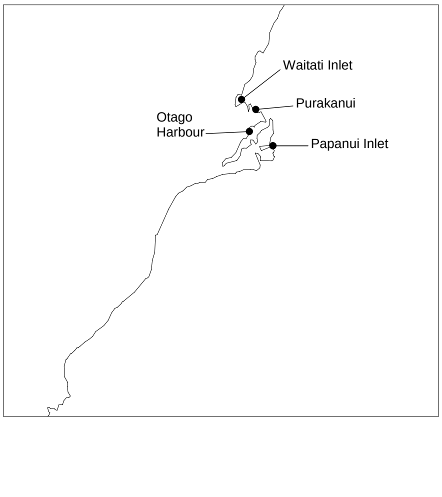
COCKLES (COC 3A) Otago Peninsula

(*Austrovenus stutchburyi*)



1. FISHERY SUMMARY

Cockles are fished commercially only in Papanui and Waitati Inlets, but they are also present in other places around the Otago Peninsula. Commercial landings from Papanui and Waitati Inlets are shown in Table 1. A limit of 104 t was in effect for Papanui and Waitati Inlets combined from 1986–87 through 1991–92. From 1992–93 to 1998–99, the catch limits were 90 t for Papanui Inlet and 252 t for Waitati Inlet. In April 2000, the catch limits were increased to 427 t for Papanui Inlet and 746 t for Waitati Inlet.

Table 1: Reported landings (t) of cockles from Papanui and Waitati Inlets, Otago, combined (FMA 3), from 1986–87 to 2004-05 based on Licensed Fish Receiver Returns (LFRR). Catch split provided by Southern Clams Ltd (Stewart, 2005).

Year	Papanui (t)	Waitati (t)	Total (t)
1986–87	14		14
1987–88	8		8
1988–89	5		5
1989–90	25		25
1990–91	90	16	106
1991–92	90	14	104
1992–93	90	92	182
1993–94	90	109	199
1994–95	90	252	342
1995–96	90	252	342
1996–97	90	252	342
1997–98	90	252	342
1998–99	90	293	383
1999–00	118	434	552
2000–01	90	606	696
2001–02	49	591	640
2002-03	52	717	767
2003-04	73	689	762
2004-05	91	709	800
2005-06	68	870	938

Commercial fishing in Papanui and Waitati Inlets began in 1983. There has been no size limit. In 1992, 35 mm shell length was the minimum size for commercial cockles; however, commercial fishers currently target ≥30 mm cockles, therefore 30 mm is used as the effective minimum size in yield calculations. CPUE data are available for this fishery. COC 3A was introduced to the Quota Management System in October 2002 with a TAC of 1,500 t; comprising a customary allowance of 10 t, a recreational allowance of 10 t, an allowance for other fishing related mortality of 10 t, and a TACC of 1470 t.

(b) Recreational fisheries

Cockles are taken by recreational fishers in many areas of New Zealand. The recreational fishery is harvested entirely by hand digging. Relatively large cockles are preferred, but ≥30 mm cockles are taken.

Amateur harvest levels in FMA 3 were estimated by telephone and diary surveys in 1993–94 (Teirney et al., 1997), 1996 (Bradford, 1998) and 2000 (Boyd & Reilly, 2004), Table 2. COC 3A is a smaller area within FMA 3. Harvest weights are estimated using an assumed mean weight of 25 g (for cockles >30 mm). The estimates for 1993-94 and 1996 are considerably less than the 2000 estimate and are considered to substantially underestimate the recreational harvest. The 2000 estimate is considered to be a more reliable estimate of absolute harvest.

Table 2: Estimated numbers of cockles harvested by recreational fishers in FMA 3, and the corresponding harvest tonnage. Figures were extracted from a telephone and diary survey in 1993–94, and the national recreational diary surveys in 1996 and 2000.

Fishstock	Survey	Harvest (N)	% CV	Harvest (t)
1993–94				
FMA 3	South	106 000	51	2.7
1996				
FMA 3		144 000	–	3.6
2000				
FMA3		1476000	45	36.9

(c) Maori customary fisheries

Many intertidal bivalves, including cockles, are very important to Maori as traditional food, particularly to Huirapa and Otakou Maori in the Otago area. Tangata tiaki issue customary harvest permits for cockles in Otago. The number of cockles harvested under customary permits is given in Table 3.

Table 3: Number of cockles harvest under customary fishing permits.

Year	Number of cockles
1998	750
1999	0
2000	1109
2001	1090
2002	0
2003	2750
2004	4390
2005	5699

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(d) Illegal catch

No quantitative information is available on the magnitude of illegal catch but it is thought to be insignificant.

