The role of the Hauraki Gulf Cable Protection Zone in protecting exploited fish species: *de facto* marine reserve?

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ABSTRACT

The Cable Protection Zone (CPZ) in northeastern New Zealand's Hauraki Gulf protects a large area of seabed from fishing and anchoring. We assessed whether the CPZ has similar conservation benefits to marine reserves; in particular, whether exploited fish species are more abundant inside the CPZ. Baited underwater video (BUV) was used to assess the abundance of carnivorous fish at stations inside and outside the CPZ in February and October 2004. Sampling was stratified between shallow soft-sediment (20–30 m depth) and deep reef (40–60 m) habitats. Carnivorous fish species were recorded in lower numbers and lower diversity on soft-sediment habitats (nine species) than on deep reef habitats (21 species). Fish assemblage structure on deep reefs was strongly influenced by depth and substratum type, whereas management status (i.e. inside v. outside the CPZ) had no detectable effect. There was also no effect of management status on the size and abundance of snapper (*Pagrus auratus*), the most heavily targeted fish species in the region. The numbers of legal-sized blue cod (*Parapercis colias*) tended to be higher at stations inside the CPZ. The overall lack of response of exploited species to protection in the CPZ may be due to the limited time of protection (< 4 years), illegal fishing observed in the CPZ, and/or a limited availability of habitat necessary to hold relatively mobile exploited species. As for marine reserves, CPZs are only likely to be effective in protecting exploited species if they contain areas of suitable habitat and the no-take status of the area is enforced.

Keywords: marine protected areas, baited underwater video, recreational fishing, effects of fishing, snapper, predatory reef fish, New Zealand

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1. Introduction

Increasing human populations and associated increases in fishing pressure have resulted in a general need to increase the level of protection afforded to coastal marine environments (Pauly et al. 2002). This requires the assessment of a variety of management measures, including the effectiveness of existing marine protected areas (MPAs). While we know that even relatively small no-take marine reserves effectively protect fish populations within their boundaries, resulting in an increased size and abundance of some exploited species (Willis et al. 2003; Denny et al. 2004), we have a very poor understanding of what conservation outcomes may accrue from other forms of MPA. Naval defence technology areas, cable protection zones and certain marine parks all prohibit fishing, and may be expected to have ecological and conservation benefits similar to those of no-take marine reserves. However, almost none of these areas have been monitored to determine whether they have any indirect conservation outcomes or fishery benefits.

Research in northeastern New Zealand has conclusively demonstrated that following the cessation of fishing, populations of exploited fish species such as snapper (*Pagrus auratus*) have increased in no-take marine reserves (Willis et al. 2003; Denny et al. 2004). Snapper are targeted by both commercial and recreational fishers, and overfishing has reduced northern stocks (SNA1) to less than 20% of virgin biomass (Annala et al. 2004). While snapper are known to undertake seasonal inshore and offshore movements in the Hauraki Gulf (Paul 1976), recent research in marine reserves has shown that in the absence of fishing, a large proportion of snapper remain resident on reefs throughout the year (Willis et al. 2001, 2003; Parsons et al. 2003; Egli & Babcock 2004). Snapper, therefore, are expected to exhibit similar behaviour and responses to protection in other types of MPAs where fishing is prohibited.

The Cable Protection Zone (CPZ) in the Hauraki Gulf (Fig. 1A) provides a unique opportunity to examine the ecological effects of closing large areas of predominantly soft-sediment habitats to all forms of fishing. The CPZ is protected by the Submarine Cables and Pipelines Protection Act (1996), but the area has only been patrolled and the no-fishing legislation enforced since 1999 (M. McGrath, Telecom, pers. comm.). Prior to 1999, the CPZ was not patrolled and was subject to both commercial and recreational fishing pressure. Given the no-take status of the CPZ, this area would be expected to support large populations of resident snapper, provided it contains areas of suitable habitat. However, unlike coastal marine reserves, the CPZ does not contain any shallow reef areas, and is dominated by soft-sediment habitats. While some reefs do occur within the CPZ, these are located in deep offshore waters of the outer Hauraki Gulf. It is unknown how exploited fish species will respond to no-take protection in such areas due to the lack of information on the fish assemblages in these habitats. In this study, we assess the effect of the Hauraki Gulf CPZ on exploited fishes, by comparing the fish populations occurring in two habitats (shallow soft-sediment and deep reef) between stations inside and outside the CPZ using baited underwater video (BUV). BUV surveys were carried out in autumn and spring 2004 to assess potential seasonal differences in fish assemblages in these habitats.

2. Methods

2.1 SURVEY DESIGN

Sampling was stratified between two physical habitats that occur in the CPZ: soft-sediment habitat and deep reef habitat (GPS positions for BUV stations, site details and raw data are given in Appendix 1). Soft-sediment habitats were sampled in the inner Hauraki Gulf (south of the Whangaparaoa Peninsula, Fig. 1A and B) where the substratum is relatively uniform with little bottom structure, and consists of fine sand, silt and mud, ranging in depth from 20 m to 30 m. In contrast, reef areas were only found in the outer Hauraki Gulf (Fig. 1A and C), where the substratum is characterised by coarse sand habitats interspersed with low-lying patch reef. Sampling in the outer Gulf was concentrated around an area of reef (commonly known as 'Nor'west Reef') that runs discontinuously in a northwest direction from Hauturu/Little Barrier Island (Fig. 1C). The largest and shallowest part of this reef system occurs in the centre of the CPZ and rises to 33 m depth, whereas the reefs outside the CPZ are typically low-lying patch reefs below 40 m depth. Observations of reef communities and fish fauna were made during two dives on the shallowest part of the reef (33 m depth; 36° 08.53′ S, 174° 56.85′ E) on 14 April 2004. Reefs

