AN ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT
THE FOVEAUX STRAIT CASE STUDY UPDATE, JUNE 2005

Advises stakeholders on progress and results of collaborative research undertaken by NIWA, the Bluff Oyster Management Company, Ministry of Fisheries, the Foundation for Research Science and Technology, and blue cod fishers, in Foveaux Strait.

In late May, we completed three investigations in Foveaux Strait: an initial test of a camera system developed to monitor the regeneration of seabed habitat, to be used in a number of upcoming investigations; a survey of the three experiment areas where shell is being returned during the oyster season, as part of a pilot trial; and a brief trial to estimate the short-term mortality of small oysters on the shells of processed oysters returned to sea. We present a brief overview of these investigations and summaries of results.

Foveaux Strait benthic camera system

NIWA is developing a compact benthic camera system to provide video and high resolution digital colour images of the seabed habitat. This system will complement an earlier camera system developed to count fish, primarily blue cod. The benthic camera system is designed to be a cost-effective tool for quantitatively sampling benthic habitat (to estimate the amount of structure, and the size and numbers of animals and plants on the seabed). The system has lasers, two red dots 200 mm apart that provide a scale for measuring the size of animals and plants on the image. It is also designed to be highly portable, so that it can be used from fishing vessels. The camera system (Figure 1) is lowered close to the seabed, and drifts along a transect sending video to the surface, where it is recorded, and taking still images at set time intervals (Figure 2) that are downloaded when the camera is retrieved.

Figure 1: Camera system being lowered over the side of the oyster vessel *Polaris*.

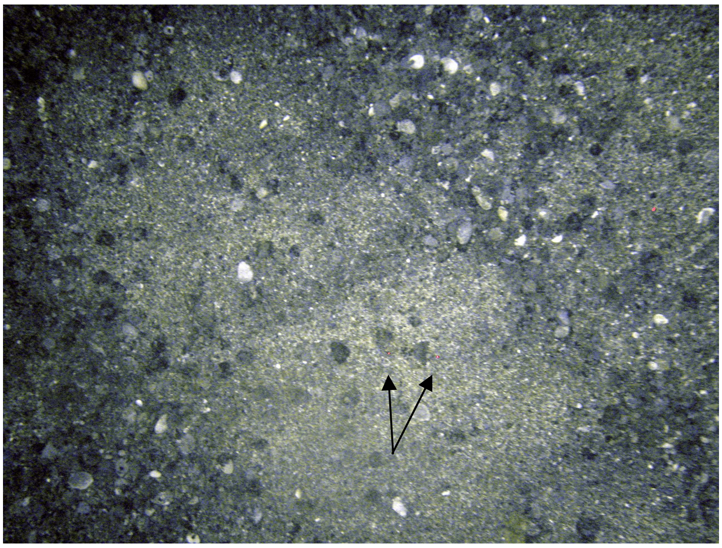

Figure 2: Oyster shells on a "pea gravel" substrate in eastern Foveaux Strait; arrows indicate red laser points.

Initial trials went well; the camera system operated as expected, it was easy to deploy, it provided good video images of the seabed, and took still images at 1 minute intervals. The next stages of development will incorporate better lighting on the frame to allow faster shutter speeds to compensate for the heave of the vessel riding swells and the rapid drift across the seabed once the tidal current is flowing swiftly, and to make the system more compact and transportable.

We plan to use this camera system as a sampling tool in experiments to: investigate the effectiveness of shell return; mapping benthic habitat to delineate fishery areas for spatial ("paddock") management, and to investigate dredging duration and intensity on the regeneration of benthic habitat, in before-and-after dredging experiments.

Pilot shell return trial

Two oyster skippers are returning most of the oyster shell processed from the commercial catch back to sea, in an experiment that will allow the effectiveness of this strategy for rebuilding oyster and blue cod populations, and enhancing the regeneration of benthic habitat, to be measured (see April 2005 update for details). Shell is being returned accurately to GPS positions in the centres of each of three areas, on daily rotation to ensure an even build up of shell in each area, and that all three areas are built up over the same period so that there are no differences in the length of time each plot has the opportunity to be settled by oysters and other plants and animals.