(e) Other sources of mortality

No quantitative information is available on the magnitude of other sources of mortality. It has been suggested that some harvesting implements, such as brooms, rakes, “hand-sorters”, bedsprings and “quick-feeds” cause some incidental mortality, particularly of small cockles, but this proposition has not been scientifically investigated. The incidental mortality from mechanical digging is thought to be relatively small. High-grading of cockles is also practised, with smaller sized cockles being returned to the beds. The mortality from this activity is unknown, but is likely to be low.

2. STOCKS AND AREAS

Little is known of the stock boundaries of cockles. No specific studies of stock structure in cockles are available. Recent assessments have considered the commercially fished areas to be “discrete populations”.

Cockles have larvae that spend about three weeks in the plankton. As in similar marine invertebrates that are essentially sessile after settlement, the planktonic phase may function as a dispersal mechanism. Populations such as those surveyed near Dunedin may receive spat from other nearby populations and may, in turn, provide spat for other areas.

3. STOCK ASSESSMENT

Stock assessments for Papanui Inlet and Waitati Inlet have been conducted using absolute biomass surveys, yield-per-recruit analyses, and Method 1 for estimating CAY (Annala et al., 2002). Breen et al. (1999) also estimated biomasses and yields for Otago Harbour and Purakanui.

(a) Estimates of fishery parameters and abundance

A project to estimate growth and mortality in Papanui and Waitati Inlets, Purakanui and Otago Harbour (Bed 1) was undertaken in the late 1990s. Notched clams did not exhibit significant growth when recovered after one year, and modes in the length frequency distributions did not shift when measured over four sampling periods within a year (Breen et al., 1999).

In 2004 yield-per-recruit modelling was conducted for Papanui and Waitati inlets separately (Stewart, 2005). For this the parameters $L\infty$ = 40.296 mm, K = 0.311/yr, t_0 = 0.0 mm, M = 0.30/yr, size at recruitment = 30 mm, a = 0.00023172, b = 3.1375, as used by Wing *et al.* (2002), were used again. For both inlets, $F_{0.1}$ was estimated for M = 0.1, 0.2 and 0.3/yr respectively.

(b) Biomass estimates

Biomass surveys have been undertaken periodically in COC 3 since 1984. A major difference in methods used to extract biomass values for different size classes exists between previous surveys. Wildish (1984) and Stewart et al. (1992) separated cockles by sieving into three size classes. Breen et al. (1999) measured random samples of cockles from each inlet to calculate length-weight relationships. The first method only allows estimation of biomass from predetermined size classes. By calculating size structure of populations using length to weight data a more flexible approach is allowed where data can be matched to current commercial needs as well as to future survey results. The 1998 survey used random samples from each inlet to calculate length to weight relationships (Breen et al., 1999). This method was once again used in the 2002 survey (Wing et al., 2002). In the 2004 survey random samples from each shellfish bed were weighed and their longest axis measured (Stewart, 2005). These data were then used to generate length to weight relationships.

In Table 4, estimates of biomass from previous surveys are compared with the 2004 survey (Stewart, 2005). In Papanui Inlet the biomass of juvenile cockles (>2−18 mm) has declined from the 1992 survey to 2002, but has since risen to above 2002 figures. The biomass of adults (19−34 mm) has declined from 3435 t in 1998 to 2414 t in 2004. The biomass of cockles ≥30 mm in 2002 was similar to that estimated in 1998 and remains similar, at 3676 t, in 2004. The biomass of the largest adults (≥35 mm) has decreased only slightly since 2002. In Waitati inlet the biomass of juveniles (256 t) in 2004 remains well below the 1210 t figure from the 1992 survey. The 2004 biomass of adults (19−34 mm) was higher than in 2002 but less than the 1998 figure. The biomass of larger-sized adults (i.e., the ≥30) was higher than previous surveys, but the ≥35 mm size class has remained about the same.

Table 4: Current (±95% CI) and previous biomass estimates from Papanui Inlet and Waitati Inlet (Wildish, 1984; Stewart et al., 1992; Breen et al., 1999; Wing et al., 2002; Stewart, 2005). Area of current commercial beds, Papanui Inlet = 815,811 m^2.

