ISSN 1175-1584

MINISTRY OF FISHERIES
Te Tautiaki i nga tini a Tangaroa

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New Zealand Fisheries Assessment Report 2004/13
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New Zealand Fisheries Assessment Report 2004/13
February 2004

Published by Ministry of Fisheries
Wellington
2004

ISSN 1175-1584

Citation:
Michael, K.P.; Dunn, A.; Diggles, B.K.; Parsons, M. (2004).
Foveaux Strait dredge oyster (*Ostrea chilensis*) stock assessment: population and bonamia surveys October 2001, January and March 2002, and yields for the 2002 oyster season.
New Zealand Fisheries Assessment Report 2004/13. 18 p.

This series continues the informal
New Zealand Fisheries Assessment Research Document series
which ceased at the end of 1999.

EXECUTIVE SUMMARY

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Three surveys of Foveaux Strait oysters were carried out between the 2001 and 2002 oyster seasons. A survey in October 2001 estimated population size, commercial population size, and yields. The survey also estimated the prevalence and intensity of infection in oysters from *Bonamia exitiosus*. Two further surveys in January and March 2002 of a subsample of stations surveyed in October 2001 estimated the effect of mortality from *B. exitiosus* infection on yield.

The 2001 Foveaux Strait oyster survey was successfully completed in 16 sampling days between 16 October and 3 November. Sea conditions were good for dredge sampling, with dredge tows all less than 80% full, indicating effective sampling. The sampling design and operational procedures were similar to those of the 1999 survey, with sampling focused on commercial areas designated by oyster skippers. Commercial, exploratory, and background areas were stratified using a number of small strata to spread the sampling effort more consistently. More stations were allocated to exploratory and background strata to provide better information on the distribution of oysters and *B. exitiosus* infection. In all, 192 of the 210 random stations were sampled and used to estimate the absolute population size. Of these stations, 103 sampled the commercial strata to estimate commercial population size. Those stations that fell over foul ground and could not be sampled were reassigned to other sites to better define high-density patches of oysters, but the data from these samples were not used to estimate population size.

The absolute population sizes of recruit (58 mm in length and greater), pre-recruit (50–57 mm) and small (10–49 mm) oysters were estimated with c.v.s of 11–12%. The absolute population size of recruited oysters in 2001 was 995 million oysters (95% confidence interval 632–1511) c.f. 1461 million (872–2334) in 1999; pre-recruit oysters 871 million (548–1330) c.f. 899 million (570–1387); and small oysters 1410 million (884–2156) c.f. 1 373 (874–2115) in 1999.

Commercial population size was estimated at 295 million (196–441) with a c.v. of 7%, a slight increase from 275 million (184–408) in 1999. However, the area covered by commercial strata increased from 103.3 km^2 in 1999 to 119.0 km^2 in 2001. Oyster density in commercial areas had not changed between the 1999 and 2001 surveys, 2.4 per m^2 (s.e. 0.4), but the distribution of oysters and location of commercial fishery areas had changed.

Changes in the distribution of oysters between the 1999 and 2001 surveys showed bonamia caused mortality in patches of high oyster density to the northwest of the 2001 commercial fishery areas. The small change in the commercial population size suggests mortality from bonamia and fishing was balanced by recruitment into the fishery of pre-recruit oysters in areas not affected by disease mortality (especially in the eastern fishery).

In October 2001, infection of oysters by *B. exitiosus* was widespread throughout the fishery area. All areas with high densities of recruited oysters, including the designated commercial fishery areas, had a high prevalence of infection and patches of high intensity of infection within or near them. The two surveys of a subsample of 35 stations that had been surveyed in October 2001 estimated that mortality from *B. exitiosus* infection has reduced the commercial population to 40–65% of the 2001 level.

Yields based on estimates of commercial population size in October 2001 were 21 to 70 million oysters. Mortality in recruited oysters over the summer of 2001–02 was expected to reduce yields to between 8 and 45 million. Bonamia will cause further oyster mortality in 2002 and will reduce the expected yields in the future.

1. INTRODUCTION

In 1993 the Foveaux Strait oyster fishery was closed to allow the population to recover from a *B. exitiosus* (bonamia) (Hine 1998) infection that had catastrophically reduced the oyster population to critically low levels (Doonan et al. 1994). Recovery of the oyster population has been monitored by two-year surveys since 1995 (Cranfield et al. 1996), which have estimated the population size and distribution of recruit and pre-recruit oysters.

In 1995, the New Zealand Fishing Industry Board Oyster Advisory Committee suggested setting the TACC by including only areas of oyster density above a commercial threshold as a sustainability measure (Anon. 1995). Yield estimates for the 1996–99 oyster seasons used the entire survey area, with estimates of the commercial population calculated as the portion of the whole population over 400 oysters per tow (0.3 oysters m^2 or more, equivalent to a commercial catch rate of 6–8 sacks per hour). In 1998, the Shellfish Working Group recommended that only the oysters within areas designated as 'commercial' by fishers should be used for TACC advice.

Following discussions between the Ministry of Fisheries, the Bluff Oyster Management Company, and NIWA, the 1999 survey design differed from those in previous years. Sampling effort was concentrated in areas likely to have commercial densities of oysters in the 2000 oyster season (Michael et al. 2001). Oyster density data from previous surveys and fishers' logbook data were summarised and plotted. Skippers from the Bluff oyster fleet designated commercial, exploratory, and non-commercial fishery areas from these data. Yields for the 2000 fishing year was based on an estimate of the entire population of recruited oysters from the designated commercial fishery areas alone.

In 2000, MFish and the Bluff Oyster Management Company accepted a five-year strategic research plan (Andrew et al. 2000). Included in this plan was the development of a length-based management model for the Foveaux Strait oyster fishery, including modelling of changes in population size, the effects of *B. exitiosus* infection, growth, mortality, fishing mortality, and the effects of fishing-induced habitat change on the oyster population. Its aim is to develop an overall harvest strategy, simple to apply, producing good yields, and robust to unforeseen mortality and poor recruitment. Central to developing this model is information on the size structure of the oyster population and size composition of the commercial catch.