The initial sampling in this experiment aimed to determine whether shell remained within the boundaries of the three areas or whether it was being dispersed widely by tidal currents and swell, and, given the low volume of shell being returned, whether we could discern any structure on the seabed, and whether blue cod had begun to migrate into these shell areas.

The clean, white, returned shell was clearly visible on the seabed. It was distributed in elongated patches oriented along the direction of the tidal flow, within 200 m down tide, either side of the return position, and about 50 m across tide. It is encouraging, at this early stage, to see most shell retained within these areas. Shell was spread over the seabed mostly in a single layer, with many clumps two and three shells deep, probably where a load of shell had been released and had drifted down to the seabed with minimal dispersion. Had more shell been available from the fishery, it is likely that we would have seen more structure on the seabed. No blue cod were observed on these shell patches, except in one area where large numbers of blue cod were observed a short distance from the shell patches, possibly drawn there by the regular return of shell.

Short-term mortality of small oysters on returned shell

One of the objectives of the shell return trial is to minimise the mortality of small oysters (spat and wings) attached to the commercial catch. Anecdotal evidence infers many of the small oysters found on legal-sized oysters could not be removed without damage, causing mortality. The survival of small oysters returned to sea on the shells of oysters after processing was investigated in a short-term trial to estimate mortality in small oysters on shells held in Bluff Harbour. Three groups of shells, with between 200 and 800 small oysters attached, were held in lantern nets (Figure 3). The mortality of small oysters, on the shells of oysters processed 6 days prior (6P), and the day prior (1P), to being put out, was compared with the mortality of small oysters caught the day prior, but not processed (controls). Shells from each group were spread through three lantern nets (3 replicates) and up to 9 trays on each lantern net to investigate whether any observed mortality could be attributed to the experiment, e.g., whether handling of samples, or environmental factors in the harbour such as fresh water, caused mortality in top trays or silt in the lower trays close to the seabed. After 5 days we examined each shell and recorded the treatment, replicate net number, and tray, and the length of each spat and its status as alive and undamaged (1), alive and damaged (2), dead and undamaged (3), or dead and damaged (4) Table 1.

Table 1: The number of small oysters alive and undamaged (1), alive and damaged (2), dead and undamaged (3), or dead and damaged (4) from each group; 6 days prior (6P), the day prior (1P), and the day prior, but not processed (control); and the percent of small oysters damaged and dead.

Group	Control				1P				6P			
Net	1	2	3	All	1	2	3	All	1	2	3	All
Status												
Live, 1	70	46	43	159	206	240	262	708	224	242	192	658
Live, 2	5		1	6	8	10	22	40	6	7	12	25
Dead, 3					4	2		6	15	12	5	32
Dead, 4	7	6	4	17	12	14	18	44	14	20	22	56
Total	82	52	48	182	230	266	302	798	259	281	231	771
% damaged	14.6	11.5	10.4	12.6	8.7	9.0	13.2	10.5	7.7	9.6	14.7	10.5
% dead	8.5	11.5	8.3	9.3	7.0	6.0	6.0	6.3	11.2	11.4	11.7	11.4

Mortality of small oysters was surprising low, even for spat and wings that had been processed 6 days prior. Mortality averaged across each group ranged from 6.3 to 11.4%, and the median of the replicates was about 6–10%. There was no measurable difference between the mortality, and therefore survival, of small spat and wings processed 1 and 6 days prior. Further, there was no difference in mortality from the control group, indicating processing had no measurable effect on small oyster mortality. However, this last point should be taken with caution as the number of small oysters in the control group was small. These results are shown in Figure 4, with the shaded boxes showing similar levels of mortality, indicated by both the boxes and "tails" (vertical lines above and below the boxes) almost fully overlapping. If mortality was significantly different in any of the groups or nets, the shaded boxes would be vertically separated and the "tails" would barely overlap. Handling during the experiment had no detectable effect on mortality, as can be seen in Figure 5 which shows percent mortality by tray position and net for each group. If there was a systematic effect, such as fresh water or silt causing mortality, we would expect to see heightened deaths in one zone across all top or bottom trays.