Papanui Inlet

Size Class	1984	1992	1998	2002	2004 Total inlet	2004 Commercial area
>2 to 18mm (juveniles)	65	139	33	16.9 ± 1.7	36.01±2.16	13.25±1.25
19 to 34mm (adults)	3705	3721	3435	1969.6 ± 191.6	2414.89±150.7	824.75±87.91
≥35mm	2370	1706	2231	2578.8 ± 252.1	2301.23±271.89	1847.14±208.4
≥30mm			3990.2	3859.7 ± 364.6	3676.81±367.4	2419.61±271.29
Total (t)	6140	5567	5699	4565.4 ± 423.8	4752.13±424.76	2685.14±297.59

Waitati Inlet. Area of current commercial beds, Waitati Inlet = 943,986 m^2

Size Class	1984	1992	1998	2002	2004 Total inlet	2004 Commercial area
>2 to 18mm (juveniles)	619	1210	304	153.1 ± 20.4	256.96±13.56	77.43±4.24
19 to 34mm (adults)	7614	5198	8519	6652.6 ± 651.9	7272.4±403.43	2735.16±128.92
≥35mm	3844	4620	4381	4297.5 ± 297.9	4534.7±507.85	3872.43±383.77
≥30mm			7235	7183.1 ± 462.7	7992.64±720.47	5612.2±6.81
Total (t)	12080	11027	13204	11103.1 ± 847.8	12064.1±924.86	6685.02±516.93

(c) Estimates of Maximum Constant Yield (MCY)

Although estimates of B_{beg} are available, MCY results for Papanui and Waitati Inlets are also presented here (Table 5). MCY was estimated using Method 1 (MCY = 0.25 $F_{0.1}$ B_0) of Annala et al. (2002) and the 2004 biomass estimates. For each of these locations MCY was estimated for both the entire inlet area and a subset area where the commercial fishery has been operating for the past several years.

Table 5: MCY estimates (±95% CI) for COC 3 cockles ≥30 mm shell length.

Papanui whole inlet
B_0 = 4119.38

M	F0.1	MCY	Lower	Upper
0.2	0.2321	213.35	192.03	234.67
0.3	0.3412	313.63	282.29	344.97
0.4	0.4767	438.18	394.40	481.97

Papanui current commercial area
B_0 = 2453.62

M	F0.1	MCY	Lower	Upper
0.2	0.2321	140.40	124.66	156.14
0.3	0.3412	206.39	183.25	229.53
0.4	0.4767	288.36	256.03	320.69

Waitati whole inlet
B_0 = 9399.11

M	F0.1	MCY	Lower	Upper
0.2	0.2321	463.77	421.97	505.58
0.3	0.3412	681.77	620.32	743.23
0.4	0.4767	952.52	866.66	1038.38

Waitati current commercial area
B_0 = 6080.69

M	F0.1	MCY	Lower	upper
0.2	0.2321	325.65	298.36	352.93
0.3	0.3412	478.72	438.61	518.83
0.4	0.4767	668.83	612.79	724.88

(d) Estimates of Current Annual Yield (CAY)

For both Papanui Inlet and Waitati Inlet, CAY was estimated (Table 6) using Method 1 (CAY = ($F_{0.1}$/Z) (1-exp(-Z))B_{beg}) (Annala et al., 2002) and the 2004 biomass estimates. For each of these locations CAY was estimated for both the entire inlet area and a subset area where the commercial fishery has been operating for the past several years.

Table 6: CAY estimates (±95% CI) for COC 3 cockles ≥30 mm shell length.

Papanui whole inlet
B_{beg} = 4119.38

M	F0.1	CAY	Lower	Upper
0.2	0.2321	776.34	705.68	847.00
0.3	0.3412	1037.58	943.14	1132.01
0.4	0.4767	1307.75	1188.73	1426.77

Papanui current commercial area
B_{beg} = 2453.62

M	F0.1	CAY	Lower	Upper
0.2	0.2321	462.41	410.24	514.58
0.3	0.3412	618.01	548.29	687.74
0.4	0.4767	778.93	691.05	866.81

Waitati whole inlet
B_{beg} = 9399.11

M	F0.1	CAY	Lower	Upper
0.2	0.2321	1771.36	1632.73	1909.99
0.3	0.3412	2367.42	2182.14	2552.70
0.4	0.4767	2983.87	2750.34	3217.39

Waitati current commercial area
B_{beg} = 6080.69

M	F0.1	CAY	Lower	Upper
0.2	0.2321	1145.97	1055.52	1236.39
0.3	0.3412	1531.59	1410.71	1652.46
0.4	0.4767	1930.39	1778.04	2082.71

The level of risk to the stock of using the CAY estimates above has not been determined. The Shellfish Working group notes that the CAYs do not take into account the different productivity between inlets. Estimates of productivity should be made in future surveys based on survey biomass estimates and catch data.

(e) Other factors

Commercial, customary and recreational fishers target different sized cockles. Biomass and yield estimates will differ for different sizes of recruitment to the fishery. Maori and recreational fishers prefer larger cockles (>45 mm shell length and greater) whereas commercial fishers currently prefer cockles of around 28-34 mm. Estimates of yields have been estimated for size of recruitment at ≥30 mm; however, these estimates do not consider multiple fisheries preferring different sized cockles. Depending on the management approach taken in the future in COC 3, the appropriateness of the current methods to estimate yield may need to be reviewed.

