

Bycatch monitoring for the Victorian Ocean Zone scallop fishery in 2002

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Executive Summary

Monitoring of bycatch was undertaken during the 2002 fishing season in the Victorian Ocean Zone scallop fishery. Some additional monitoring was undertaken during exploratory cruises to examine scallop condition during January and February 2003. Sixty-six species of bycatch were identified. Amongst the most conspicuous and consistent invertebrate bycatch species were doughboy scallops, *Mimachlamys asperrima*, 11-arm starfish, *Coscinasterias muricata*, black and

white starfish, *Luidia australiae*, and spider crabs, *Leptomithrax gaimardii*. Small numbers of finfish were also taken. The most abundant of these were smooth stingrays, *Dasyatis brevicaudata*, and sparsely spotted stingarees, *Urolophus paucimaculatus*. All the bycatch species identified have a wide distribution and it is unlikely that any of them are endangered by scallop fishing in the Victorian Ocean Zone.

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Introduction

The taking of bycatch species in addition to the target catch may be considered as one of the major problems in commercial fishing. The taking and subsequent discarding of undersized commercial species, or of commercial species for which the fisher is not licensed, destroys individuals which could potentially have become a harvestable resource; and the taking of bycatch of non-commercial species increases mortality rates and may endanger populations of these species (Hall 1999).

The potential problems associated with the taking of bycatch have been recognised by fisheries managers throughout Australia. The Australian Fisheries Management Authority has developed bycatch action plans for those fisheries that it manages, including the Central Zone Scallop Fishery (AFMA 2002). These plans have been developed because of requirements under international agreements on fisheries matters to which Australia is a party. In addition, the development of bycatch action plans has become a legal requirement under the Commonwealth Fisheries Management Act 1991 in relation to its objective to:

'...ensure that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, in particular, the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment'.

The present report describes the results of on-board monitoring of bycatch undertaken during the 2002 scallop fishing season in the Victorian Ocean Zone fishery. The monitoring was undertaken in order to assess the potential impact of the scallop fishery, which targets the commercial scallop, *Pecten fumatus*, on other species. Various terms have been used to describe the catch of non-target species (Hall 1999). For the purposes of this report, bycatch is taken to be all those other species that are landed on board along with the commercial scallop catch.

Project Design and Methods

Within a few days of the opening of the season in May 2002, scientists from MAFRI (now PIRVic, Queenscliff, Victoria) acted as observers on commercial cruises from Lakes Entrance (where most of the scallop boats are based). Bycatch species were identified during the cruises; and where species could not be identified on board samples were taken back to the laboratory at Queenscliff for subsequent identification.

During the remainder of the season monitoring was carried out by observers who normally undertake monitoring on boats commercially fishing for finfish. Samples of dredge contents landed on the sorting tray were put into fish bins and sorted for scallops and bycatch. A few species of fish additional to those collected at the beginning of the season were identified. For invertebrates, identifications on these cruises are by major grouping (eg crabs, sponges, starfish) although specific identifications were made for easily recognisable species. Except for one cruise, during which items were weighed, relative proportions of the major constituents of the bycatch and of scallops were estimated in terms of fish bins full, the size of a fishbin (length x height x width) being 58 x 37 x 28 cm. Items which occurred in small numbers were counted. Analyses for individual cruises have been made on the basis of those items which occurred in sufficient quantity to be measured in fishbins or fractions of a fish bin full. About one eighth of a fish bin was the minimum quantity measured.

The scallop-fishing season occurs within the

period April to December. Following the end of the commercial fishing season for 2002, exploratory cruises, to examine the abundance and condition of scallops, were undertaken in January and February 2003. Bycatch was also monitored on these trips and is reported here.

Fishers make multiple hauls for scallops during a trip and on catch and effort returns are required to indicate the catch and effort cell in which they fished. The following results summarise the amount of bycatch collected during monitoring and the relative proportions of the species or categories of bycatch recognised are given. A comparison of bycatch by area is also given. A list of the species identified is given in Appendix 1, the numbering and location of catch and effort cells is given in Appendix 2 and the results of sampling on individual cruises are given in Appendix 3.

