

Survey of blue cod (*Parapercis colias*) abundance in Milford and Doubtful Sounds

Blue cod (*Parapercis colias*) are highly sought after by a wide range of New Zealand fishers and are particularly important to Southland fishers. When concerns were raised about the Fiordland environment, the government and local interest groups developed the Fiordland Management plan. As part of this plan 12 new non-commercial fishing areas were agreed to and eight new reserves that were closed to all fishing were established. This effectively limited recreational fishing to specific areas within the fiords and excluded commercial fishing from large areas within the fiords.

In Doubtful and Milford Sounds, commercial fishing was effectively excluded and recreational fishing for blue cod has been prohibited since mid 2005 to allow stocks to recover.

In 2006 a research project was undertaken to determine the feasibility of using line fishing to monitor the blue cod abundance during the closed period. This project was initiated by the Ministry of Fisheries (MFish) and is being undertaken by the Guardians of the Fiordland recreational fisheries representative Alan Key and his team of fishers. Alan and his team provide the fishing expertise while MFish provides scientific support. This article serves to inform fishers in the area about the project and provides an update on what progress has been made to date. It is anticipated that the data collected during these research surveys will be comparable to the data collected from the diary surveys, and both sets of data will then be used to monitor the fishery both during and after the closure.

The objectives of this project are:

- To monitor blue cod stocks in Doubtful and Milford Sounds, during and after the closure to recreational blue cod fishing.
- To monitor changes in recreational catch rates of blue cod in Doubtful and Milford Sounds using experimental fishing.
- To assess the movement of blue cod within Doubtful and Milford Sounds by tagging and releasing blue cod.
- To determine the impact of recreational fishing on blue cod populations in Milford sound by comparing catch rates and size composition of fish from within the longstanding marine reserve, that has been closed to fishing for 10 years, with those from the previously open area.

Research fishing was conducted using the *Southern Sam*, an aluminium 6.7m monohull vessel with a 200hp outboard engine. Owing to the depth of both Milford and Doubtful Sounds blue cod are distributed in a narrow band close to the shore. Most recreational fishing takes place at waterfalls between ten and a hundred meters from the shore and within a depth range of 10 to 50m. Fourteen and 16 sites were identified within Milford and Doubtful Sounds, respectively. In addition to this, eight sites were chosen within the Milford Sound marine reserve. Sites were based on knowledge of recreational fishers who had operated in each sound for 10 to 30 years. The sampling team consisted of a scribe, boat operator and three fishers. Each site was fished for 15 minutes using two 6/0 hooks per line and sea perch as bait. The length of each fish caught was recorded and the fish were released. Owing to the

effect of the wind and swell, it was often necessary for the skipper to maintain the approximate position (within about 15 m of the starting point) using engine power. Given the steepness of the bottom, depth typically varied by up to 20 m during a fishing session. Both Sounds were surveyed in January, March and November 2006 and February 2007.

The preliminary data and some inferences from those data are discussed below.

To date 1181 fish have been caught during the survey belonging to 13 different species (Table 1). Sea perch (Jock Stewarts) dominate the catch (69%, 56% and 47% in Doubtful, Milford and Milford reserve respectively) followed by blue cod (14%, 19% and 33% in Doubtful, Milford and Milford reserve respectively). While many other species were caught, with the exception of terakihi, most are often either released or used for bait by recreational fishers, and as a result will be under-reported by boat ramp or diary surveys. This survey therefore gives us some insight as to the true nature of the recreational fishery in the Sounds and will allow us to estimate the catches of other species based on the blue cod catch.

A total of 244 blue cod have been caught of which 193 have been tagged. Nine (5%) fish have been recaptured. All of these fish were recaptured at the site of release with the time free ranging from 0 to 392 days (average 206 days). This high degree of adult residency had important implications for the management of blue cod (see below).

Fisheries scientists use catch rate information to assess relative abundance of species that means that the higher the catch rate the more fish there are estimated to be at that location. This is expressed as a catch per unit effort (*cpue*), for this survey we used the number of fish caught per hour fished. The results are shown in Tables 2 and 3. The catch rates in the fished areas were similar between surveys and both in Doubtful and Milford Sounds but were almost double in the Milford reserve.

In addition to *cpue*, fish size can give an indication of the state of a fish population. A healthy fish stock where the species is resident will have a wide range of fish sizes and many large fish. Heavily fished stocks will tend to have few large fish and a relatively higher numbers of small fish. The biggest size range of blue cod was found in Doubtful Sound at 200-570 mm total length (TL) (average 370 mm TL). In Milford Sound the average size of blue cod was smaller at 352 mm TL (range 230-540), but was 341 mm TL (range 230-530 mm TL) in the fished area and 370 mm TL (range 260-540) in the reserve (Figure 1). In all areas a high proportion of undersize fish were caught (33, 42 and 24% in Doubtful, Milford fished and Milford reserve respectively). However, at this early stage of the programme it is difficult to draw too many conclusions from these length data as the number of samples in each area are too small to make any reasonable statistical comparison. Hopefully at the completion of the survey enough data will have been collected to make statistically robust conclusions about the state of these blue cod populations.