A new *B. exitiosus* epizootic confirmed by a survey in March 2000 (Dunn et al. 2000) had reportedly caused significant mortality in the main commercial fishery area. However, there was no information on the distribution of prevalence and intensity of *B. exitiosus* infection in the Foveaux Strait fishery area. As yield for the fishery was to be estimated from the October 2001 survey data, and *B. exitiosus* caused significant disease mortality over the previous two summers (1999–2001), the risk of continued disease mortality on the sustainability of the yield needed to be assessed.

This report presents the results of three surveys.

1. The two-yearly stock assessment survey of Foveaux Strait oysters in October 2001 (OYS2001/01, Objective 1). The survey estimated numbers and distribution of recruited and pre-recruit oysters, the density and distribution of new clocks (shells of oysters that had died recently) to estimate recent mortality from bonamia, and the distribution of the prevalence and intensity of infection by *B. exitiosus*, and the population size structure of oysters in Foveaux Strait.
2. A subsample of stations that were surveyed in October 2001 were sampled in January 2002 (MOF2001/03I) for changes in density of live recruit-sized oysters, recruit-sized new clocks, and the prevalence and intensity of *B. exitiosus* infection.
3. Survey 2 was repeated in March 2002 (MOF2001/03L) to further estimate disease mortality.

This report presents estimates of population size and yields for the 2002 oyster season, the impact of mortality from bonamia on yields, a brief summary of other factors that could modify these yields, and the status of the stock at the beginning of the oyster season in March 2002.

2. POPULATION SIZE ESTIMATES

2.1 Estimates of the absolute population size of oysters in the Foveaux Strait fishery area

The absolute population size of oysters in the Foveaux Strait fishery area was estimated in October 2001 using the same survey methods and analysis as the October 1999 survey (Michael et al. 2001). Both used a dredge efficiency of 0.17. Sampling strata and stations are shown in Figures 1 and 2 respectively. Absolute population estimates for recruited, pre-recruit, and small oysters are given in Table 1 along with 1999 estimates. Population estimates by stratum are given in Tables 2–4. The absolute population size of recruited oysters (995 million) was estimated with a c.v. of 11.8%. The population size of recruited and pre-recruit oysters was lower in 2001 than 1999, reflecting the heightened mortality from bonamia between the two surveys. The population size of small oysters was higher in 2001.

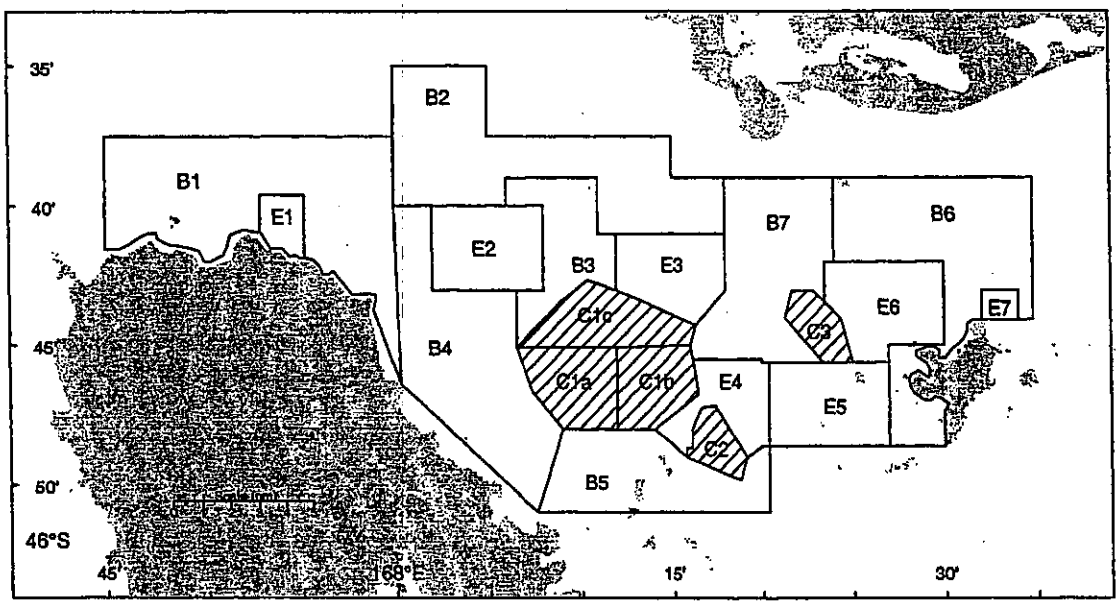

Figure 1: The stratifications used for the October 2001 survey design. Strata designated commercial are those strata defined by the hashed region prefixed "C". Exploratory strata are those prefixed "E"; background strata prefixed "B".

