	9.8	12	3	0	10.1	5	4.5	0	8	1
7.3	1	11.9	2	9.9	1	6	1	10.4	0	4.5	6	7	0
7.5	0	12.8	0	9.3	2	5	4	8.7	3	4.3	0	7	0
8.9	0	13	0	9.3	1	5	2	8.3	2	4.4	2	6	0
9.5	0	11.2	0	9.1	2	5	0	7.6	0	4.7	1	6	0
10.3	0	11.1	5	8.5	3	5	2	7.5	2	4.6	0	6	0
140.2	0	10.9	0	7.5	1	6	0	7.7	0	5.3	0	7	0
10	0	10.9	0	7.7	2	6	0	7.7	0	5.5	3	6	0
9.4	1	9.9	0	6.6	0	6	0	7	0	5.4	0	7	0
8	0	9.8	0	5.8	0	6	0	6.4	0	5.5	0	7	0
7.9	1	9.8	0	5.7	0	5	0	5.2	0	5.6	0	5	0
7	0	8.9	2	5.9	0	5	2	5	0	5.7	0	6	0
6.5	0	8.3	13	5.2	0	5	2	6.6	1	5.3	0	5	0
6.4	0	7.5	6	5	0	5	0	7.2	1	5.3	0	5	0
6.3	0	7	3	5	0	5	4	7.3	2	5.4	0	5	0
5.5	0	7	1	5.2	1	5	8	7.4	2	5.8	0	5	0
6	0	7	0	5.6	0	5	0	6.9	0	5.4	0	6	0
5.9	1	0	0	5.6	2	5	0	6.1	0	4.6	0	5	1
						5	0						

Appendix 19. Density data for cats eye snail (*Turbo smaragdus*) collected in April 2002. 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Depth	1	Depth	2	Depth	3	Depth	4	Depth	5	Depth	6	Depth	7
6	0	7	0	5.5	6	6	0	6.5	9	4.5	19	6	0
6	0	7	0	7	2	6.5	4	6.5	9.2	4.5	7	6.5	0
6	1	7.5	0	9	0	6	6	7.5	14	4.5	19	8.5	0
5.5	0	7.5	0	10	0	6	6	6.5	9	5	14	8.5	0
5.5	0	8	0	10	0	6	6	7	14	5	15	8	0
6	1	8	0	10	0	5.5	9	7.5	5	5	24	9	0
6.5	0	7.5	0	10	0	6	5	7.5	8	5	21	9.5	0
6.5	1	7	0	7.5	0	6.5	6	7	6	5	27	10	0
7	0	7	0	7	0	6	0	8.5	2	5	26	10	0
7.5	0	9	0	6.5	3	6	0	8.5	1	5	39	9.5	0
9.5	0	9	0	6.5	0	6	2	8	3	5	11	8.5	0
10	0	9	0	6	1	6	5	8.5	1	4	24	9	0
10	0	9	0	6	4	5.5	2	9	1	4	15	8	0
10	0	11	0	5	0	5.5	5	9.5	0	4	19	7	0
10	0	11	0	5.5	0	5.5	0	10	0	4	9	6.5	0
10	0	11	0	6.5	2	5	0	10	0	4	29	6.5	0
9.5	0	12	0	7	0	5.5	0	10	1	4	17	5.5	0
9.5	0	13	0	12.5	0	6	4	10	1	4	10	5	0
6	0	13	0	11	0	6	6	10	0	4	21	5.5	0