The yield estimates use information from yield-per-recruit analyses that assume constant recruitment, and constant growth and mortality rates. Yield estimates will be improved when growth, mortality and recruitment variation are better known.

As cockles become sexually mature at around 18 mm, using a size of recruitment of 30 mm should provide some protection against egg overfishing under most circumstances. Certainly the increase in the biomass of small cockles (<2 - >19mm) seen in both inlets in 2004 suggests that the very poor recruitment observed by Wing et al. (2002) may have been due to natural variability, and supports the conjecture that significant recruitment might occur only sporadically in the Otago fishery, as suggested by John Jillett (pers. comm.) and Breen et al. (1999). The possibility that fishing has an effect on recruitment remains an unknown.

In other cockle fisheries it has been shown that recruitment of juvenile cockles can be reduced by the removal of a large proportion of adult cockles from a given area of substrate. This would suggest that there is some optimal level of adult biomass to facilitate recruitment, although its value is not known. To date it has not been determined whether the cockles being targeted by commercial harvesting in the Otago fishery comprise the bulk of the spawning stock or if disturbance of the cockle beds is influencing settlement.

The distribution of very small size classes (2-10mm) across the various beds is variable. The fact that very small shellfish are notably absent, or present in only low numbers, on Beds C and E+ in Papanui Inlet and on Bed G in Waitati, suggests that heavily fished beds may have low numbers of recruits. This is, however, by no means consistent, with other commercial beds having reasonably high numbers of recruits that are comparable with non-commercially harvested beds. A comparison of the size/frequency histograms with fishing history for each bed would be a worthwhile exercise and may reveal more. The fact that the relationship between spawning stock and recruitment in this fishery is poorly understood remains a concern.

The possibility that fishing has an effect on recruitment does, however, remain an unknown. To date it has not been determined whether the cockles being targeted by commercial harvesting comprise the bulk of the spawning stock or if disturbance of the cockle beds is influencing settlement.

The increase in biomass recorded in the current survey suggests that the current level of harvest is sustainable or may tolerate a slight increase. What is not known is if the increase in biomass is a long-term trend or simply the result of natural variability, possibly linked to sporadic recruitment.

The impacts of the illegal catch, the Maori traditional catch and incidental handling mortality are unknown, although illegal catch is thought to be insignificant. The impacts of the recreational fishery are probably minor compared with those from the commercial fishery.

4. STATUS OF THE STOCKS

The last stock assessment for Papanui Inlet and Waitati was 2005. In Papanui Inlet the biomass of juvenile (>2−18 mm) cockles has more than doubled relative to 2002 numbers. The biomass of adult (19−34 mm) cockles has also increased over 2002 figures but lies below 1992 and 1998 levels. The biomass of large cockles (≥30mm class and ≥35mm class) has decreased from 2002. There is, however, a new cohort of relatively small (<10 mm) cockles evident across most of the beds in Papanui.

In Waitati Inlet the biomass of juvenile cockles (>2−18 mm) has increased from 2002 levels but remains well below figures for 1992. The biomass of adult (19−34 mm) cockles has increased over 2002 levels but is lower than that recorded in 1998. The biomass of large adult (≥35 mm) cockles has remained at a similar level since 1992, but the biomass of cockles ≥30 mm has risen through time.

No size limit has been set for COC 3; however, commercial fishers currently target cockles between 28-34 mm, and >38 mm. In both inlets, the estimates of CAY for this size category are above current catch levels and recent reported landings. Furthermore, CAY estimates for the areas of both inlets where commercial fishing currently occurs are also above current catch levels and recent reported landings. Catch levels higher than recent reported landings would be required to move the stocks in these two inlets towards a size that will support the maximum sustainable yield. The Shellfish Working Group noted that current catch is within the MCY for 2005.

Cockles recruit to the spawning stocks in the Otago area at a length of about 18 mm shell length. The harvested beds may receive spat from other areas. For these reasons, and because of the low harvesting levels, the risk of recruitment overfishing is probably low.

Yields and reported landings, for the 2005/060 fishing year, are summarized in Table 7.

Table 7: Summary of yields (t) and reported landings for the most recent fishing year.

Area	2005 MCY	2005 CAY	2003-04 Reported landings	2004-05 Reported landings	2005-06 Reported landings
Whole of Papanui Inlet	213-438	692-1167	73	91	68
Whole of Waitati Inlet	463-952	1506-2537	689	709	870
COC3A Total landings			762	800	938

5. FOR FURTHER INFORMATION

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