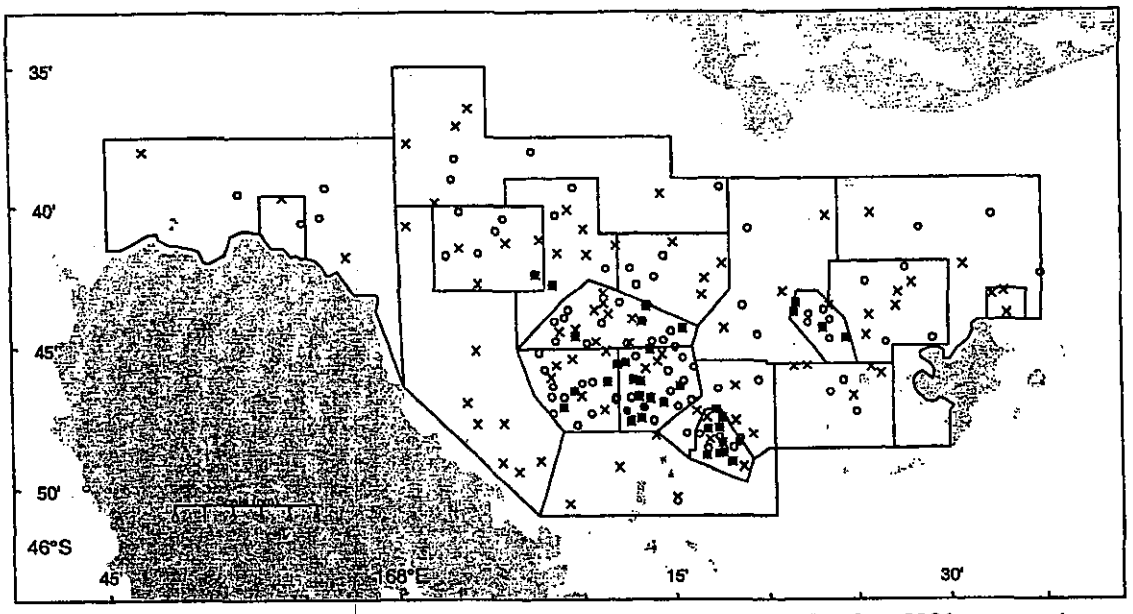

Figure 2: The locations of the start positions of tows used for the October 2001 survey (open circles), stations where a subsample of oysters was taken to estimate *B. exitiosus* infection rates in 2001 (crosses), and the stations resampled in the January 2002 and March 2002 surveys (closed circles).

Table 1: Absolute population estimates of oysters (millions) within the area of Foveaux Strait surveyed in 1999 (1054 km^2). Recruited oysters (58 mm in length and greater), pre-recruit oysters (50–57 mm), and small oysters (10–49 mm); 95% confidence intervals in parentheses include error in dredge efficiency.

Survey	Recruits	Pre-recruits	Small
1999 (October)	1 461 (872–2 334)	899 (570–1 387)	1 373 (874–2 115)
2001 (October)	995 (632–1 511)	871 (548–1 330)	1 410 (884–2 156)

2.2 Estimates of recruitment between 1999 and 2001

We assume pre-recruits are fully retained in the dredge, but unless small oysters were attached to other oysters and shell, they could readily pass through the rings of the dredge so their numbers are probably underestimated (Tables 1 and 4).

Between 1992 (after large-scale mortality from *B. exitio*sus had ceased) and 1999, the mean increase in the recruited oyster population was consistent with about half the pre-recruits recruiting between surveys. This rate is consistent with the expected mean annual height increment of this size group (see Cranfield et al. 1993). The decrease in the numbers of recruited and pre-recruit oysters between 1999 and 2001 was due to mortality caused by bonamia (Dunn et al. 2000, Dunn & Michael 2002, Dunn et al. 2002).

2.3 Estimates of commercial population

The commercial population size is defined as the recruited oyster population from commercial fishery areas designated by oyster fishers and assigned in the survey as commercial strata (Figure 1). The mean oyster density sampled at the 103 stations was 2.48 per m^2 (s.d. 0.18). Estimates by stratum (prefixed "C") are given in Table 2. The commercial population size was estimated at 295 million (196–441) in 2001, estimated with a c.v. of 7% and had increased slightly from 275.3 million (167.1–437.1) in 1999. The area of commercial strata

was 119.0 km^2 in 2001 compared with 103.3 km^2 in 1999, and therefore oyster density in commercial areas is not likely to have changed between surveys.

The 1999 and 2001 commercial population estimates used a dredge efficiency estimate of 0.17 (revised from 0.16), the mean estimated from two dredge surveys and a dive survey in 1990 (Michael et al. 2001). The size of the commercial population was reduced by mortality from *B. exitiosus* infection before the 2002 oyster season began (Dunn & Michael 2002).

Table 2: Absolute population estimate for recruited oysters (≥ 58 mm): the number of stations sampled (No. stations), the mean oyster density per m^2 (mean density), standard deviation (*s.d.*) of the density estimate, coefficient of variation (*c.v.*) of the population estimate, mean population size (Mean population, in millions of oysters), upper and lower 95 % confidence intervals (CI), and the area of each stratum, by stratum for the October 2001 Foveaux Strait oyster survey. Commercial strata are those prefixed "C"; exploratory strata prefixed "E" prefix; background strata prefixed "B".

					Population estimates (millions) and stratum areas			
	No.	Mean	Density		Mean	Lower	Upper	Area
Stratum	stations	density	s.d.	c.v.	population	95% CI	95% CI	(km^2)
B1	5	0.09	0.02	0.28	12.90	5.40	22.97	149.45
B2	9	0.72	0.30	0.42	94.69	18.33	195.43	131.00
B3	5	0.74	0.37	0.50	33.00	0.72	73.72	44.67
B4	8	0.84	0.49	0.59	94.09	0.00	224.60	112.40
B5	3	0.64	0.50	0.78	45.38	0.00	127.66	70.50
B6	4	0.29	0.18	0.63	34.53	0.00	85.41	118.29
B7	6	1.36	0.69	0.51	120.50	2.45	272.27	88.67
C1a	22	2.20	0.36	0.16	68.79	40.38	111.26	31.27
C1b	26	3.26	0.54	0.17	87.51	51.55	141.11	26.84
C1c	25	2.29	0.27	0.12	78.85	50.07	121.78	34.45
C2	20	3.60	0.45	0.12	44.98	28.16	70.15	12.49
C3	10	1.09	0.16	0.15	15.18	9.05	24.25	13.95
E1	2	0.04	0.04	1.00	0.42	0.00	1.38	11.16
E2	10	1.41	0.40	0.28	60.40	23.93	109.78	42.83
E3	9	1.89	0.36	0.19	71.22	40.32	117.70	37.62
E4	7	0.70	0.36	0.52	21.36	0.00	48.65	30.62
E5	8	1.09	0.47	0.43	51.29	7.70	106.22	47.03
E6	10	1.13	0.21	0.19	52.10	29.30	86.20	46.22
E7	3	1.50	0.88	0.59	7.66	0.00	18.29	5.12
All	192	0.94	0.10	0.11	994.85	632.09	1510.98	1054.60

Table 3: Absolute population estimate for pre-recruited oysters (50–57 mm): the number of stations sampled (No. stations), the mean oyster density per m^2 (mean density), standard deviation (*s.d.*) of the density estimate, coefficient of variation (*c.v.*) of the population estimate, mean population size (Mean population, in millions of oysters), upper and lower 95 % confidence intervals (CI), and the area of each stratum, by stratum for the October 2001 Foveaux Strait oyster survey. Commercial strata are those prefixed "C"; exploratory strata prefixed "E" prefix; background strata prefixed "B".