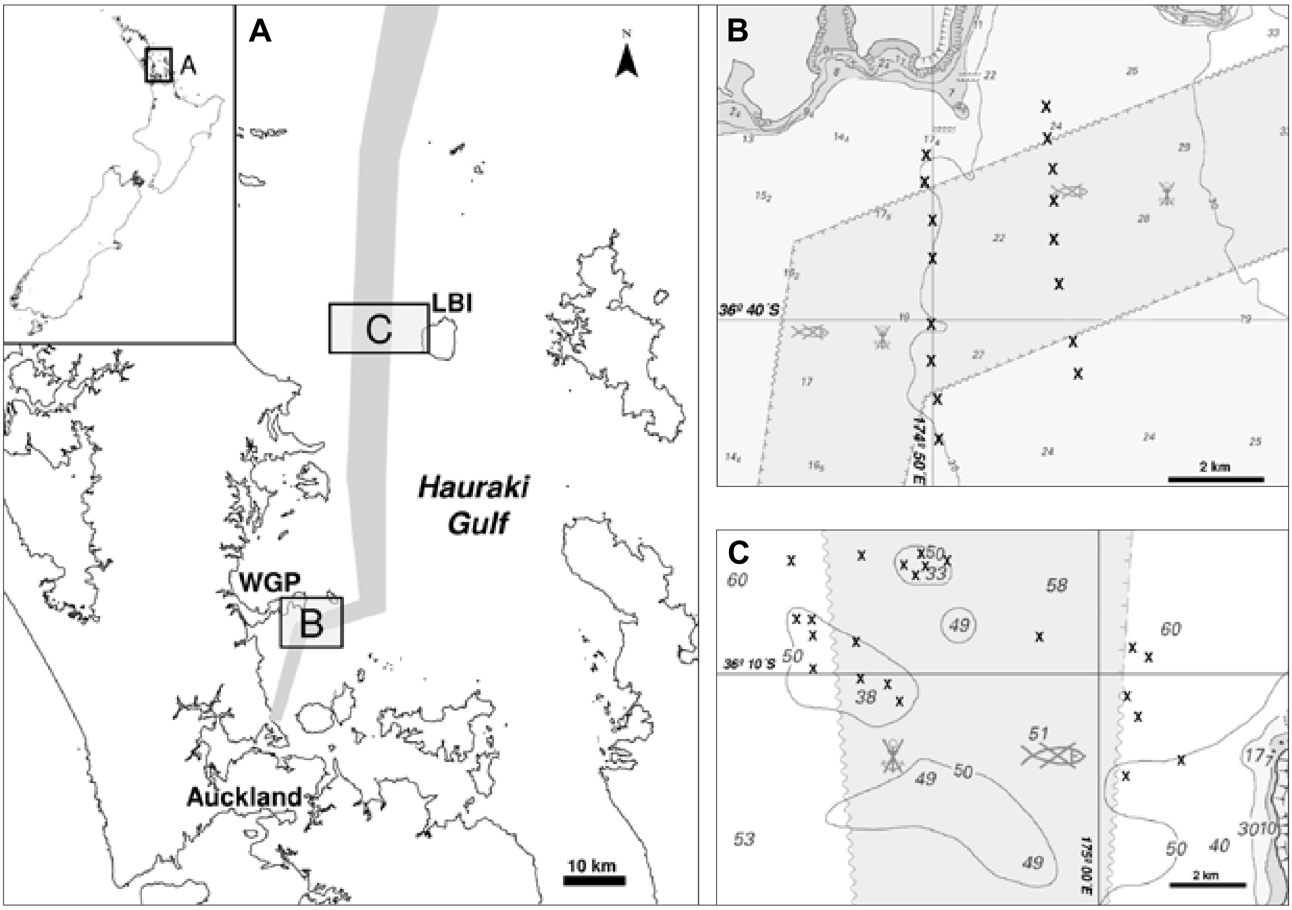

Figure 1. A. Location of the Cable Protection Zone (shaded area) in the Hauraki Gulf, northeastern New Zealand (inset). Boxes B and C indicate the two sampling areas in the inner and outer Hauraki Gulf respectively, and the position of BUV stations in each area (X indicates sampling station and numbers indicate depths (m) from NZ nautical charts). 'WGP' indicates the Whangaparaoa Peninsula and 'LBI' indicates Hauturu/Little Barrier Island.

were found to support a diverse encrusting invertebrate assemblage. Sponges such as *Ancorina elata*, *Stelleta crater*, *Dendrilla rosea*, *Raspailia* sp. and *Aaptos aaptos* were typically the structurally dominant component on these reefs, although soft corals (*Alcyonium aurantiacum*), cup corals (*Monomyces rubrum* and *Culicia rubeola*), hydroids (e.g. *Solanderia ericopsis* with the nudibranch *Jason mirabilis*) and bryozoans (e.g. *Steganoporella neozelanica*) were also common. Only low numbers of mobile macro-invertebrates were present and macroalgae were generally rare on these deep reefs. Crustose coralline algae were the dominant algal component.

Sampling in both areas was carried out in April (autumn) and October (spring) 2004, and was stratified between regions inside and outside the CPZ. Due to the uniform nature of the substratum in the inner Hauraki Gulf, BUV deployments were carried out at pre-determined positions inside ($n = 8$) and outside ($n = 8$) the CPZ (Fig. 1B). Stations were sampled along transects running perpendicular to the CPZ and corresponding to the 20-m and 25-m depth contours. An attempt was also made to sample along a transect at 30 m depth, but due to poor visibility and the fact that the BUV stand sank into the mud at these depths, it was not possible to accurately analyse the video from these stations.

BUV stations in the outer Hauraki Gulf were haphazardly positioned on patches of reef, or sand near reef, inside ($n = 11$) and outside ($n = 11$) the CPZ (Fig. 1C). Patches of reef were located using a Simrad dual-frequency colour depth sounder. Comparable areas were selected and sampled inside and outside the CPZ. Depth and substratum type were recorded at each location to account for differences in habitat type between samples. Substratum type was treated as a categorical variable, whereby sand = 0, shell hash = 1, sand near edge of reef = 2, mix of reef and sand = 3, and reef = 4.

2.2 BAITED UNDERWATER VIDEO SYSTEM

The baited underwater video (BUV) system used in this study was a modification of that developed by Willis & Babcock (2000), which has been used extensively in shallow habitats to survey carnivorous fishes in the northeast of the North Island (Willis et al. 2000, 2003; Denny & Babcock 2004; Denny et al. 2004). This system allows the sampling of species that are not amenable to underwater visual census methods due to their diver-negative behaviour, as well as sampling below safe diving depths (Willis & Babcock 2000). It consists of a triangular stainless steel stand, with a high-resolution colour video camera positioned 1.25 m above a bait container holding c. 300 g of pilchards (*Sardinops neopilchardus*). During each deployment, the video records for 30 min from the time the video assembly reaches the bottom. A 100-m coaxial cable usually connects the camera to a Sony GV-S50E video monitor and 8-mm video recorder located on the anchored survey vessel. This allows the operator to ensure that the stand is upright and over suitable substratum. However, the cable connection between the vessel and camera stand typically limits the use of this system to a maximum depth of 40 m due to logistics associated with anchoring the support vessel over the camera, vessel movement when at anchor, and underwater drag on the cable due to currents.

In the present study, a modified BUV system was used that employed an independently operating camera with no direct connection to the support vessel. This involved mounting a Sony digital camcorder in underwater housing onto a purpose-built stand with the same measurements and field of view as the original BUV system (Willis & Babcock 2000), ensuring that the results obtained from the two systems were comparable. At each deployment, the camera was set to record, lowered to the bottom and left for 30 min. After 30 min, the survey vessel returned and retrieved the BUV using a surface float attached to the stand. The absence of a cable tethering the camera to the survey vessel meant that the modified BUV could be quickly deployed and retrieved from an unanchored vessel (a requirement for sampling in the CPZ), and the reduced drag on the stand allowed its use in a greater range of sea conditions and at greater depths. The main disadvantage of the modified BUV was that the operator could not observe whether the stand was upright or over suitable substratum, making it most suited to soft-sediment habitats or low-relief reefs with little kelp cover.

Video footage from each BUV station was analysed using the methodology of Willis & Babcock (2000). For any given species, a total fish count and associated length measurements were made at the point where the maximum number of individuals was present within the 30-min sampling period.

2.3 STATISTICAL ANALYSIS

Similarities in fish assemblages between BUV stations during both surveys in the outer Hauraki Gulf were investigated using principal coordinates analysis. This was based on a Bray-Curtis similarity matrix calculated using the untransformed abundance estimates for 13 species from BUV surveys (Table 1). Analysis was restricted to demersal, carnivorous fishes, as these are the only species reliably sampled by the BUV methodology (Willis & Babcock 2000). Furthermore, analysis was only carried out on species recorded on more than one BUV station. Species, depth and substratum type categories were correlated with principal coordinates axes 1 and 2, and plotted as bi-plots, to investigate potential relationships between these variables and the multivariate patterns. The importance of depth and substratum type in explaining variation in fish assemblages was tested using multivariate multiple regression (DISTLM v2; Anderson 2002). The multivariate null hypothesis was that there is no relationship between fish communities and these environmental variables. Two-way non-parametric multivariate analysis of variance (NPMANOVA; Anderson 2001) was also carried out to test for differences between the two surveys (Survey) and areas with different protection status (Status). No multivariate analyses were carried out on fish assemblages in soft-sediment habitats, due to the low diversity and number of individuals (see section 3.1).

Differences in the abundance of individual fish species inside and outside the CPZ (Status) and between surveys (Survey) were tested with a generalised linear model using the GLMMIX procedure in SAS (Littell et al. 1996). The model was fitted to a Poisson distribution, as count data do not satisfy the assumptions of normality and homogeneity of variance required by ANOVA. 'Area' (i.e. inner v. outer Hauraki Gulf) was also included as a factor for snapper, which were common in both sampling areas.

TABLE 1. FISH SPECIES RECORDED DURING BAITED UNDERWATER VIDEO (BUV) SURVEYS DURING AUTUMN AND SPRING 2004 IN THE INNER AND OUTER HAURAKI GULF.

Total numbers recorded in each survey are given, and the overall number of BUV deployments on which each species was recorded is given in parentheses. The codes for species used in multivariate analyses for the outer Hauraki Gulf are also given in parentheses.