7.5	0	12	0	12	0	6	0	7	1	3.5	26	5	0
8	0	11	0	10.5	0	6	3	5.5	21	4	36	6.5	0
8	0	9.5	0	10.5	0	6	1	5	4	4	21	7	0
9.5	0	10	0	10	0	6	1	5.5	5	4	34	7	0
9.5	0	9	0	10	7	5.5	1	6	4	5	25	7.5	0
7	0	10	0	8	0	6.5	1	7.5	0	5	26	8	0
5.5	0	10	1	5	4	6.5	0	8	0	6	7	8	0
5	0	9	1	6	6	6.5	0	8	1	6	7	10	0
5	0	9	1	6	4	6.5	2	8.5	1	6	8	10	0
5	0	9.5	0	6.5	5	6	0	8	10	6	0	8.5	0
5	0	8.2	0	8	0	5.5	0	8	5	6	20	9	0
6.9	1	8	0	5	21	5	0	6.9	9	3.7	22	9	0
6.7	0	8.9	0	5.5	3	5	2	6.5	14	3.6	55	10	0
6.5	2	9.4	0	6	8	5	13	7	13	3.4	32	9	0
6.8	0	9.1	0	6.1	1	6	8	7.1	22	4.3	15	9	0
6.9	0	10.6	0	5.9	8	6	0	7.3	7	4.3	22	9	0
6.8	0	10.2	0	5.6	0	6	0	6.9	10	4.5	15	9	0
7	0	10.2	0	6.8	15	6	6	8.2	13	4.6	8	9	0
7	0	10.9	0	6.5	20	6	8	8.3	2	4.7	4	9	0
7.2	0	10.6	0	7.9	3	6	4	9.9	0	4.2	4	8	0
7.4	0	9.7	0	8.8	0	6	8	9.9	1	4.3	0	7	0
7.5	0	11.2	0	9.5	3	6	10	9.8	3	4.3	8	7	0
7.1	0	12.1	0	10	0	5	1	9.2	0	4.2	9	7	0
7.1	0	12.6	0	9.8	0	3	5	10.1	0	4.5	5	8	0
7.3	0	11.9	0	9.9	2	6	12	10.4	0	4.5	3	7	0
7.5	0	12.8	0	9.3	0	5	9	8.7	5	4.3	6	7	0
8.9	0	13	0	9.3	0	5	4	8.3	10	4.4	3	6	0
9.5	0	11.2	0	9.1	0	5	4	7.6	13	4.7	7	6	0
10.3	0	11.1	0	8.5	0	5	0	7.5	14	4.6	13	6	0
140	0	10.9	0	7.5	1	6	1	7.7	11	5.3	10	7	0
10	0	10.9	0	7.7	0	6	3	7.7	4	5.5	0	6	0
9.4	0	9.9	0	6.6	10	6	3	7	3	5.4	5	7	0
8	0	9.8	0	5.8	20	6	8	6.4	16	5.5	5	7	0
7.9	0	9.8	0	5.7	13	5	4	5.2	25	5.6	6	5	0
7	0	8.9	0	5.9	17	5	2	5	23	5.7	1	6	1
6.5	0	8.3	0	5.2	9	5	4	6.6	13	5.3	8	5	0
6.4	0	7.5	0	5	20	5	7	7.2	12	5.3	8	5	0
6.3	0	7	0	5	20	5	4	7.3	7	5.4	3	5	0
5.5	0	7	0	5.2	11	5	0	7.4	5	5.8	12	5	0
6	0	7	0	5.6	2	5	3	6.9	8	5.4	19	6	0
5.9	0	0	0	5.6	11	5	8	6.1	10	4.6	22	5	0
						5	3						