Mortality of small oysters by tray, over all groups and controls, ranged from 0 to 50%, but the higher mortalities observed were the result of small samples; for example, many of the control group oysters had either no or very few small oysters attached, and one death from two oysters (50% mortality), and more likely to distort the data than 1 death in 10.

The mortality of small oysters was size dependent, with small spat more vulnerable to both damage and death (Figure 6). Almost 80% of all spat under 25 mm in length were killed, compared to 9% of all small oysters in the samples. Further, this size group represented about 30% of all small oysters in the experiment. This pattern is repeated over all groups of shell.

Figure 3: Lantern nets being stocked with shell with spat and wings attached; each net comprises 10 trays. The nets were suspended in Bluff Harbour, with top trays positioned 1 m under the surface at low tide and bottom trays off the seabed.

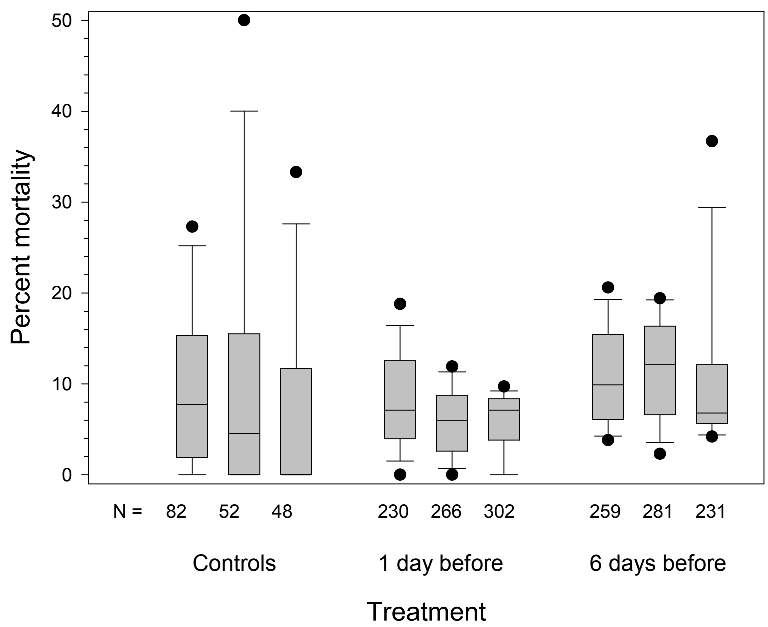

Figure 4: Box plots of percent mortality (deaths) of small oysters in each net, grouped by treatment; note low numbers of spat and wings on control oysters.