					Population estimates (millions) and stratum areas			
	No.	Mean	Density		Mean	Lower	Upper	Area
Stratum	stations	density	s.d.	c.v.	population	95% CI	95% CI	km^2
B1	5	0.08	0.03	0.33	12.18	4.14	22.76	149.45
B2	9	0.78	0.26	0.34	101.55	34.21	194.03	131.00
B3	5	0.66	0.25	0.37	29.32	7.31	58.45	44.67
B4	8	0.28	0.14	0.52	31.11	0.00	70.61	112.40
B5	3	0.12	0.09	0.71	8.64	0.00	23.13	70.50
B6	4	0.28	0.14	0.48	33.60	2.77	73.16	118.29
B7	6	2.01	0.96	0.48	178.15	14.72	390.27	88.67
C1a	22	0.84	0.15	0.17	26.37	15.22	43.06	31.27
C1b	26	1.97	0.33	0.17	52.95	31.21	85.37	26.84
C1c	25	0.91	0.14	0.15	31.52	18.94	50.30	34.45
C2	20	2.52	0.27	0.11	31.41	20.09	48.33	12.49
C3	10	2.54	0.34	0.13	35.45	21.74	55.83	13.95
E1	2	0.03	0.03	1.00	0.34	0.00	1.13	11.16
E2	10	1.09	0.40	0.37	46.86	11.98	92.09	42.83
E3	9	1.94	0.37	0.19	73.05	40.91	121.26	37.62
E4	7	0.57	0.26	0.45	17.44	2.18	37.05	30.62
E5	8	1.02	0.47	0.46	48.03	4.90	101.37	47.03
E6	10	2.42	0.39	0.16	111.82	66.28	181.28	46.22
E7	3	0.43	0.14	0.33	2.22	0.74	4.16	5.12
All	192	0.83	0.10	0.12	872.00	548.05	1330.45	1054.60

Table 4: Absolute population estimate for small oysters (10–49 mm): the number of stations sampled (No. stations), the mean oyster density per m^2 (mean density), standard deviation (*s.d.*) of the density estimate, coefficient of variation (*c.v.*) of the population estimate, mean population size (Mean population, in millions of oysters), upper and lower 95 % confidence intervals (CI), and the area of each stratum, by stratum for the October 2001 Foveaux Strait oyster survey. Commercial strata are those prefixed "C"; exploratory strata prefixed "E" prefix; background strata prefixed "B".

					Population estimates (millions) and stratum areas			
	No.	Mean	Density		Mean	Lower	Upper	Area
Stratum	stations	density	s.d.	c.v.	population	95% CI	95% CI	km^2
B1	5	0.66	0.31	0.47	98.36	9.10	210.27	149.45
B2	9	1.40	0.60	0.43	182.80	30.73	381.87	131.00
B3	5	0.88	0.18	0.20	39.38	20.96	66.54	44.67
B4	8	0.20	0.07	0.37	22.30	6.11	43.94	112.40
B5	3	0.06	0.03	0.58	4.22	0.00	10.13	70.50
B6	4	0.59	0.19	0.33	70.31	24.33	133.04	118.29
B7	6	2.93	1.38	0.47	259.94	23.81	566.88	88.67
C1a	22	0.52	0.09	0.18	16.34	9.27	26.83	31.27
C1b	26	1.49	0.21	0.14	40.00	24.56	63.20	26.84
C1c	25	0.69	0.12	0.17	23.87	13.89	38.60	34.45
C2	20	1.97	0.20	0.10	24.63	15.84	37.80	12.49
C3	10	5.52	0.93	0.17	77.04	44.27	124.78	13.95
E1	2	0.39	0.34	0.87	4.40	0.00	13.23	11.16
E2	10	1.86	0.78	0.42	79.64	13.40	164.13	42.83
E3	9	2.92	0.84	0.29	109.85	46.19	200.15	37.62
E4	7	0.73	0.20	0.27	22.38	9.65	40.17	30.62
E5	8	1.90	0.61	0.32	89.16	31.41	165.90	47.03
E6	10	5.28	0.84	0.16	244.18	145.89	394.53	46.22
E7	3	0.27	0.08	0.28	1.40	0.57	2.51	5.12
All	192	1.34	0.16	0.12	1410.19	883.97	2155.66	1054.60

3. DISTRIBUTION OF OYSTERS

Sampling effort in the 2001 Foveaux Strait oyster dredge survey was focused on designated commercial areas and data on the distribution of oysters outside those areas are limited and biased towards the recruited population. Oyster distribution data were summarised using the same method as for previous survey data. The estimated kriged densities of recruited, pre-recruit, and small oysters from the 2001 survey are shown in Figures 3–5.

The distribution of oysters and location of commercial fishery areas have shifted southeast from the fishery areas surveyed in 1999 (see Michael et al. 2001) where there was high mortality of oysters caused by bonamia. Large numbers of new and old clocks and gapers (Figure 6) confirm oyster mortality in these areas.

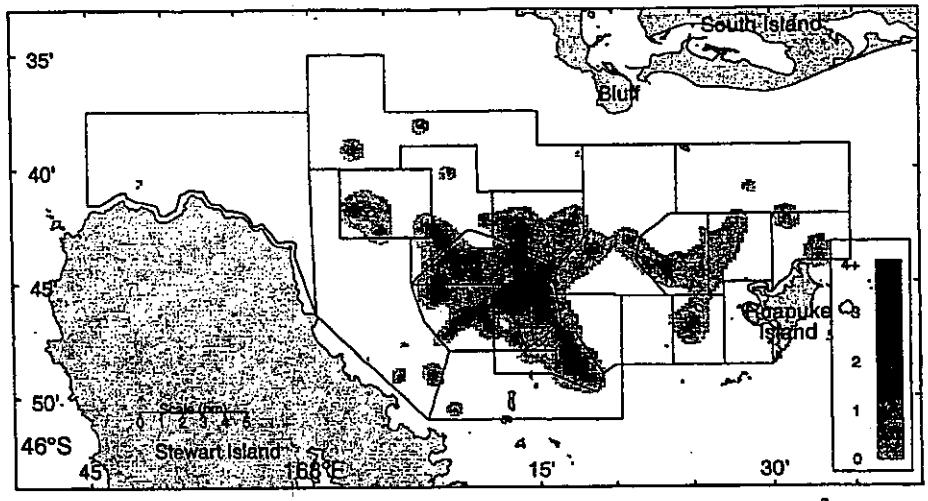

Figure 3: Estimated (kriged) density of live recruited oysters (oysters per m^2) from the 2001 survey.