Appendix 20. Density data for limpets (*Cellana* sp.) collected in April 2002. 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Depth	1	Depth	2	Depth	3	Depth	4	Depth	5	Depth	6	Depth	7
6	0	7	8	5.5	0	6	0	6.5	0	4.5	8	6	0
6	2	7	3	7	0	6.5	0	6.5	0	4.5	10	6.5	0
6	3	7.5	6	9	0	6	0	7.5	0	4.5	7	8.5	0
5.5	1	7.5	9	10	0	6	0	6.5	0	5	6	8.5	0
5.5	0	8	6	10	0	6	0	7	0	5	5	8	0
6	0	8	2	10	0	5.5	0	7.5	0	5	4	9	0
6.5	0	7.5	5	10	0	6	0	7.5	0	5	2	9.5	0
6.5	0	7	6	7.5	0	6.5	0	7	0	5	1	10	0
7	0	7	5	7	0	6	1	8.5	0	5	9	10	0
7.5	0	9	3	6.5	0	6	0	8.5	0	5	4	9.5	0
9.5	0	9	2	6.5	0	6	0	8	0	5	0	8.5	0
10	0	9	0	6	0	6	0	8.5	0	4	0	9	0
10	0	9	1	6	0	5.5	0	9	0	4	1	8	0
10	0	11	0	5	0	5.5	0	9.5	0	4	8	7	0
10	0	11	0	5.5	0	5.5	0	10	0	4	0	6.5	0
10	0	11	0	6.5	0	5	0	10	0	4	6	6.5	0
9.5	0	12	0	7	0	5.5	0	10	0	4	3	5.5	0
9.5	0	13	0	12.5	0	6	0	10	0	4	13	5	0
6	0	13	0	11	0	6	0	10	0	4	6	5.5	0
7.5	0	12	0	12	0	6	0	7	0	3.5	5	5	0
8	0	11	0	10.5	0	6	0	5.5	0	4	4	6.5	0
8	0	9.5	0	10.5	0	6	0	5	1	4	5	7	0
9.5	0	10	0	10	0	6	0	5.5	0	4	2	7	0
9.5	0	9	3	10	0	5.5	0	6	0	5	2	7.5	0
7	0	10	0	8	0	6.5	0	7.5	0	5	5	8	0
5.5	0	10	1	5	0	6.5	0	8	0	6	5	8	0
5	0	9	0	6	0	6.5	0	8	0	6	1	10	0
5	1	9	2	6	0	6.5	0	8.5	1	6	1	10	0
5	1	9.5	2	6.5	0	6	0	8	0	6	0	8.5	0
5	6	8.2	0	8	0	5.5	0	8	0	6	4	9	0
6.9	0	8	0	5	2	5	0	6.9	0	3.7	0	9	0
6.7	0	8.9	0	5.5	1	5	0	6.5	0	3.6	2	10	0
6.5	0	9.4	0	6	0	5	0	7	0	3.4	2	9	0
6.8	0	9.1	0	6.1	0	6	0	7.1	0	4.3	1	9	0
6.9	0	10.6	0	5.9	0	6	0	7.3	0	4.3	3	9	0
6.8	1	10.2	0	5.6	0	6	0	6.9	0	4.5	1	9	0
7	0	10.2	0	6.8	0	6	0	8.2	0	4.6	3	9	0
7	0	10.9	0	6.5	0	6	0	8.3	0	4.7	0	9	0
7.2	0	10.6	0	7.9	0	6	0	9.9	0	4.2	0	8	0
7.4	0	9.7	0	8.8	0	6	0	9.9	0	4.3	2	7	0
7.5	0	11.2	0	9.5	0	6	0	9.8	0	4.3	2	7	0
7.1	0	12.1	0	10	1	5	0	9.2	0	4.2	4	7	0
7.1	0	12.6	0	9.8	0	3	0	10.1	0	4.5	3	8	0
7.3	0	11.9	0	9.9	0	6	0	10.4	0	4.5	2	7	0
7.5	0	12.8	0	9.3	0	5	0	8.7	0	4.3	6	7	0
8.9	0	13	0	9.3	0	5	0	8.3	0	4.4	0	6	0
9.5	0	11.2	0	9.1	0	5	0	7.6	0	4.7	1	6	0
10.3	0	11.1	0	8.5	0	5	1	7.5	0	4.6	5	6	0
140.2	0	10.9	0	7.5	0	6	0	7.7	0	5.3	2	7	0
10	0	10.9	2	7.7	0	6	0	7.7	0	5.5	0	6	0
9.4	0	9.9	0	6.6	0	6	0	7	0	5.4	3	7	0
8	0	9.8	0	5.8	0	6	0	6.4	0	5.5	8	7	0
7.9	0	9.8	0	5.7	0	5	0	5.2	1	5.6	6	5	0
7	0	8.9	0	5.9	2	5	0	5	0	5.7	6	6	0
6.5	0	8.3	0	5.2	2	5	0	6.6	0	5.3	4	5	0
6.4	0	7.5	0	5	1	5	1	7.2	0	5.3	3	5	0
6.3	0	7	0	5	0	5	0	7.3	0	5.4	3	5	0
5.5	0	7	0	5.2	1	5	0	7.4	0	5.8	6	5	0
6	0	7	0	5.6	1	5	0	6.9	0	5.4	2	6	0
5.9	0	0	0	5.6	0	5	0	6.1	0	4.6	2	5	0
						5	0						