The area of the fishery

Fishing was carried out from a little to the east of Lakes Entrance to Wilsons Promontory during the 2002 season (Fig.1). Twenty-six boats took part in the fishery and the total hours (ie hours summed over all trips for all boats) for which dredging occurred was 4,975. The majority of time spent fishing (51%) was recorded from just three cells, D40, D41, E4, a little to the west of Lakes Entrance. These three cells also provided over half (59%), by shell weight, of the scallops taken.

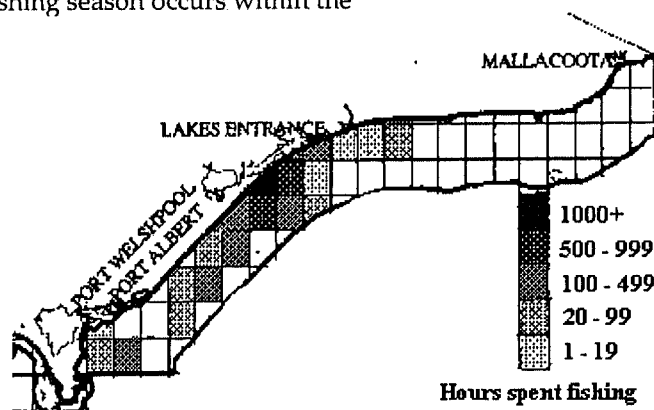


Figure 1. Hours spent fishing by catch and effort cell for the 2002 scallop season in the Victorian Ocean Zone scallop fishery.

(A chart showing catch and effort cells identified by letter and number is shown in Appendix 2.)

Results

Number of bycatch species

Sixty-six species were identified from monitoring (Appendix 1). The actual number of species taken was greater than this since sponges were collected but not identified to species.

Amount and identity of bycatch

Monitoring during commercial fishing

Samples were taken during 5 commercial fishing cruises between May and October. The summary is based only on those bycatch items which occurred in sufficient bulk or abundance to fill about an eighth or more of a fishbin. Other species also appeared in the bycatch samples, and their presence was noted, but these species were either too small (eg. hydroids, bryozoa) or occurred in insufficient numbers (eg. sea urchins, fish) for their volume to be measured.

The samples examined during commercial fishing generally consisted of around 50 – 100% of the material in the dredge. In a few instances about a quarter to a third of the dredge material was examined. Percentage composition of the samples varied considerably from haul to haul (Table 1). Nevertheless, samples were mostly dominated by dead shell and rocks, which on average accounted for about 50% or more by volume. Live bycatch accounted on average for about 13 to 40% by volume; and commercial scallops accounted for about 10 to 25% by volume. The samples taken from hauls at the border of cells D40 and D41 had, on average, a relatively low proportion of dead shells and a high proportion of commercial scallops.

On one cruise, made during October, samples were measured by weight (Table 2). The percentage composition of the catch by weight was similar to that determined by volume. On this trip scallops were counted and their weight was subsequently estimated by assuming there were 100 meats to the kilogram and that meat weight was 11% of total weight. (The number of meats per kilogram varies from about 80 to 120 and a count of 100 was taken as an average value. The figure for meat weight as 11% of total weight was calculated from catch and effort statistics, which list both total shell weight and total meat weight.)

The predominant bycatch (by volume) was sponge, starfish (mostly the 11-arm starfish and the black and white starfish) and doughboy scallops (Table 3). For samples combined over all catch and effort cells (Table 3) the number of bins of live bycatch collected was 1.7 times the number of bins of commercial scallops collected. For samples from within individual catch and effort cells (Table 4), the volume of bycatch ranged from 3 times the volume of scallops taken to equal to that of the scallops taken.