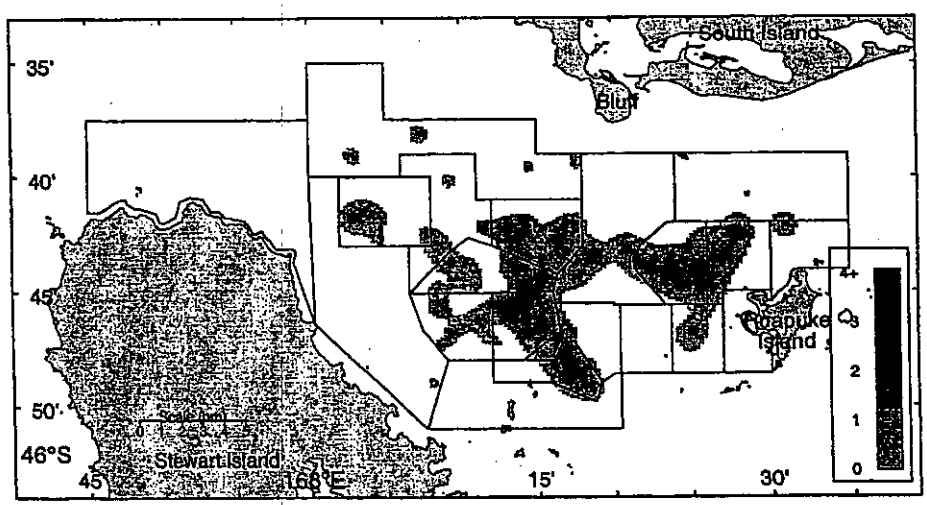

Figure 4: Estimated (kriged) density of live pre-recruited oysters (oysters per m^2) from the 2001 survey.

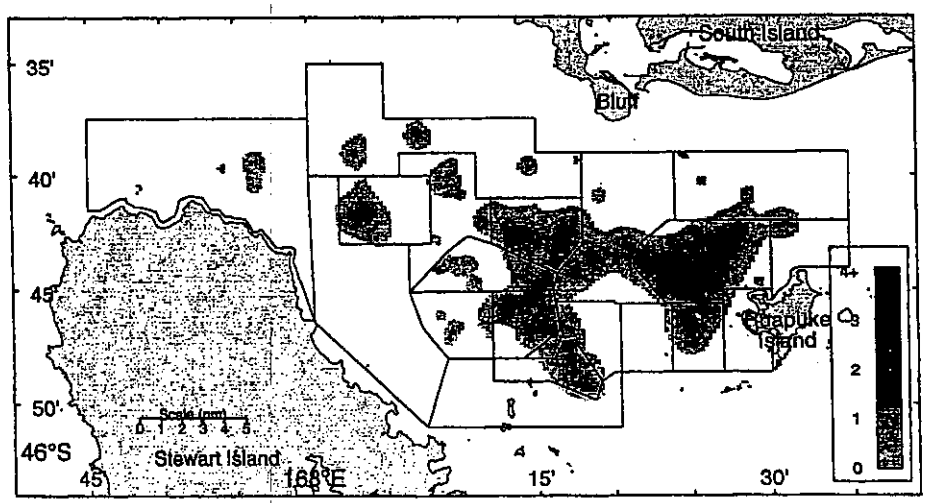

Figure 5: Estimated (kriged) density of live small oysters (oysters per m^2) from the 2001 survey.

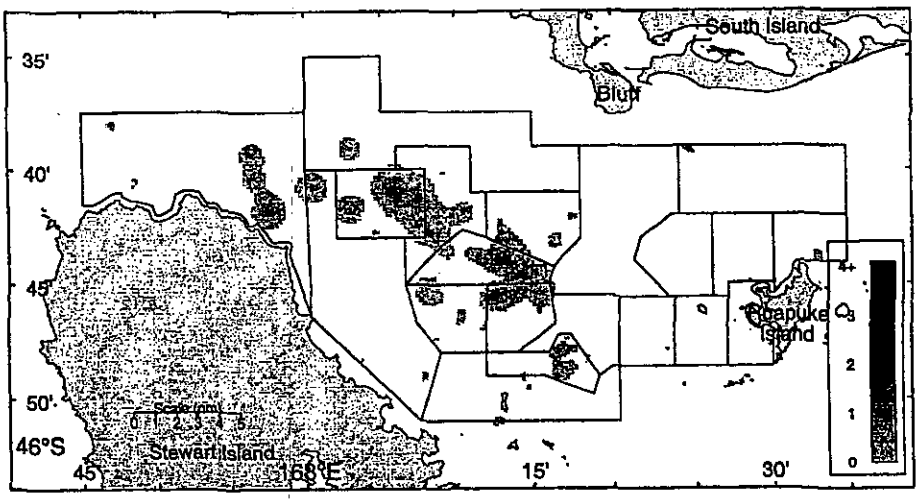

Figure 6: Estimated (kriged) density of recruit size new clocks (articulated shells of oysters which have died since the last summer and have glossy inner valves with no fouling organisms), old clocks (articulated shells of oysters which have died 1–3 years ago and have fouling organisms on their inner valves), and gapers (moribund oysters with valves apart) from the 2001 survey.

4. YIELD ESTIMATES

Yield has been estimated using a Current Annual Yield (CAY) method since 1996 from estimates of commercial population size from the two-yearly surveys. Yield for the 2002 fishing year was based on a commercial population size estimated at 295.3 million oysters. Although yield is estimated from commercial areas only, fishers are permitted to fish their quota from anywhere within the Foveaux Strait oyster fishery.