Appendix 21. Kina size class data collected in April 2002 from the ATNP coast. 1=Separation Pt., 2=Awaroa Head, 3=Canoe Bay, 4=Arch Point, 5=Foul Point, 6=Whale Rock, 7=Totara Rock.

Size	1	2	3	4	5	6	7
30							
31						1	
32			1				
33							
34							
35							2
36		1					3
37	1						2
38							6
39	9				1	1	5
40	1			1		4	7
41				2	1		8
42	2	1	1		1	1	9
43	3		2			1	13
44	1		2		1	1	8
45	2		2	5		2	10
46	2	2	2	2	2	2	8
47		1	1		1		3
48	2	5			2	2	8
49	2	7	3	1	1	2	2
50	2		5	9	1	4	9
51	4	1	5		3		5
52	8	2	1	1	4		3
53	9	2	2	1	4	2	4
54	7	7	3	4	6	2	4
55	8	4	4	8	5	14	1
56	5	4	6	1	2	3	2
57	2			3	5		1
58	3	1	5	2	8	3	
59	7	3	8	1	1	1	1
60	1	3	8	14	7	15	
61	3	7	10	4	6		
62	3	3	9	8	3	2	
63	2	2	5	5	3	3	
64	1	4	4	3	6	6	
65		5	3	7	4	7	
66		2	3	2	1	2	
67	1	3	2	3	3		1
68		1	2		2	2	
69		3	2	1	3		
70		2	3	2	2	8	
71	1	1	1	2	1	3	
72			2	1		4	
73		1	2				
74	1		4	1			
75			2	1	2	2	
76				1	1		
77				1		1	
78							
79	1			1			
80			1			2	
81			1				
82			1				
83							
84			1				
85			1			1	
86		1			1		
87					1		
88							
89							
90							
91				1			
92							
93							
94							
95							
96			1	1			

Appendix 22. Cook's turban size class data collected in April 2002 from the ATNP coast.

Reserve						Control						
26	46	53	28	32	38	29	53	32	40	53	34	46
27	46	53	28	32		31	54	32	40	54	34	46
27	46	53	28	32		31	54	32	41	55	34	46
27	47	53	28	32		31	54	32	41	55	35	46
28	47	53	28	32		31	54	33	41	58	35	46
28	47	53	28	32		34	54	33	41	58	35	46
29	48	54	28	32		34	55	33	42	59	35	46
30	48	54	28	32		34	55	33	43	60	35	46
30	48	54	29	32		35	55	33	43	60	36	47
30	48	54	29	33		35	55	33	43	60	36	47
31	48	54	29	33		35	55	34	43	22	36	47
31	48	54	29	33		36	56	34	43	24	36	47
31	48	54	29	33		36	56	35	43	25	36	47
33	48	55	29	33		37	56	35	43	26	36	47
34	49	55	29	33		37	56	35	44	27	37	47
35	49	55	29	34		37	56	35	45	27	37	48
35	49	55	30	34		37	56	35	45	27	37	48
35	49	55	30	34		40	56	35	45	27	38	48
36	49	56	30	34		40	56	36	45	27	38	48
36	49	56	30	34		42	56	36	45	27	38	48
37	49	56	30	34		42	57	36	45	28	38	48
37	50	56	30	34		43	57	36	46	28	38	48
37	50	57	30	34		43	57	36	46	29	38	48
38	50	57	30	34		44	57	36	46	29	38	48
38	50	57	30	34		44	57	36	47	29	38	49
38	50	57	30	34		44	57	36	47	29	38	50
38	50	57	30	34		44	57	36	47	29	38	50
38	50	57	30	34		45	57	37	48	30	39	50
38	50	58	30	35		45	58	37	48	30	39	50
38	50	59	30	35		45	58	37	48	30	40	50
38	50	60	30	35		45	58	37	48	30	40	50
39	50	60	30	35		46	58	37	48	31	40	51
39	50	61	30	35		46	59	37	48	31	40	51
40	50	18	30	35		46	60	37	48	31	40	52
40	50	19	30	35		46	60	37	48	31	40	53
41	51	20	30	35		47	60	37	49	31	41	55
42	51	20	31	35		47	61	38	49	32	41	62
42	51	21	31	36		47	61	38	49	32	41	63
42	51	24	31	36		48	61	38	49	32	41	32
42	51	24	31	36		48	64	38	50	32	42	
42	51	25	31	36		48	64	38	50	32	42	
43	51	25	31	36		49	64	38	50	32	42	
43	51	25	31	36		50	65	38	50	33	42	
43	51	25	31	36		50	66	38	50	33	42	
43	51	26	31	36		50	67	38	50	33	43	
44	52	26	31	36		50	20	39	50	33	43	
44	52	26	31	36		51	25	39	51	33	43	
44	52	26	31	37		51	26	39	51	33	44	
45	52	27	31	37		51	28	39	51	33	44	
45	52	27	31	37		52	29	39	51	33	44	
45	52	27	32	37		52	30	40	52	34	44	
46	52	27	32	37		52	30	40	52	34	44	
46	52	27	32	37		53	31	40	52	34	44	
53	52	27	32	38		53	32	40	52	34	44	
38	53	27	32	38		53	32	40	53	34	45	

Appendix 23. Scallop size data collected in March 2003 from the ATNP coast.