COMMON NAME	SCIENTIFIC NAME	INNER GULF		OUTER GULF		TOTAL
		AUTUMN ($n = 16$)	SPRING ($n = 16$)	AUTUMN ($n = 22$)	SPRING ($n = 22$)	
Blue cod (BC)	*Parapercis colias*	–	–	42 (16)	53 (18)	95
Leatherjacket (LJ)	*Parika scaber*	–	–	58 (12)	25 (13)	83
Snapper (SN)	*Pagrus auratus*	18 (9)	6 (6)	25 (14)	10 (9)	59
Scarlet wrasse (SW)	*Pseudolabrus miles*	–	–	27 (14)	30 (18)	57
Pigfish (PG)	*Bodianus unimaculatus*	–	–	30 (15)	25 (16)	55
Trevally	*Pseudocaranx dentex*	–	35 (2)	6 (3)	2 (2)	43
Tarakihi (TA)	*Nemadactylus macropterus*	–	–	16 (5)	18 (8)	34
Golden snapper (GO)	*Centroberyx affinis*	–	–	18 (6)	13 (4)	31
Carpet shark (CA)	*Cephaloscyllium isabellum*	–	–	1 (1)	15 (11)	16
Northern scorpionfish (SC)	*Scorpaena cardinalis*	–	–	3 (3)	6 (3)	9
Gurnard	*Chelidonichthys kumu*	–	5 (5)	4 (2)	–	9
John dory (JD)	*Zeus faber*	–	–	4 (4)	4 (4)	8
Southern bastard cod (BA)	*Pseudophycis barbata*	–	–	2 (1)	5 (2)	7
Sweep	*Scorpis lineolatus*	–	–	7 (1)	–	7
Jack mackerel	*Trachurus novaezelandiae*	7 (2)	–	–	–	7
Porae (PO)	*Nemadactylus douglasii*	–	–	4 (4)	–	4
Red moki (RM)	*Cheilodactylus spectabilis*	–	–	1 (1)	2 (2)	3
Eagle ray	*Myliobatis tenuicaudatus*	3 (3)	–	–	–	3
Short-tailed stingray	*Dasyatis brevicaudata*	3 (3)	–	1 (1)	–	3
School shark	*Galeorhinus galeus*	1 (1)	2 (2)	–	–	3
Spotty	*Notolabrus celidotus*	–	3 (2)	–	–	3
Goatfish	*Upeneichthys lineatus*	–	–	2 (1)	–	2
Butterfly perch	*Caesioperca lepidoptera*	–	–	1 (1)	1 (1)	2
Conger eel	*Conger wilsoni*	–	–	1 (1)	–	1
Smooth hammerhead	*Sphyrna zygaena*	–	1 (1)	–	–	1

3. Results

3.1 FISH ASSEMBLAGES

The fish species recorded on the BUV varied considerably between the two habitats sampled (Table 1). Only nine fish species were recorded in the soft-sediment habitats of the inner Hauraki Gulf (Table 1). Snapper was the most commonly recorded species in the inner Hauraki Gulf, being present on half of the BUV deployments. While trevally (*Psudocaranx dentex*) were the most numerically abundant in the inner Hauraki Gulf, these were only recorded on two deployments. In general, only very low numbers of the other species were recorded in both surveys. In contrast, the deep reefs in the outer Hauraki Gulf supported a more diverse and abundant fish assemblage, with a total of 21 species being recorded during BUV surveys (Table 1). These were typically reef-associated species common to shallow coastal areas (Francis 2001). During two dives in the CPZ, a number of other species were also observed, including northern splendid perch (*Callanthias australis*) and large schools of butterfly perch (*Caesioperca lepidoptera*), sweep (*Scorpis lineolatus*), demoiselles (*Chromis dispilus*), kingfish (*Seriola lalandi*) and koheru (*Decapterus koheru*).

Overall, reef fish assemblages were not significantly different between areas inside and outside the CPZ in the outer Hauraki Gulf (NPMANOVA, Status: $F = 1.23$, $df = 1, 40$, $P = 0.291$), and this was consistent for both surveys (Status × Survey: $F = 0.54$, $df = 1, 40$, $P = 0.797$) (Fig. 2A). However, the fish assemblages in the outer Hauraki gulf varied significantly between the two surveys (Survey: $F = 2.36$, $df = 1, 40$, $P = 0.026$). This was not clearly apparent from the MDS ordination (Fig. 2A), although samples from the spring survey were generally clustered on the right of the ordination. Consequently, two species that were more commonly recorded during the spring survey (blue cod *Parapercis colias* and carpet sharks *Cephaloscyllium isabellum*, Table 1) were positively correlated with PC 1 (Fig. 2B). A number of species varied significantly between surveys; these patterns are described below (section 3.2).

Fish assemblages were significantly related to both depth (DISTLM, pseudo-$F = 4.86$, $P < 0.001$) and substratum type (pseudo-$F = 2.86$, $P = 0.01$), and together explained 17.5% of the observed variation when fitted sequentially (pseudo-$F = 2.40$, $P = 0.033$). Depth and substratum type were inversely correlated with PC 2 (Fig. 2B), as shallow stations (33–45 m) tended to be dominated by reef, while the deeper stations (45–60 m) tended to have a higher proportion of sand. Fish species that were positively correlated with PC 2 (e.g. leatherjackets *Parika scaber* and scarlet wrasse *Pseudolabrus miles*) were typically more common in shallow reef areas (Fig. 2B).

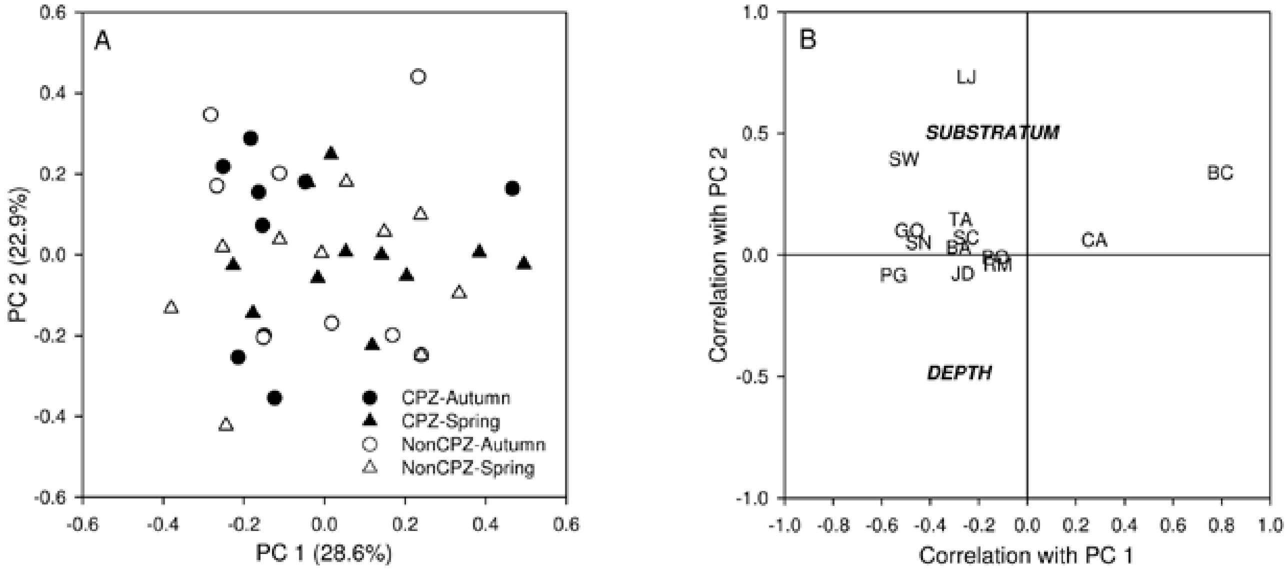

Figure 2. A. Principal coordinates analysis of fish assemblages (13 species) in the outer Hauraki Gulf from baited underwater video (BUV) samples inside and outside the Cable Protection Zone (CPZ) during spring and autumn 2004. B. Bi-plots showing the correlations between the principal coordinates axes, and the physical variables (depth and substratum) and individual reef fish species. Species names are given in Table 1.