The data presented above show that blue cod seem to be resident for long periods of time, that there are larger blue cod inside the Milford Sound reserve than outside and that catch rates are double in the reserve than out. These data suggest that the reserve is protecting localised blue cod populations from fishing and that reserves in the Sounds can offer refuges from over-fishing in localised areas. But they do not suggest

that reserves can be used as a fishery enhancement tool. In order to do that we need to know intimate details of the spawning and recruitment patterns of blue cod. If most of the recruitment is coming from offshore, i.e. outside of the Sounds, then small refuges will not contribute significantly to the recruitment. If, however, recruitment is coming from within each Sound then protecting large spawning females in each Sound will provide some fishery benefit. But these questions cannot be answered by the data collected during this programme. But the data does suggest that closing an area to fishing will allow blue cod populations in those areas to recover, the rates of recovery are currently not known as there is little comparable data with which to compare our study prior to the closure. As this survey progresses through time an assessment of recovery rates may be estimated.

In order to gain a full understanding of the recreational fishery characteristics in these two Sounds, and to assess the impact of the temporary closure on both the blue cod stocks and the recreational fishery, more data collection is necessary. To this end the blue cod survey will continue and a concurrent project in the form of a recreational diary survey is being conducted. This data will allow us to make an assessment of the effects of the closure both on fish stocks and the fishers utilising those stocks. Accurate reporting from diarists is therefore vital to our understanding of this fishery and your continued involvement is essential to the success of this project.

Table 1: Species composition of the catch in the Fiordland blue cod survey, the mean size (mm), size range is shown in parentheses (mm) and the percentage contribution to the catch of each species.

Species	Doubtful	Milford - Fished	Milford - Reserve
Blue Cod (<i>Parapercis colias</i>)	368 (200-565) 14.2%	342 (230-534) 18.7%	370 (260-540) 32.5%
Red Cod (<i>Lotella rhacinus</i>)	380 (300-450) 1%		
Sea perch – Deepwater (<i>Helicolenus barathri</i>)	290 (270-310) 0.4%		
Sea Perch – Jock Stewart (<i>Helicolenus percooides</i>)	230 (110-400) 69.4%	213 (90-380) 55.6%	246 (150-430) 46.7%
Spiny Dogfish (<i>Squalus acanthias</i>)	980 (980-980) 0.2%	816 (590-920) 4.6%	
Sting Ray (<i>Dasyatis</i> species)		380 (380-380) 0.2%	
Terakihi (<i>Nemadactylus macropterus</i>)	329 (250-400) 2.4%	340 (300-400) 1.4%	330 (280-380) 1.8%
Witch flounder (<i>Arnoglossus scapha</i>)	300 (290-310) 0.4%		
Wrasse – Banded (<i>Pseudolabrus fucicola</i>)	255 (210-300) 0.4%	249 (160-370) 5%	360 (360-360) 0.6%
Wrasse – Girdled (<i>Pseudolabrus cinctus?</i>)	300 (300-300) 0.2%		
Wrasse – Scarlet (<i>Pseudolabrus miles</i>)	301 (200-390) 7.9%	271 (160-335) 11.6%	303 (200-350) 18.3%
Wrasse – Spotted (<i>Pseudolabrus celidotus</i>)	194 (110-230) 2.8%	243 (190-360) 1.2%	
Wrasse – Unidentified species (<i>Pseudolabrus</i> species)	245 (210-330) 0.6%	321 (360-380) 1.8%	

Table 2: Catch per unit effort (fish per angler hour) of blue cod caught in Doubtful Sound on 4 sampling trips.

Site	Jan-06	Mar-06	Nov-06	Feb-07
1	2.7	0.0	6.7	1.3
2	0.0	0.0	4.0	0.0
3	6.7	2.7	1.3	2.7
4	1.3	0.0	1.3	1.3
5	1.3	4.0	6.7	2.7
6	0.0	0.0	5.3	0.0
7	2.7	1.3	2.7	2.7
8	0.0	0.0	0.0	0.0
9	0.0	0.0	1.3	0.0
10	0.0	1.3	2.7	1.3
11	1.3	1.3	4.0	1.3
12	1.3	0.0	0.0	0.0
13	2.7	0.0	0.0	0.0
14	2.7	0.0	4.0	1.3
15	0.0	0.8	1.3	0.0
16	2.7	1.3	0.0	0.0
Average	1.6	0.8	2.6	0.9

Table 3: Catch per unit effort (fish per angler hour) of blue cod caught in Milford Sound on 4 sampling trips.