SITES	1	2	3	4	4 (continued)	5
	70	106	102	104	73	82
	79	104	62	94	74	70
	75	83	105	104	74	87
	92	76	102	94	74	93
	87	80	66	75	55	100
	80	75	81	93	78	84
	69	100	55	76	98	75
	71	102	93	79	82	92
	81	79	109	73	77	98
	86	90	99	76	76	70
	84	93	62	82	72	78
	58	108	49	83	69	84
	45	86	77	75	67	89
	87	93	60	72	74	101
	74	80	97	116	65	73
	86	90	61	102	84	108
	85	82	67	113	86	73
	66	82	99	76	69	84
	78	82	104	75	76	84
	79	82	96	80	72	98
	86	68	81	101	70	63
	83	84	101	100	71	74
	81	78	109	79	67	77
	69	96	100	75	77	77
	71	92	69	78	70	92
	76	106	79	73	88	73
	76	72	74	74	79	82
	67	80	96	30	80	98
	85	76	91	71	75	77
	82	98	56	80	70	98
	69	103		75	79	84
	84	98		64	77	85
	74	68		83	78	82
	84	106		86	72	70
	80	87		75	78	90
	72	96		78	66	80
	68	82		80	73	82
	73	90		80	71	66
	80	100		90	85	68
	90	94		76	75	66
	82	96		84	76	87
	82	89		79	74	94
	51	82		73	65	99
	74	88		70	72	71
	77	86		75	81	106
	65	107		73	70	69
	62	86		91	102	70
	78	85		80	93	59
	81	109		67	78	85
	91	112		71	99	92
	71	101		75	95	75
	76	94		68	92	78
	69	101		80	106	95
	85	97		72	91	98
	88	76		90	79	93
	76	71		69	83	94
	83	122		68	77	75
	66	87		101	84	61
	68	90		80	74	59
	79	106		64	82	66
	78	90		65	76	60
	84	85		85	82	89
	82	99		73	74	87
	80	98		74	78	57
	78	65		71	73	
	71	93		80	62	
	78	104		82	81	
	82	93		78	65	
	70	92		80	78	
	77	107		75	76	
	73	95		80	73	
	75	70		72	108	
	77	80		80		
		78		72		
		95		70		
Number of scallops	73	75	30		147	64
Mean size	76.5890411	90.34666667	83.4		79.0472973	81.65625
SD	8.62463464	11.84299694	18.81232171		11.24316751	12.68447213
95% CI	1.978459216	2.680271641	6.731775056		1.817514312	3.10763667

Appendix 24. Scallop size data collected in April 2006 from the ATNP.

	Reserve		Control	
SITES	S1	S3	S4	S5
	97	108	39	23
	80	108	92	75
	80	101	98	47
	82	89	93	76
	86	91	112	101
	83	107	86	105
	74	98	112	108
	86	76	93	113
	76	67	85	84
	90	45	87	74
	107	66	101	104
	93	76	119	85
	106	85	95	79
	97	87	98	107
	95	76	95	92
	91	107	92	85
	88	94	105	95
	85	97	119	105
	100	84	97	88
	77	98	88	97
	78	86	91	94
	85	99	89	89
	100	88	115	106
	77	102	95	101
	81	114	92	100
	78	88	94	42
	99	99	106	30
	72	82	85	48
	90	96	99	42
	84	88	87	75
	44	94	102	82
	79	98	39	78
	72	60	125	47
	94	77	116	102
	101	103	108	88
	83	97	112	91
	74	101	112	98
	94	82	109	102
	89	85	111	90
	91	97	90	84
	89	90	95	91
	89	95	90	92
	100	86	102	76
	103	95	98	90
	93	90	110	86
	92	82	117	104
	103	73	107	87
	80	90	87	100
	78	96	89	40
	94	101	102	45
	79	90	93	114
	97	86	82	111
	70	95	91	112
	67	71	84	89
	83	88	112	86
	82	93	90	87
	95	90	102	81
	86	82	109	94
	94	83	114	115
	93	93	104	104
	73	81	109	113
	88	83	94	106
	98	89	98	85
	80	100	79	83
	94	97		95
	98	99		85
	84	81		81
	80	99		82
	81	84		102
	79	88		90
	93	91		94
	84	87		91

Appendix 24 (cont). Scallop size data collected in April 2006 from the ATNP.