4.1 Estimation of Current Annual Yield (CAY)

Fishing occurs over a short period at the beginning of the oyster season (1 March to 31 August). The oyster season usually begins early in March and most of the quota is caught by June or July. The Shellfish Working Group agreed to estimate CAY using Method 1 (Annala et al. 2001):

$$CAY = (1-e^{-F0.1}) B_{beg}$$

Where B_{beg} is the recruited commercial population at the beginning of the oyster season. As the commercial population is estimated in October 2001 and fishing begins in March 2002, we assume recruitment into the fishery over the summer will equal or exceed natural mortality (normally greater in late autumn and winter). B_{beg} was 295 million in 2001 and 275 million oysters in 1999. $F_{0.1}$ was estimated from a yield per recruit model. The Shellfish Working Group considered the likely range of M for the oyster population (0.020–0.100) and at each level of M, CAY was estimated from the population point estimate and the 95% confidence limits of the estimates (Table 5).

Table 5: Estimates of CAY in millions of oysters from 1999 and 2001 estimates of commercial population size at each assumed value of M, $F_{0.1}$, CAY, and the lower and upper 95% confidence limits (in parentheses).

M	$F_{0.1}$	1999 CAY	2001 CAY
0.020	0.116	30 (18-47)	32 (21-48)
0.042	0.129	33 (20-52)	36 (24-53)
0.100	0.173	44 (27-69)	47 (31-70)

The risk to the stock associated with harvesting at the estimated CAYs cannot be determined.

5. FACTORS MODIFYING YIELD ESTIMATES

5.1 Continuing mortality from *Bonamia exitiosus*

The October 2001 survey of the oyster population found all areas with high densities of recruited oysters, including the designated commercial areas, had a high prevalence of infection by *B. exitiosus*, and some patches of high intensity of infection within or near them. The pattern of infection in March 2000, and changes in the distribution of high oyster density between 1999 and 2001, suggested some risk of heightened mortality caused by bonamia over the summer of 2001–02. Oysters scored with an intensity of infection category 3 or more out of 5 (see Dunn & Michael 2002) were thought likely to die in the spring and early summer after spawning.

Two surveys of 35 stations in commercial strata surveyed in October 2001 were surveyed again in January and March 2002 for changes in density of live recruit and pre-recruit-sized oysters, new clocks, and the prevalence and intensity of *B. exitiosus* infection. Recent mortality caused by bonamia was estimated, and yield estimates updated (see Dunn & Michael 2002, Dunn et al. 2002 for detailed results).

In March 2002, heart imprints indicated *B. exitiosus* infection at all 35 stations. Eleven stations (31%) had a prevalence of at least 50% (25% in October 2001 and 40% in January 2002) and only four stations had a mean intensity 3 or above (1 in October 2001 and 13 in January 2002, see Dunn & Michael 2002, Dunn et al. 2002). Heart imprint analysis from the January 2002 survey showed *B. exitiosus* infection at almost all stations, with most stations having a higher prevalence and intensity than in October 2001. Prevalence was only slightly higher in strata C1a, C1b, and C1c, but noticeably higher in stratum C2. By March 2002, levels of prevalence were about the same as in January 2002, but intensity of infection was slightly less (see Figures 7 and 8).

In general, the density of live recruited oysters in March 2002 was lower than that found in January 2002 in 26 of the 35 stations. The mean density at the 35 stations was 1.2 oysters/m^2 in March 2002, down from 1.9 oysters/m^2 in January 2002 and 3.1 oysters/m^2 in October 2001. The density of recruit-sized new clocks was higher in March 2002 than in both January 2002 and October 2001 (see Dunn & Michael 2002, Dunn et al. 2002). New clocks were found in increased numbers over most of the sampled stations, except in strata C3 (Figure 9).