3.2 DOMINANT FISH SPECIES

Snapper was the most commonly recorded exploited species in this study, being recorded on half of the BUV deployments (Table 1). However, the total abundance was relatively low, with only 59 snapper being recorded from 76 BUV deployments. There was no significant difference in snapper abundance between areas inside and outside the CPZ for either region of the Hauraki Gulf, and this was consistent for both spring and autumn surveys (Table 2, Fig. 3). However, snapper were significantly less abundant during the spring survey in both the inner and outer Hauraki Gulf (Table 2, Fig. 3). Overall, the number of snapper was 2.5 (95% CI = 1.4–4.6) times higher in the autumn survey than in spring. No difference was found in the total number of snapper between the two regions, although there was a suggestion that legal-sized snapper (> 270 mm fork length; FL) were more common in the outer Hauraki Gulf and that sublegal-sized snapper were more abundant in the inner Hauraki Gulf (Table 2, Fig. 3). Snapper recorded in the outer Hauraki Gulf were generally larger, ranging in size from 220 mm to 540 mm FL, while in the inner Hauraki Gulf they ranged from 173 mm to 420 mm FL, with only a few individuals being larger than minimum legal size (Fig. 4). There was no apparent difference in the size distribution of snapper between areas inside and outside the CPZ in either region. In the outer Hauraki Gulf, the largest snapper was recorded outside the CPZ.

Figure 3. Mean (+ SEM) relative abundance of total snapper (*Pagrus auratus*), legal-sized snapper (> 270 mm fork length) and sublegal-sized snapper from baited underwater video (BUV) sampling inside and outside the Cable Protection Zone (CPZ) in the inner and outer Hauraki Gulf during autumn and spring 2004.

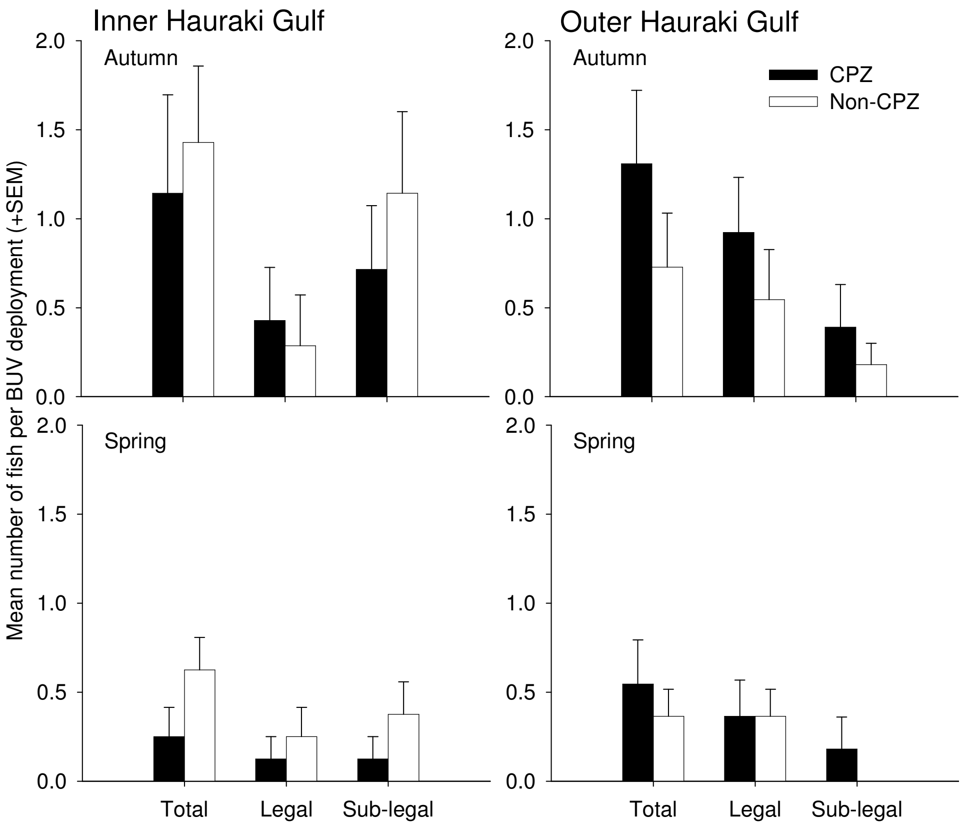

TABLE 2. RESULTS FROM MIXED MODEL ANALYSIS OF VARIANCE ON NUMBERS OF SNAPPER (*Pagrus auratus*) FROM BAITED UNDERWATER VIDEO (BUV) SAMPLING IN THE HAURAKI GULF.

Two surveys were conducted (Survey: spring v. autumn) in areas inside and outside the Cable Protection Zone (Status) in the inner and outer Hauraki Gulf (Area). The model was back-fitted by removing non-significant interaction terms. Separate models were fitted to data for all snapper sampled, legal-sized snapper (> 270 mm fork length) and sublegal-sized snapper.

	FACTOR	*F*	df	*P*
Total Snapper	Survey	9.32	1,72	0.003
	Status	0.53	1,72	0.468
	Area	0.00	1,72	0.949
Legal	Survey	3.43	1,72	0.068
	Status	0.89	1,72	0.350
	Area	3.83	1,72	0.054
Sublegal	Survey	4.50	1,72	0.037
	Status	0.00	1,72	1.000
	Area	3.61	1,72	0.062

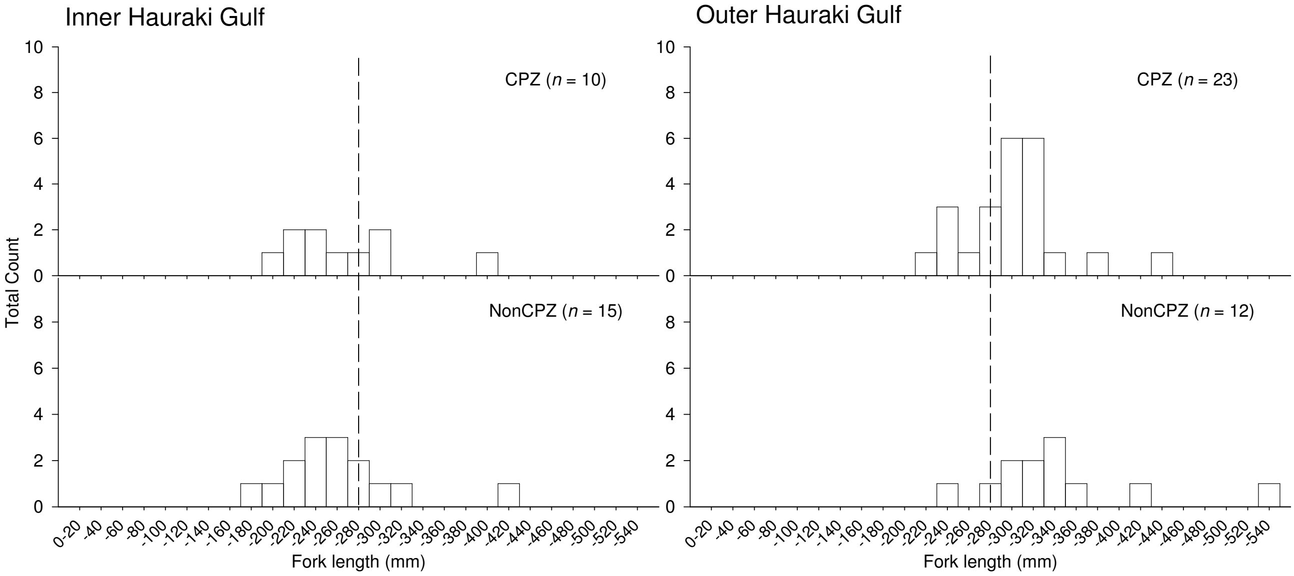

Figure 4. Size frequency distribution of snapper (*Pagrus auratus*) sampled from the inner and outer Hauraki Gulf in areas inside and outside the Cable Protection Zone (CPZ). Data are combined for both spring and autumn surveys. Dashed line indicates the size range that includes the minimum legal size (270 mm fork length).

Very low numbers of fish species other than snapper were recorded in the inner Hauraki Gulf (Table 1). Consequently, we were unable to statistically assess any differences between surveys or differences associated with protection status. The abundances of other species commonly recorded in the outer Hauraki Gulf are shown in Fig. 5. Some seasonal differences were apparent for leatherjackets, which were much more common but highly variable in the autumn survey, while carpet sharks were more common in the spring survey. The abundance of three species varied significantly between areas inside and outside the CPZ (Table 3, Fig. 5): scarlet wrasse and carpet shark were more abundant in the CPZ, while tarakihi were more abundant outside the CPZ. Golden snapper (*Centroberyx affinis*) also appeared to be more common outside the CPZ (Fig. 5), although numbers were highly variable and this difference was not significant (Table 3).