	73	81	109	113
	88	83	94	106
	98	89	98	85
	80	100	79	83
	94	97		95
	98	99		85
	84	81		81
	80	99		82
	81	84		102
	79	88		90
	93	91		94
	84	87		91
	101	73		77
	90	84		92
	39	86		74
	41	81		90
	60	101		83
	82	79		89
	76	78		97
	101	68		87
	84	93		89
	82	99		97
	80	90		97
	88	95		45
	80	96		36
	93	78		51
	81	84		101
	80	76		94
	82	92		86
	80	105		82
	43	87		84
	40	86		110
	38	90		82
	80	79		75
	76	95		65
	77	97		
	39	108		
	101	107		
	80	90		
	96	81		
	80	88		
	83	91		
	80	96		
	92	108		
	76	98		
	73	86		
	71	89		
	87	95		
	81	79		

Appendix 24 (cont.). Scallop size data collected in April 2006 from the ATNP.

		87		
		81		
		87		
		80		
		80		
		106		
		95		
		102		
		82		
		81		
		105		
		96		
		82		
		82		
		78		
		100		
		90		
		85		
		76		
		79		
		84		
		93		
		90		
		80		
		76		
		87		
		96		
		94		
		92		
		75		
		86		
		92		
Number of scallops	109.00	141.00	64.00	95.00
Mean size	83.03	89.01	97.52	85.54
SD	14.43	10.54	15.07	20.06
SE	2.71	1.74	3.69	4.03

Appendix 25. Horse mussel and scallop density data collected from the Abel Tasman from 50 m^2 quadrats in March 2003.

BarkBay (middle)			Bark Bay (north)		
Depth (m)	Horse mussel	Scallop	Depth (m)	Horse mussel	Scallop
5	34	3	3	26	15
5	50	2	3	8	7
4.5	108	1	4	17	8
3.5	99	2	4	12	2
4	24	6	4	4	4
5	21	4	3.5	18	1
6	20	2	4	5	1
6	8	3	4	26	2
5	13	9	4	13	3
4	49	0	4	23	3
Mean density	42.6	3.2		15.2	4.6
Standard deviation	35.00	2.62		8.18	4.35
Stabdard error	11.07	0.83		2.59	1.38

Tonga (south)			Tonga (north)			Tonga (north-west)		
Depth (m)	Horse mussel	Scallop	Depth (m)	Horse mussel	Scallop	Depth (m)	Horse mussel	Scallop
8	13	39	12	0	4	6	37	6
7	6	63	9	4	14	4	35	5
5	0	29	9	1	12	5	8	0
7	6	49	8	3	5	5	24	1
7	2	40	12	2	8	5	2	1
7	0	56	11	2	5	5	4	5
8	0	77	12	6	10	6	11	6
7	1	9	9	3	19	5.5	6	9
8	0	7	10	3	4	5.5	9	0
8	0	9				6	11	10
Mean density	2.8	37.8		2.67	9.00		14.7	4.3
Standard deviation	4.32	24.31		1.73	5.22		12.70	3.65
Stabdard error	1.36	7.69		0.55	1.65		4.02	1.16

Appendix 26. Horse mussel and scallop density data collected from the Abel Tasman from 50 m^2 quadrats in April 2006.

BarkBay (middle)			Bark Bay (north)		
Depth (m)	Horse mussel	Scallop	Depth (m)	Horse mussel	Scallop
5.5	3	5	5	4	4
6	2	16	5	3	2
6	12	6	5.5	6	0
7	5	6	6	2	0
6	3	9	6	1	2
7	8	4	6	3	5
7	3	4	5.5	2	3
6	5	9	5.5	0	2
5.5	5	12	5	4	3
6	3	10	5	2	5
Mean (50m^2)	4.90	8.10	Mean (50m^2)	2.70	2.60
SD	3.03	3.87	SD	1.70	1.78
SE	0.96	1.22	SE	0.54	0.56

Tonga (south)			Tonga (north-west)		
Depth (m)	Horse mussel	Scallop	Depth (m)	Horse mussel	Scallop
8	13	33	10	19	15
8	8	27	10	20	22
8	5	39	11	6	18
9	15	11	11	10	11
8	3	38	11	16	18
8.5	18	20	11	1	6
7.5	4	31	10.5	2	4
7	5	42	11	13	8
8	4	47	10.5	1	3
8.5	11	28	10.5	7	5
Mean (50m^2)	8.60	31.60	Mean (50m^2)	9.50	11.00
SD	5.32	10.73	SD	7.26	6.82
SE	1.68	3.39	SE	2.30	2.16