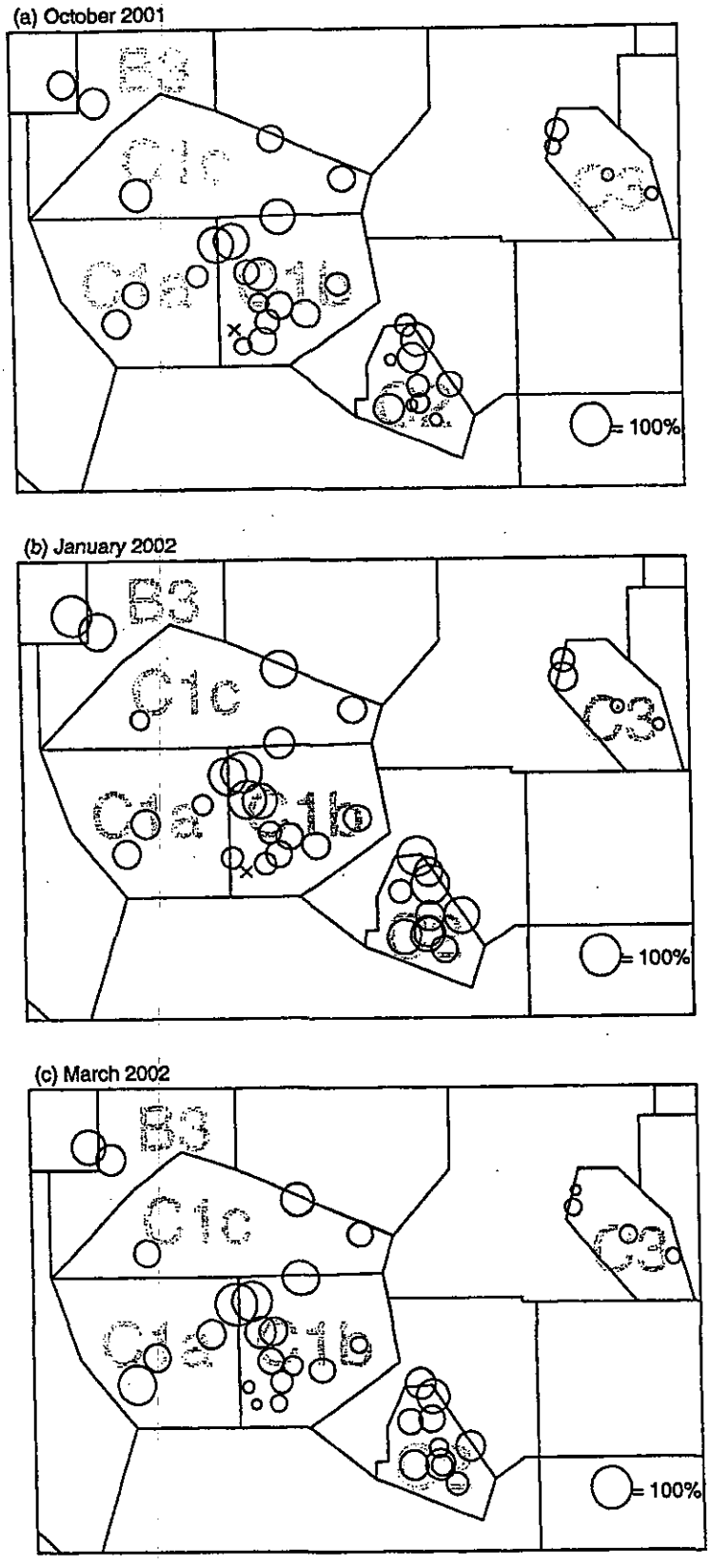

Figure 7: Estimated prevalence of *B. exitiosus* infection for the (a) October 2001, (b) January 2002, and (c) March 2002 surveys for the selected stations. Circle area is proportional to prevalence, with stations of zero prevalence indicated by a cross.

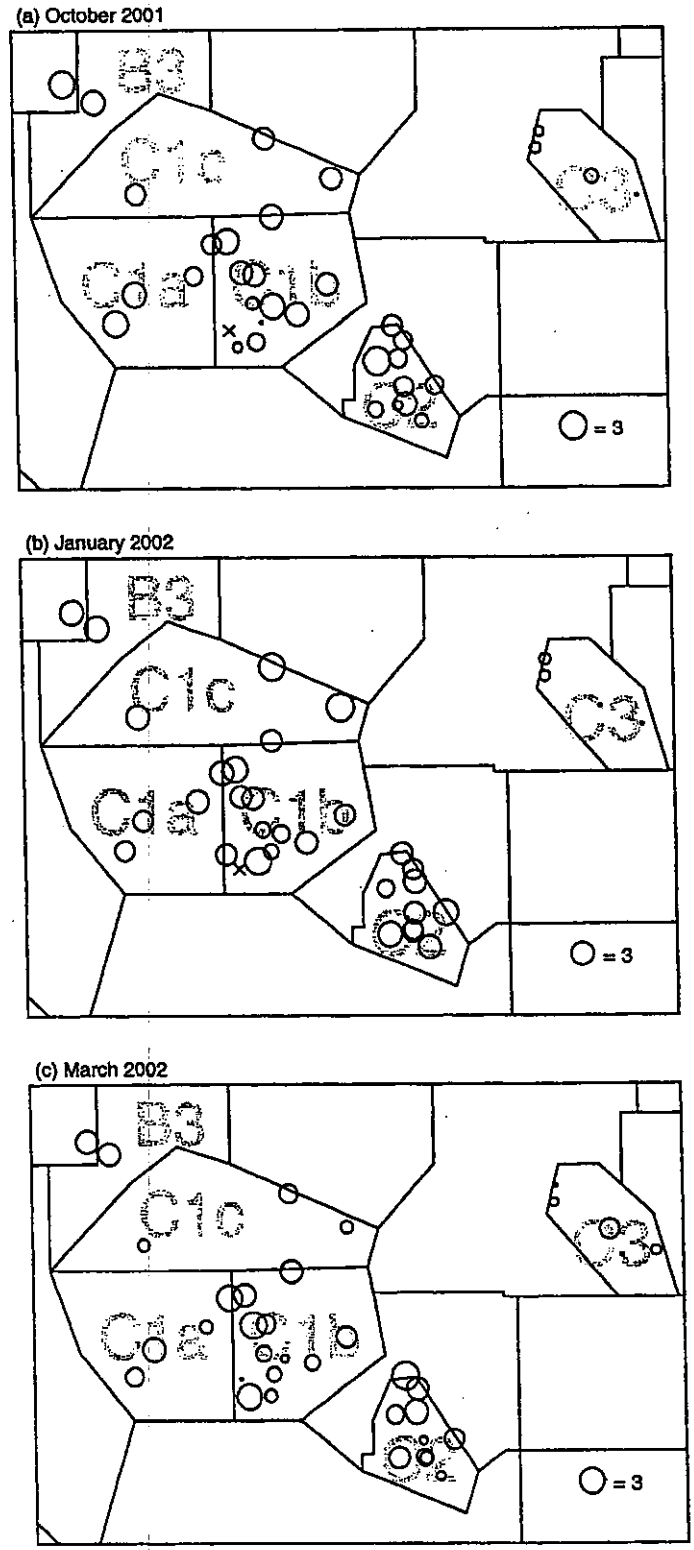

Figure 8: Estimated intensity of *B. exitiosus* infection for the (a) October 2001, (b) January 2002, and (c) March 2002 surveys for the selected stations. Circle area is proportional to intensity (range 1–5), with stations of zero prevalence indicated by a cross.