There were no apparent differences in the size of these fish species between areas inside and outside the CPZ, except for blue cod (Fig. 6). Outside the CPZ, blue cod ranged in size from 93 mm to 330 mm FL, while inside they ranged from 92 mm to 497 mm FL, with low numbers of individuals being greater than minimum legal size (330 mm FL) in both surveys (Fig. 6).

Figure 5. Mean (+ SEM) relative abundance of common fish species other than snapper (*Pagrus auratus*) recorded on baited underwater video (BUV) deployments in areas inside and outside the Cable Protection Zone (CPZ) in the outer Hauraki Gulf during autumn and spring 2004. See Table 3 for specific names of fish. * indicates significant differences ($P < 0.05$).

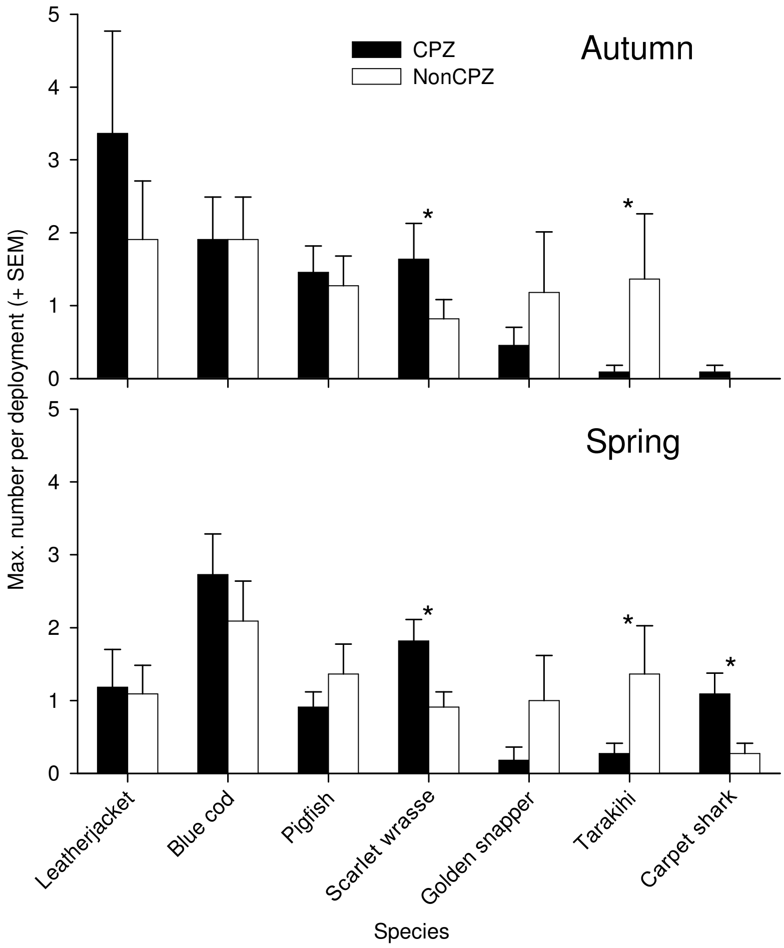

TABLE 3. RESULTS FROM MIXED MODEL ANALYSIS OF VARIANCE ON NUMBERS OF COMMON SPECIES (OTHER THAN SNAPPER *Pagrus auratus*) SIGHTED DURING BAITED UNDERWATER VIDEO (BUV) SAMPLING IN THE OUTER HAURAKI GULF.

Sampling was conducted during autumn and spring 2004 (Survey) in areas inside and outside the Cable Protection Zone (CPZ) (Status). The model was back-fitted by removing non-significant interaction terms.

SPECIES	FACTOR	*F*	df	*P*
Blue Cod (*Parapercis colias*)	Survey	0.77	1,41	0.384
	Status	0.31	1,41	0.578
Leatherjacket (*Parika scaber*)	Survey	3.54	1,41	0.067
	Status	0.98	1,41	0.328
Scarlet wrasse (*Pseudolabrus miles*)	Survey	0.18	1,41	0.675
	Status	6.88	1,41	0.012
Pigfish (*Bodianus unimaculatus*)	Survey	0.41	1,41	0.524
	Status	0.15	1,41	0.702
Golden snapper (*Centroberyx affinis*)	Survey	0.24	1,41	0.629
	Status	2.44	1,41	0.126
Tarakihi (*Nemadactylus macropterus*)	Survey	0.04	1,41	0.842
	Status	4.89	1,41	0.033
Carpet shark (*Cephaloscyllium isabellum*)*	Survey	–	–	–
	Status	4.90	1,42	0.032

* Only data from the spring survey were analysed, as very low numbers were recorded in autumn.

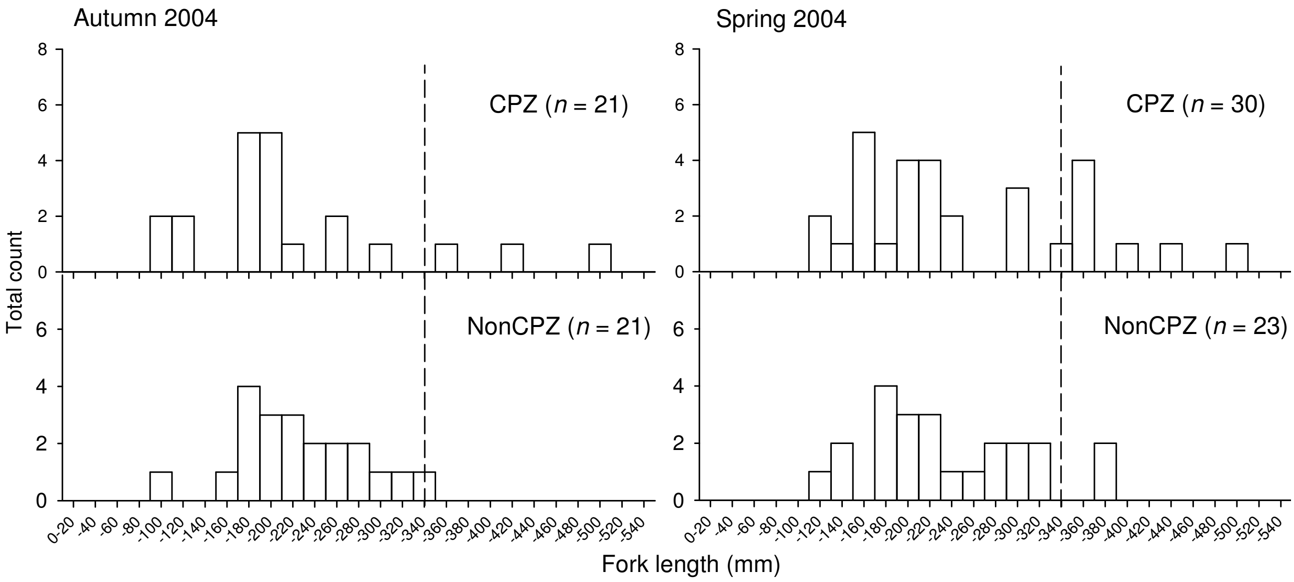

Figure 6. Size frequency distribution of blue cod (*Parapercis colias*) in areas inside and outside the Cable Protection Zone (CPZ) in the outer Hauraki Gulf during autumn and spring 2004. Dashed line indicates the size range that includes the minimum legal size (330 mm fork length).

4. Discussion

In most northern New Zealand marine reserves, snapper populations have shown significant increases in size and abundance following protection (Ward 2002; Willis et al. 2003; Denny et al. 2004; but see Shears & Usmar 2006). All marine reserves where this has occurred contain substantial areas of shallow subtidal reef, upon which large numbers of snapper become resident (Willis et al. 2001; Parsons et al. 2003). In contrast, the Cable Protection Zone (CPZ) in the Hauraki Gulf is largely dominated by soft-sediment habitats, with some relatively small areas of deep offshore reef habitat. We found little evidence of a protection effect on snapper, or other exploited fish species, in either of these habitats across both surveys (autumn and spring 2004).