Site	Jan-06	Mar-06	Nov-06	Feb-07
1	1.3	2.7	2.7	2.7
2	0.0	1.3	1.3	1.3
3	4.0	2.7	4.0	1.3
4	2.7	2.7	1.3	1.3
5	1.3	0.0	0.0	0.0
6	2.7	1.3	1.3	0.0
7	1.3	2.7	1.3	0.0
8	6.7	1.3	17.3	12.0
9	4.0	0.0	0.0	2.7
10	1.3	4.0	4.0	4.0
11	1.3	0.0	1.3	1.3
12	4.0	1.3	1.3	1.3
13	1.3	1.3	0.0	0.0
14	5.3	4.0	1.3	2.7
A			4.0	6.7
B			2.7	10.7
C			0.0	0.0
D			9.3	10.7
E			10.7	1.3
F			2.7	-
G			5.3	0.0
H			4.0	5.3
Average	2.7	1.8	3.5	3.1
Average	Fished area		2.7	2.2
Average	Marine reserve		4.8	5.0

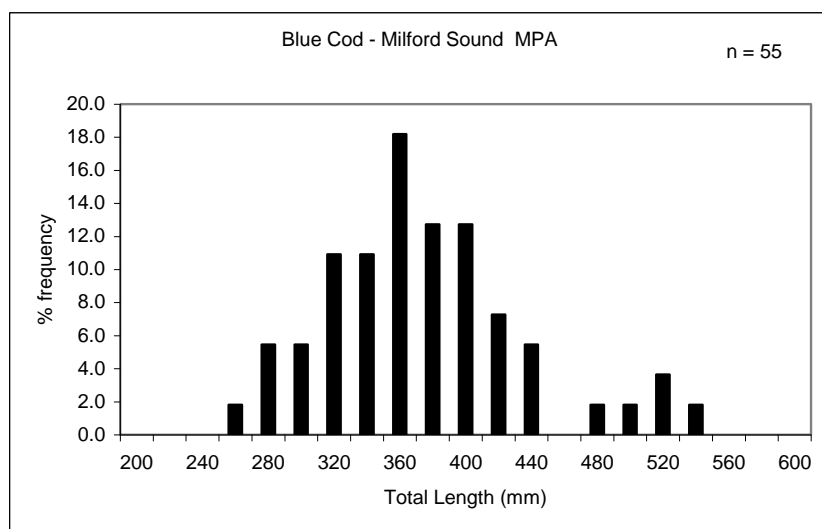
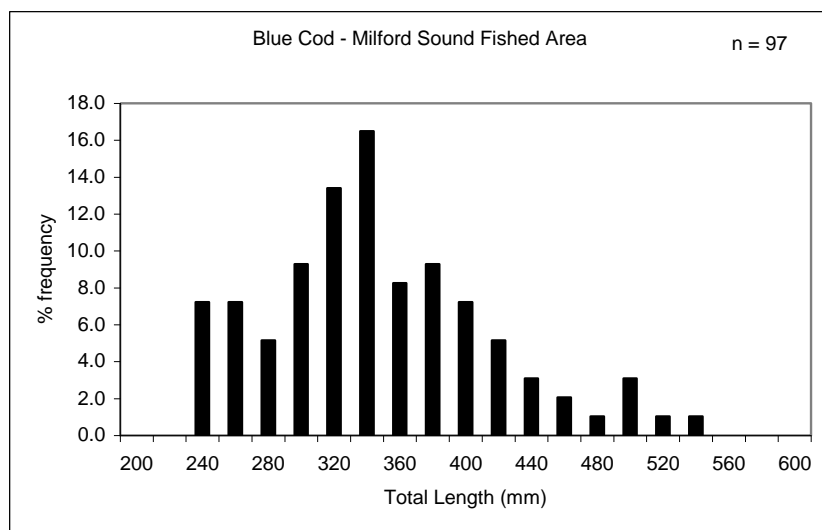
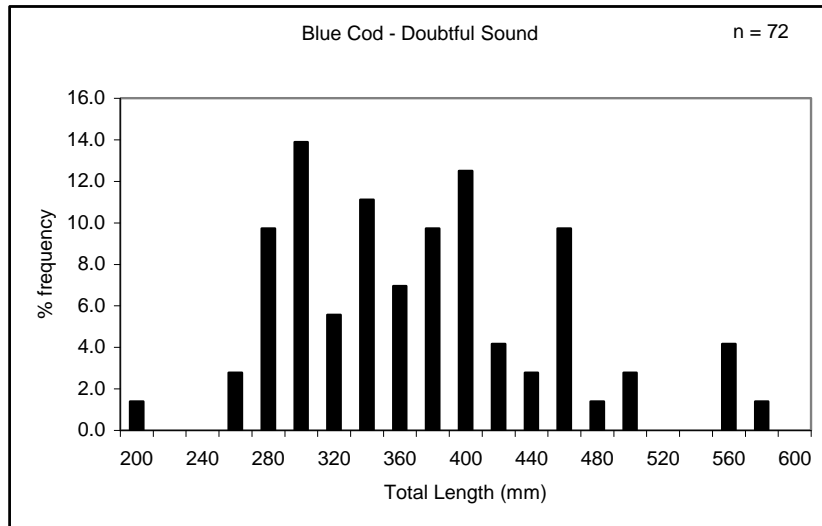


Figure 1: Length frequency distribution of blue cod caught in the Fiordland blue cod survey. Note: 33% of the fish caught in Doubtful sound were below the minimum size limit, 42% of the fish in the Milford Sound fishing area were below the minimum size limit and 24% of the fish in the Milford Sound reserve were below the minimum size limit.