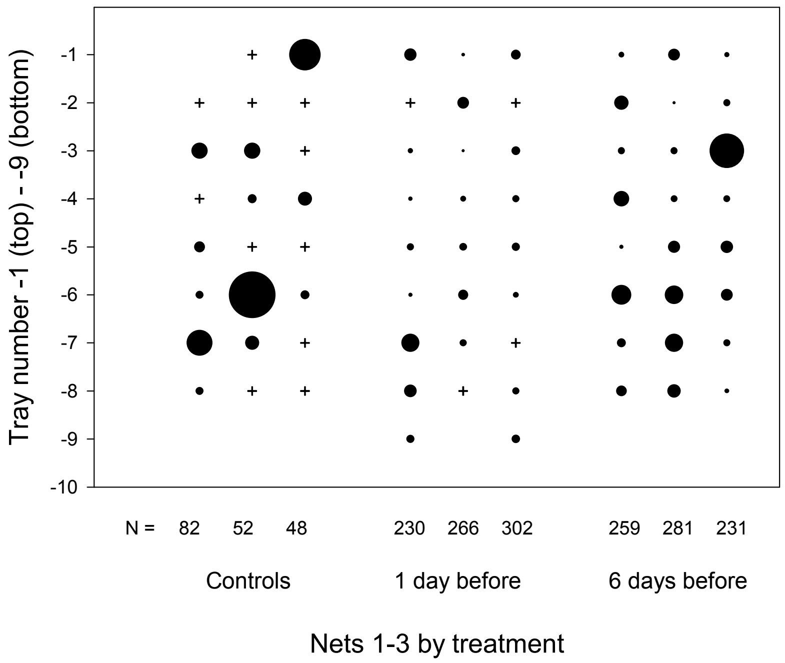

Figure 5: Bubble plots of percent mortality (deaths) of small oysters in each net by tray, grouped by treatment. Largest bubble represents 50% mortality. Trays with no spat and wings attached to oysters or no shell do not show a point; those with no mortality indicated by a cross.

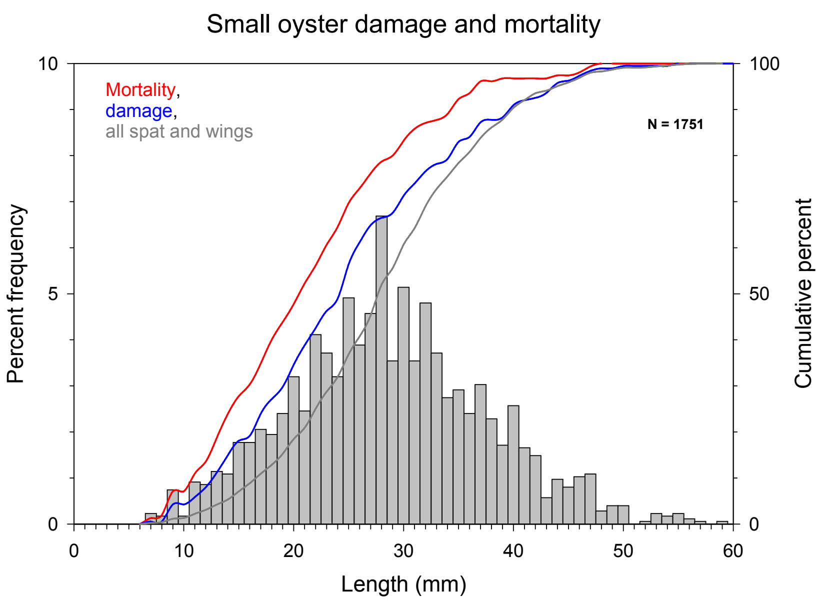

Figure 6: The percent length frequency distribution of small oysters across all groups. Note the cumulative mortality (red line) and cumulative non-fatal damaged (blue line) are both well left of the cumulative length frequency (grey line); indicating smaller oysters were more vulnerable to death and non-fatal damage than oysters larger than 25 mm in length.

Future investigations, pending funding by FRST

We propose to sample the shell return areas again in early September, after the oyster season. In early November, we will deposit volumes of weathered shell similar to those of fresh shell returned in-season. This shell will be deposited in three new randomly chosen areas. The distribution of all shell patches will be mapped by drift camera and side scan sonar if sufficient structure is developed. We will sample and compare the settlement of oysters and benthic fauna on fresh shell returned in-season, weathered shell returned just before the peak oyster settlement period, and control areas with no shell at the end of summer. The availability of oyster larvae and other reproductive propagules for settlement in these areas will be independently monitored by cement board spat collectors deployed over the summer.

A camera developed for fish counts as part of this research (Figure 7) will continue to be used to monitor the numbers and sizes of blue cod on the shell patches. Settlement and retention of juvenile blue cod and other benthic fish species will also be examined, both on and off shell patches, and adjacent natural areas using fish settlement traps over summer.

Figure 7: Glen Carbines deploying the “Fish Cam” used to estimate blue cod numbers and size composition.

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