Snapper were the most commonly recorded fish during the surveys and the absence of an obvious protection effect in the inner Hauraki Gulf is probably due to the mobile nature of this species over soft-sediment habitats (Bentley et al. 2004), rather than its location. Ward (2002) recorded higher numbers of snapper inside the Long Bay-Okura Marine Reserve, located south of the Whangaparaoa Peninsula, compared with adjacent fished sites. In contrast to the CPZ, this marine reserve has large areas of shallow reef habitat (Shears & Babcock 2004). While adult snapper taken in the commercial fishery are considered to be relatively mobile and inhabit a home range of c. 10–20 km in diameter (Bentley et al. 2004), they have also been shown to become permanently resident on shallow rocky reefs in marine reserves, where they inhabit a considerably smaller home range (Willis et al. 2001; Parsons et al. 2003; Egli & Babcock 2004). It is therefore conceivable that in the absence of fishing, adult snapper may become resident, at least temporarily, in areas of biogenic structure on soft sediments. However, the inner-gulf stations sampled in this study generally lacked any biogenic structure, and while snapper may utilise these relatively uniform soft-sediment habitats as feeding grounds, it seems unlikely that they would take up residence within this part of the CPZ.

The reefs sampled in the outer Hauraki Gulf appeared to provide more suitable habitat for resident snapper, and during the spring survey snapper were recorded more frequently and tended to be more abundant in the CPZ than outside it. However, this was not statistically significant, and overall abundance was very low compared with that observed using the same methodology in no-take reserves in the region (Willis et al. 2003). On average, less than one legal-sized snapper was recorded per BUV deployment on reefs in the CPZ, which is comparable to findings from surveys in fished areas adjacent to reserves (Willis et al. 2003; Denny et al. 2004). In contrast, the mean number of legal-sized snapper typically recorded in reserves using BUV ranges from 5 to 12 per deployment (Willis et al. 2003; Denny et al. 2004). BUV surveys were also carried out at the Poor Knights Islands and Te Whanganui a Hei (Cathedral Cove) at the same time as our autumn survey (Denny & Shears 2004; Taylor et al. 2004); snapper numbers recorded during these surveys were comparable to the previously mentioned surveys in reserves. This suggests that our findings were not influenced by any unusual environmental conditions in autumn 2004. The seasonal patterns in snapper abundance found in the present study were consistent with other studies (Willis et al. 2003; Denny et al. 2004), with snapper numbers being lowest during the spring survey, when water temperatures were cooler. It was initially expected that the deep reef habitats sampled in the outer Hauraki Gulf would support higher numbers of snapper during winter and spring months. However, this was not apparent, and snapper in these habitats showed the same seasonal response as snapper in the inner Hauraki Gulf (Table 2: no significant interaction between Area and Survey). Regardless of the time of year, if a resident population of snapper did exist in the CPZ, the numbers would be expected to be proportionally higher here year-round, as seen in marine reserves (Willis et al. 2003; Denny et al. 2004).

In the outer Hauraki Gulf, a number of other species showed varying responses to protection in the CPZ. Both scarlet wrasses and carpet sharks were more common at stations in the CPZ. While these species are not targeted by fishermen, they are often caught as bycatch on long-lines and in craypots, and therefore may benefit from protection. However, scarlet wrasses were more common at shallow stations; therefore, their higher abundance in the CPZ may have been due to BUV stations generally being shallower in the CPZ (average depth of stations 44.7 ± 1.5 m) than outside it (50.1 ± 1.3 m). In contrast, tarakihi were more common at stations outside the CPZ. This species is commercially targeted but is typically found over sandy substratum near reef edges in water deeper than 25 m in northern New Zealand (Francis 2001). Therefore, the apparent difference in abundance between areas inside and outside the CPZ may also be due to the greater depth and lower extent of rocky substratum outside the CPZ. It should also be noted that the BUV methodology is not likely to provide a reliable estimate of abundance for some species, due to their behavioural characteristics (Willis & Babcock 2000). For example, tarakihi are highly mobile and exhibit schooling behaviour (Francis 2001); as a result, measured abundances were highly variable between BUV stations. Similarly, golden snapper is another deeper water, schooling species (Francis 2001) that was highly variable among stations both inside and outside the CPZ.

Blue cod, a species commonly caught by commercial and recreational fishermen, was one of the dominant fish species recorded in the outer Hauraki Gulf. While no difference in abundance was found between stations inside and outside the CPZ, larger numbers of legal-sized blue cod (> 330 mm FL) were recorded in the CPZ. Adult blue cod have a relatively small home range size (only 300–500 m diameter) and have been shown to rapidly increase in size following protection in South Island marine reserves (Cole et al. 2000; Davidson 2001). While blue cod are generally more abundant and grow larger in southern areas (Ayling & Cox 1982), they do occur at higher numbers and larger sizes in northern marine reserves, e.g. Cape Rodney–Okakari Point (Leigh) and Te Whanganui a Hei (Cathedral Cove), than in adjacent fished areas (Willis 2001; Taylor et al. 2003a,b).

The Hauraki Gulf CPZ has been patrolled since the beginning of 1999; however, some commercial boats continued to fish illegally in the CPZ up until the end of the 2000/2001 summer (M. McGrath, Telecom, pers. comm.). Therefore, the CPZ had only been 'effectively' patrolled for 3 years at the time of the autumn survey. The rate of response of snapper populations to marine reserve protection has been shown to vary between regions. For example, snapper showed a rapid response to protection at the Poor Knights Islands (< 2 years) (Denny et al. 2003, 2004), whereas the response has generally been slower (c. 5 years) at coastal reserves (e.g. Te Whanganui a Hei (Cathedral Cove) Marine Reserve; Willis et al. 2003). Blue cod also exhibited a rapid response to protection in the Marlborough Sounds (< 5 years; Davidson 2001). Therefore, it is possible that the length of time since total protection began is not sufficient to have allowed a detectable recovery of exploited fish populations in the CPZ. Another possible explanation for the lack of response of fish to protection is high levels of illegal fishing in the CPZ. While commercial fishermen largely comply with the no-fishing restrictions in the CPZ, due to the threat of large fines, both recreational and charter fishing boats were observed fishing in the CPZ on numerous occasions during this study (NTS, pers. obs.). The effect of marine reserves on exploited species has been shown to be related to levels of enforcement (e.g. Paddack & Estes 2000; Maliao et al. 2004) and the implementation of more stringent regulations often results in an increased density of fished species (Russ & Alcala 1994; Watson & Ormond 1994). Recent studies conducted both in New Zealand and internationally indicate that marine protected areas that allow recreational fishing provide little benefit to exploited populations (Westera et al. 2003; Denny & Babcock 2004; Shears & Usmar 2006; Shears et al. 2006). Recreational fishing pressure in northeastern New Zealand is very high; in fact, recent estimates suggest that the recreational take of snapper is greater than the commercial take for SNA1, New Zealand's largest snapper fishery (Annala et al. 2004). While we have a limited understanding of how fish populations respond to no-take protection in offshore, deep reef habitats, it is possible that the current level of illegal fishing is sufficient to prevent the recovery of exploited fish species on deep reefs in the CPZ, in particular the establishment of resident snapper populations. This can only be tested once the levels of illegal fishing in the CPZ have been reduced.

Approximately 5% of the Hauraki Gulf (including the CPZ) is protected from fishing by some form of legislation (e.g. marine reserves, marine parks and defence areas) (N. Barr, Leigh Marine Laboratory, unpubl. data). While the CPZ may largely be viewed as a 'paper park' (i.e. a protected area that exists at the level of legislation but not implementation), the area may still be successful at mitigating the impact of certain activities, as has been seen for similar 'paper parks' in terrestrial systems (Bruner et al. 2001). For example, there are likely to be ecological and possibly fishery benefits in protecting such a large area of seabed from destructive forms of commercial fishing, such as bottom trawling and dredging (Thrush et al. 1995, 1998). Furthermore, given the CPZ extends throughout a large portion of the Hauraki Gulf, it is also possible that it may protect a proportion of exploited species undertaking seasonal movements through the Hauraki Gulf (e.g. snapper; Bentley et al. 2004).