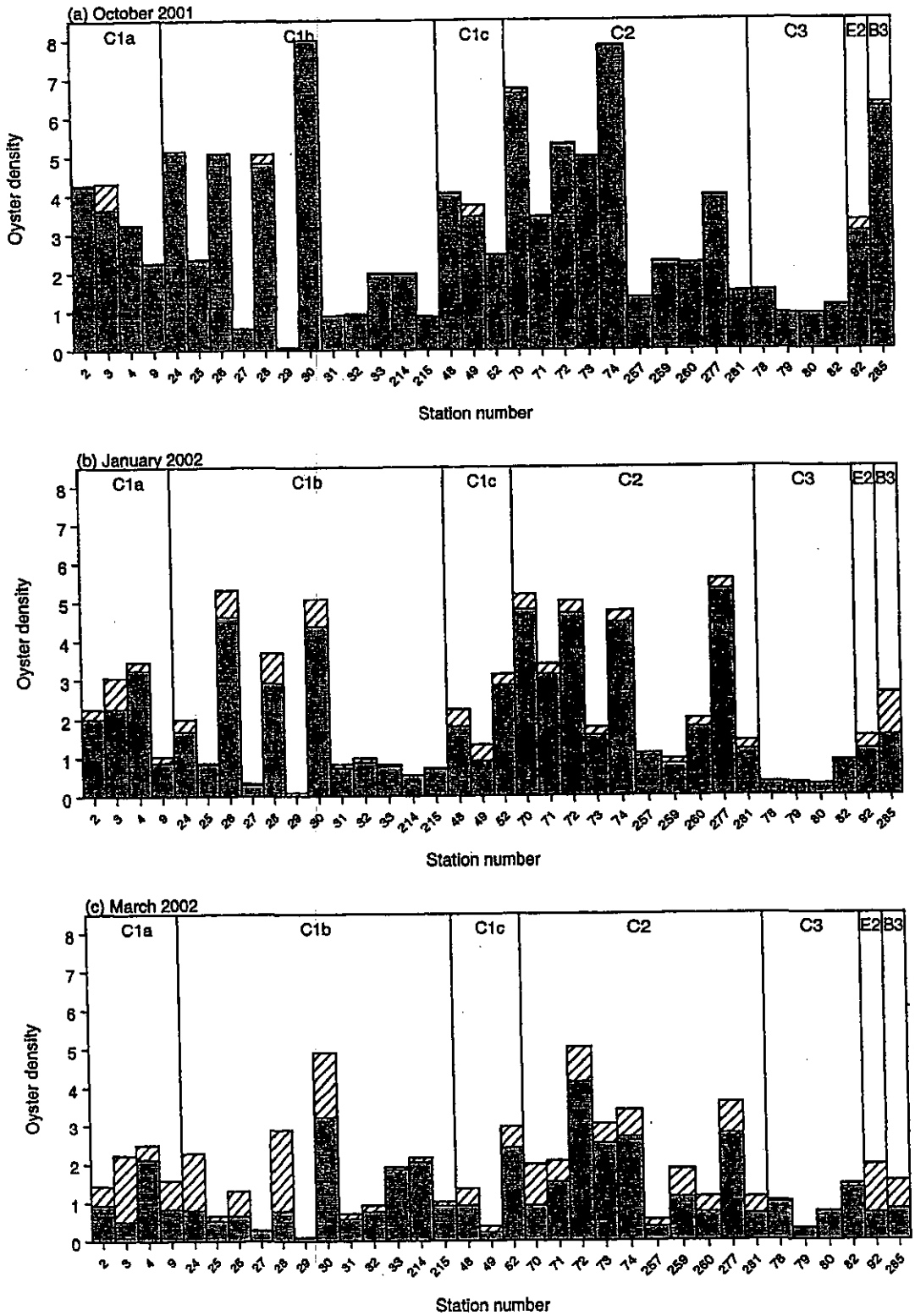

Figure 9: Oyster density (oysters/m^2) at the re-sampled stations in (a) October 2001, (b) January 2002, and (c) March 2002 for live recruit oysters (grey bars) and recruit-sized new clocks (hashed bars), ordered by strata.

The size of the commercial population in March 2002 was estimated from changes in the densities of oysters and new clocks between October 2001 and March 2002 (Dunn & Michael 2002). These estimates suggested a reduction to about 40–65% of the estimated population from October 2001, probably resulting from bonamia related mortality. This compares with an estimate of about 60–86% suggested in January 2002.

5.2 Dredge efficiency

A major potential source of error in yield estimation is the estimate of dredge efficiency, and its effect on commercial population size estimates. Dredge efficiency was last calculated in 1990. The absolute population size was estimated using a stratified random dive survey. The efficiency of the small survey dredge and of commercial dredges was estimated by comparing oyster density in the same areas using these dredges with the density from the dive survey. The distribution of oysters, the structure of oyster beds, the substrate and epifauna, and the number of clocks (shells of dead oysters) are likely to have changed since then. Dredge efficiency is therefore likely to have increased from the 0.17 used to estimate yield in 2001.

During the October 2001 population survey, we investigated a fish-down method for estimating dredge efficiency. Operational difficulties precluded data from the trial being used to estimate dredge efficiency, but this project provided a base from which to develop this technique.

6. MANAGEMENT IMPLICATIONS

6.1 Continued mortality from *Bonamia exitiosus*

Oyster mortality from *B. exitiosus* infection is a recurrent feature of Foveaux Strait oyster population dynamics and has caused significant mortality between 1999 and 2001. Based on the high prevalence and intensity of infection found in October 2001 and in January and March 2002, bonamia will cause further oyster mortality in 2002 and will reduce the expected yields in the future (Dunn & Michael 2002, Dunn et al. 2002).

6.2 Declining absolute and commercial oysters populations

The absolute population size of recruited oysters in October 2001 has declined to 68% of the 1999 level, down from 1461 million (95% confidence interval 872–2334) to 995 million (632–1511), while pre-recruit and small oyster abundance have remained similar at 899 (570–1387) to 871 (548–1330) and 1373 (874–2115) to 1410 (884–2156) million oysters respectively.

The commercial population size has increased slightly from 275 (95% confidence interval 167–408) million oysters to 295 (196–441) since 1999. The area of the commercial strata increased from 103.3 km^2 to 119.0 km^2. The commercial population size in October 2001 suggests that mortality from bonamia and fishing from 1999 to 2001 has been balanced by recruitment of pre-recruit oysters into the fishery. However, further mortality of oysters from bonamia between October 2001 and March 2002 has further reduced the commercial population to 40–65% of the 2001 level.

Estimated yields based on the estimate of commercial population size from the October 2001 survey ranged from 21 to 70 million oysters. Yields based on the revised estimates of the commercial population size in March 2002 suggested a range of between 8 and 45 million oysters.

6.3 Outlook for the fishery

The Foveaux Strait oyster population rebuilt between 1996 and 1999, but the current bonamia epizootic has reduced the size of the population down to a level close to that when the fishery was closed in 1992. Bonamia will further reduce the size of the commercial population substantially by the beginning of the 2002 oyster season. The distribution of oysters and location of commercial fishery areas has shifted east since 1999 as a result of rebuilding of

relatively high density patches there. However, bonamia is also spreading east and is likely to cause mortality in these remaining areas in the near future.

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