5. Conclusions

To improve the level of protection afforded to the coastal marine environment, it is necessary to assess the effectiveness of existing protected areas such as marine reserves and other restricted fishing areas. We found little evidence that the Hauraki Gulf Cable Protection Zone has been effective in allowing the recovery of exploited fish species within its boundaries. This is likely to be due to a combination of factors: the short time since total protection began (< 4 years); the levels of illegal fishing that still occur in the CPZ; the highly mobile nature of many exploited species; and the availability of suitable habitat to attract and maintain resident populations of exploited fish species. A number of useful outcomes would be achieved if illegal fishing were eliminated in the CPZ, including allowing a better assessment of how exploited fish populations respond to no-take protection in the soft-sediment or deep-reef habitats examined, maximising the overall conservation benefits of the CPZ, and the official purpose of avoiding damage to the cable itself.

6. Management recommendations

- Greater enforcement of no-fishing regulations and an effort to increase public awareness of the CPZ and its potential benefits is necessary to reduce levels of illegal fishing and maximise the conservation benefits of the CPZ.
- A regular fish monitoring programme should be established to determine whether fish populations in the CPZ recover over time. This is necessary to assess the ecological or conservation benefits of management decisions that assign additional resources to the enforcement of regulations in the CPZ.
- The extent and variety of habitats currently protected in the CPZ should be considered when designing a marine reserve network for the Hauraki Gulf. The selection of new marine reserve sites should concentrate on protecting habitats that are poorly represented in existing no-take areas.
- Additional research is needed into the ecosystem-level effects of fishing, and the potential fishery-level benefits of protecting such a large area from fishing. Furthermore, information gathered on the distribution and connectivity among habitats, and their utilisation by exploited species, will also be highly valuable for the management of fisheries in the Hauraki Gulf. The size of the CPZ as a no-take area provides a unique opportunity for such research.

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Appendix 1

SITE DETAILS AND COUNT DATA FROM SAMPLING IN THE HAURAKI GULF

TABLE A1.1. SAMPLING IN SOFT-SEDIMENT HABITATS IN THE INNER HAURAKI GULF DURING AUTUMN AND SPRING 2004.

Latitude (Lat.): DD° MM.mmm′ S; Longitude (Long.): DD° MM.mmm′ E. Status indicates baited underwater video stations inside (CPZ) and outside (NonCPZ) the Cable Protection Zone. Legal snapper = number of snapper > 270 mm fork length. See Table 1 for species names.

SEASON	STATION	DATE	HABITAT	LAT.	LONG.	STATUS	DEPTH (m)	TIME	TOTAL SNAPPER	LEGAL SNAPPER	EAGLE RAY	SHORT-TAILED STINGRAY	JACK MACKEREL	SCHOOL SHARK	SPOTTY	SMOOTH HAMMERHEAD	TREVALLY	GURNARD
Autumn	TR1	30 Mar	Hard sand, algae	36 38.020	174 87.000	NonCPZ	17.6	1015	2	0	0	0	0	0	0	0	0	0
Autumn	TR2	30 Mar	Fine sand/silt/holes	36 38.474	174 49.921	NonCPZ	20.5	1115	0	0	0	0	0	0	0	0	0	0
Autumn	TR3	31 Mar	Fine sand/silt/holes	36 38.818	174 49.931	CPZ	20.0	0926	2	0	1	0	0	0	0	0	0	0
Autumn	TR4	30 Mar	Fine sand/silt/holes	36 39.223	174 49.954	CPZ	20.6	1307	0	0	0	0	0	0	0	0	0	0
Autumn	TR5	31 Mar	Fine sand/silt	36 40.064	174 49.986	CPZ	20.0	1020	4	2	0	1	6	0	0	0	0	0
Autumn	TR6	31 Mar	Fine sand/silt	36 40.565	174 49.991	CPZ	20.0	1115	1	1	0	1	1	0	0	0	0	0
Autumn	TR7	31 Mar	Silt	36 41.007	174 50.014	NonCPZ	20.2	1200	1	0	0	0	0	0	0	0	0	0
Autumn	TR8	5 Apr	Fine sand/silt	36 41.543	174 50.057	NonCPZ	19.5	1020	2	0	1	0	0	0	0	0	0	0
Autumn	TR9	5 Apr	Fine sand/silt	36 37.412	174 51.553	NonCPZ	24.3	1315	0	0	0	0	0	0	0	0	0	0
Autumn	TR10	31 Mar	Fine sand/silt	36 37.890	174 51.602	NonCPZ	25.0	1430	2	2	0	0	0	1	0	0	0	0
Autumn	TR11	31 Mar	Silt	36 38.264	174 51.652	CPZ	24.0	1345	0	0	0	0	0	0	0	0	0	0
Autumn	TR12	31 Mar	Silt	36 38.664	174 51.717	CPZ	24.0	1535	0	0	0	1	0	0	0	0	0	0
Autumn	TR13	31 Mar	Silt	36 39.133	174 51.789	CPZ	24.2	1255	1	0	1	0	0	0	0	0	0	0
Autumn	TR14	5 Apr	Mud	36 39.603	174 51.855	CPZ	23.4	1130	0	0	0	0	0	0	0	0	0	0
Autumn	TR15	5 Apr	Mud	36 40.251	174 51.913	NonCPZ	23.6	1200	0	0	0	0	0	0	0	0	0	0
Autumn	TR16	5 Apr	Silt	36 40.785	174 51.961	NonCPZ	23.5	1225	3	0	0	0	0	0	0	0	0	0

Continued on next page

Table A1.1—continued

SEASON	STATION	DATE	HABITAT	LAT.	LONG.	STATUS	DEPTH (m)	TIME	TOTAL SNAPPER	LEGAL SNAPPER	EAGLE RAY	SHORT-TAILED STINGRAY	JACK MACKEREL	SCHOOL SHARK	SPOTTY	SMOOTH HAMMERHEAD	TREVALLY	GURNARD
Spring	TR1	1 Nov	Fine sand/silt	36 37.412	174 51.553	NonCPZ	24.0	0850	1	0	0	0	0	0	0	0	20	1
Spring	TR2	1 Nov	Fine sand/silt	36 37.890	174 51.602	NonCPZ	25.0	0938	0	0	0	0	0	0	1	0	0	1
Spring	TR3	1 Nov	Silt	36 38.264	174 51.652	CPZ	24.0	1009	0	0	0	0	0	0	0	0	0	0
Spring	TR4	1 Nov	Silt	36 38.664	174 51.717	CPZ	24.0	1045	0	0	0	0	0	0	0	0	0	0
Spring	TR5	1 Nov	Silt	36 39.603	174 51.855	CPZ	23.5	1115	0	0	0	0	0	0	0	0	0	0
Spring	TR6	1 Nov	Silt	36 40.251	174 51.913	NonCPZ	23.5	1150	1	1	0	0	0	1	0	0	0	0
Spring	TR7	1 Nov	Silt	36 39.133	174 51.789	CPZ	24.0	1227	1	0	0	0	0	1	0	0	0	1
Spring	TR8	1 Nov	Silt	36 40.785	174 51.961	NonCPZ	23.5	1311	1	0	0	0	0	0	0	0	0	1
Spring	TR9	1 Nov	Fine sand/silt	36 41.543	174 50.057	NonCPZ	19.5	1351	0	0	0	0	0	0	0	0	0	0
Spring	TR10	1 Nov	Silt	36 41.007	174 50.014	NonCPZ	20.0	1425	1	1	0	0	0	0	0	1	0	0
Spring	TR11	1 Nov	Fine sand/silt	36 40.565	174 49.991	CPZ	20.0	1454	1	1	0	0	0	0	0	0	0	0
Spring	TR12	2 Nov	Fine sand/silt	36 40.064	174 49.986	CPZ	20.0	0916	0	0	0	0	0	0	0	0	0	0
Spring	TR13	2 Nov	Fine sand/silt/holes	36 39.223	174 49.954	CPZ	20.5	0951	0	0	0	0	0	0	0	0	0	0
Spring	TR14	2 Nov	Fine sand/silt/holes	36 38.818	174 49.931	CPZ	20.0	1022	0	0	0	0	0	0	0	0	0	1
Spring	TR15	2 Nov	Fine sand/silt/holes	36 38.474	174 49.921	NonCPZ	20.5	1100	1	0	0	0	0	0	2	0	15	0
Spring	TR16	2 Nov	Hard sand, algae	36 38.020	174 87.000	NonCPZ	17.5	1130	0	0	0	0	0	0	0	0	0	0

TABLE A1.2. SAMPLING IN DEEP REEF HABITATS IN THE OUTER HAURAKI GULF DURING AUTUMN AND SPRING 2004.

Habitat: R = reef, Sp = sponges, Sa = sand, Sh = shell, SM = sand megaripples, Mu = mud, Ho = crab holes. Latitude (Lat.): DD° MM.mm′ S; Longitude (Long.): DD° MM.mm′ E. Status indicates baited underwater video stations inside (CPZ) and outside (NonCPZ) the Cable Protection Zone. Legal snapper = number of snapper > 270 mm fork length. See Table 1 for species names.

SEASON	SITE	DATE	HABITAT	LAT.	LONG.	STATUS	DEPTH (m)	TIME	TOTAL SNAPPER	LEGAL SNAPPER	BLUE COD	SCARLET WRASSE	LEATHERJACKET	PORAE	PIGFISH	TARAKIHI	JOHN DORY	NORTHERN SCORPIONFISH	SHORT-TAILED STINGRAY	TREVALLY	GOLDEN SNAPPER	RED MOKI	SOUTHERN BASTARD COD	GURNARD	CARPET SHARK	CONGER EEL	SWEEP	GOATFISH	BUTTERFLY PERCH
Autumn	1	14 Apr	R	36 08.53	174 56.85	CPZ	35.0	1047	3	3	2	4	15	0	1	0	1	0	0	1	0	0	0	0	0	0	7	0	0
Autumn	2	14 Apr	R/Sa	36 08.53	174 56.68	CPZ	44.5	1154	3	3	2	4	5	0	3	0	0	1	0	0	2	0	0	0	0	0	0	0	0
Autumn	4	14 Apr	R/Sa	36 08.53	174 57.07	CPZ	45.5	1320	1	1	2	2	3	0	3	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Autumn	5	14 Apr	R/Sa	36 08.75	174 56.79	CPZ	48.0	1350	1	1	1	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	6	14 Apr	R	36 08.60	174 56.82	CPZ	37.0	1435	1	0	2	4	4	1	1	0	1	0	0	4	0	0	2	0	0	0	0	0	0
Autumn	15	16 Apr	R/Sa	36 10.06	174 56.14	CPZ	45.0	1415	1	1	3	1	8	1	2	0	0	0	0	1	1	0	0	0	1	0	0	2	0
Autumn	18	11 Jun	R/Sa/Sp	36 10.27	174 56.76	CPZ	47.0	1002	1	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	14	16 Apr	R/Sa	36 10.35	174 56.48	CPZ	42.0	1332	0	0	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	20	11 Jun	R/Sa/Sp	36 09.38	174 58.75	CPZ	50.0	1130	1	1	1	1	0	0	3	1	0	0	0	0	2	0	0	0	0	0	0	0	0
Autumn	12	16 Apr	SM	36 12.61	174 58.83	CPZ	49.0	1210	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	10	16 Apr	S/Mu	36 13.87	174 56.24	CPZ	49.0	1030	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0
Autumn	7	14 Apr	R/Sa	36 09.33	174 54.93	NonCPZ	45.0	1555	0	0	0	2	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	8	14 Apr	R/Sa	36 09.21	174 54.98	NonCPZ	48.0	1627	0	0	3	2	4	0	4	2	0	0	0	0	3	0	0	0	0	0	0	0	1
Autumn	19	11 Jun	S	36 09.43	174 55.31	NonCPZ	47.0	1045	0	0	3	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	16	16 Apr	R/S	36 09.68	174 55.44	NonCPZ	46.0	1450	0	0	6	0	6	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	21	11 Jun	Sa/Ho	36 09.64	175 01.08	NonCPZ	58.0	1222	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	17	16 Apr	Mu/R/Sa	36 10.07	175 00.54	NonCPZ	56.0	1545	3	3	2	2	3	0	2	10	0	0	0	0	9	0	0	0	0	0	0	0	0
Autumn	24	11 Jun	R/Sa	36 10.58	175 00.72	NonCPZ	55.0	1424	1	1	3	1	0	1	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Autumn	22	11 Jun	R/Sa	36 11.12	175 01.60	NonCPZ	50.0	1305	1	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Autumn	23	11 Jun	R/Sa	36 11.42	175 00.46	NonCPZ	50.0	1345	1	1	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	11	16 Apr	Sh/SM	36 11.94	174 55.68	NonCPZ	48.0	1122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Autumn	9	16 Apr	SM	36 14.17	174 55.87	NonCPZ	48.0	0950	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

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Table A1.2—continued

SEASON	SITE	DATE	HABITAT	LAT.	LONG.	STATUS	DEPTH (m)	TIME	TOTAL SNAPPER	LEGAL SNAPPER	BLUE COD	SCARLET WRASSE	LEATHERJACKET	PORAE	PIGFISH	TARAKIHI	JOHN DORY	NORTHERN SCORPIONFISH	SHORT-TAILED STINGRAY	TREVALLY	GOLDEN SNAPPER	RED MOKI	SOUTHERN BASTARD COD	GURNARD	CARPET SHARK	CONGER EEL	SWEEP	GOATFISH	BUTTERFLY PERCH
Spring	1	22 Oct	R/Sa	36 10.35	174 56.48	CPZ	42.0	0955	0	0	7	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring	2	22 Oct	R/Sa/Sp	36 10.27	174 56.76	CPZ	47.0	1033	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Spring	4	22 Oct	R/Sa	36 08.53	174 57.07	CPZ	45.5	1155	1	1	2	3	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Spring	5	22 Oct	R/Sa	36 08.60	174 56.82	CPZ	37.0	1225	0	0	3	3	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Spring	6	26 Oct	R/Sa/Sp	36 09.38	174 58.75	CPZ	50.0	1214	0	0	3	1	1	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Spring	9	22 Oct	R/Sa	36 10.06	174 56.14	CPZ	45.0	1515	0	0	1	2	2	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Spring	12	26 Oct	R/Sa	36 08.75	174 56.79	CPZ	48.0	1015	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Spring	14	26 Oct	R/Sa	36 08.53	174 56.68	CPZ	44.5	1135	0	0	3	2	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Spring	18	26 Oct	R	36 08.53	174 56.85	CPZ	35.0	1450	2	0	4	3	6	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Spring	20	3 Nov	Sa/Sh	36 09.07	174 55.85	CPZ	48.0	1253	1	1	3	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Spring	21	3 Nov	R/Sa/Sp	36 08.38	174 56.07	CPZ	55.0	1332	2	2	1	2	1	0	2	0	0	3	0	1	2	0	0	0	2	0	0	0	0
Spring	3	22 Oct	R/Sa/Sp	36 09.68	174 55.44	NonCPZ	46.0	1110	0	0	3	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Spring	7	22 Oct	Sa/Ho	36 09.64	175 01.08	NonCPZ	58.0	1355	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring	8	22 Oct	R/Sa	36 10.58	175 00 .72	NonCPZ	55.0	1433	0	0	2	2	1	0	3	3	0	2	0	1	0	0	0	0	0	0	0	0	0
Spring	10	22 Oct	R/Sa	36 09.21	174 54.98	NonCPZ	48.0	1556	0	0	3	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring	11	26 Oct	R	36 09.33	174 54.93	NonCPZ	45.0	0940	0	0	3	2	4	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Spring	13	26 Oct	Sa	36 09.43	174 55.31	NonCPZ	47.0	1050	0	0	2	1	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Spring	15	26 Oct	R/Sa	36 10.07	175 00.54	NonCPZ	56.0	1251	0	0	1	1	1	0	1	7	1	0	0	0	4	0	4	0	0	0	0	0	0
Spring	16	26 Oct	R/Sa	36 11.12	175 01.60	NonCPZ	50.0	1333	1	1	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring	17	26 Oct	R/Sa	36 11.42	175 00.46	NonCPZ	50.0	1407	1	1	6	1	2	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Spring	19	3 Nov	R/Sa	36 09.42	175 00.82	NonCPZ	60.0	1047	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring	22	3 Nov	R	36 08.46	174 55.23	NonCPZ	58.0	1414	1	1	0	1	0	0	4	3	1	0	0	0	6	0	1	0	0	0	0	0	0