Results by weight, available only for catch and effort cells C41 (1 haul) and D41 (3 hauls), were generally similar to those by volume. Sponges, starfish and doughboy scallops constituted the bulk of the live bycatch and dead shell and rock were the biggest constituent of the total catch (Table 5). The predominant bycatch by weight was starfish and this was also the predominant bycatch by volume for cells C41 and D41. The weight of bycatch collected was 3.4 times the weight of scallops collected.

Results from individual cruises or from individual cells were insufficient to allow conclusions regarding correlations between the amount of scallops and the amount of bycatch taken. However, when all the samples are considered there were statistically significant positive correlations between the number of bins of scallops taken and the number of bins of starfish ($r = 0.68$, $p < 0.0001$) and between the number of bins of scallops and the total number of bins of bycatch ($r = 0.73$, $p < 0.0001$).

Monitoring during surveys of scallop condition

In addition to monitoring carried out during the fishing season, some additional monitoring was carried out on exploratory cruises undertaken in January and February 2003 to assess scallop condition. Samples were taken from catch and effort cells D41 and E40, which had been commercially fished during the previous few months.

The results of monitoring were generally similar to those of monitoring on commercial cruises. Samples consisted mainly of dead shell and rock with smaller proportions of live bycatch and commercial scallops (Table 6). On average the

proportion of live bycatch was about twice that of commercial scallops.

Bycatch was restricted to sponges, doughboy scallops and starfish (Table 7). These were also amongst the major bycatch collected during commercial fishing.

A few finfish were also found in the samples. These were: 3 hookfish, 1 sparsely spotted stingaree, 3 flounder (not identified to species), 1 globefish and 2 cobblers.

Table 1. Average composition by volume of samples from commercial scallop hauls, May to July 2002.
Figures outside brackets are the percentage composition averaged over all hauls sampled. Figures in brackets show the range of values for individual samples.

Catch and Effort Cell	Number of hauls sampled	Percent dead shell and rock	Percent live bycatch	Percent commercial scallops
D41	11	47 (11 – 75)	43 (14 – 89)	10 (0 – 20)
C41	3	66 (38 – 89)	24 (0 – 50)	10 (6 – 13)
E40	8	62 (0 – 93)	26 (0 – 100)	12 (0 – 33)
E41	3	40 (11 – 60)	36 (30 – 44)	24 (10 – 44)
D40/D41*	3	36 (33 – 42)	35 (25 – 47)	29 (20 – 33)
D40	6	75 (23 – 95)	13 (0 – 58)	12 (5 – 28)
D40/E40*	3	71 (57 – 80)	13 (7 – 19)	15 (4 – 29)

*Haul crossed over the boundary of two cells

Table 2. Average composition by weight of samples from commercial scallop hauls, October 2002.
Figures outside brackets are the percentage composition averaged over all hauls sampled. Figures in brackets show the range of values for individual samples. One haul was from catch and effort cell C41 and three were from D41.

Catch and Effort Cell	Number of hauls sampled	Percent dead shell and rock	Percent live bycatch	Percent commercial scallops
C41/D41	4	63 (56 – 77)	28 (14 – 38)	9 (6 – 16)

Table 3. Total number of bins of bycatch and of scallops collected during monitoring on commercial cruises, May to July 2002.

Thirty-seven hauls were monitored.

Category	Number of bins for all monitoring cruises	Number of bins of live bycatch as percent of all bins of live bycatch	Number of bins as percent of total number of bins
Sponge	17.25	39.4	9.3
Starfish	17.25	39.4	9.3
Doughboy scallops	4.75	10.9	2.6
Spider crabs	2.75	6.3	1.5
Hermit crabs	1.00	2.3	0.5
Molluscs*	0.75	1.7	0.3
Total live Bycatch	43.75		23.5
Dead shell and rocks	116.60		62.6
Commercial scallops	25.86		13.9
Total number of bins	186.21		

*Excluding doughboy and commercial scallops

Table 4. Bins of live bycatch and of scallops collected during commercial cruises, May to July 2002, listed by catch and effort cell.
Thirty-seven hauls were monitored.

Catch and effort cell	Sponge	Starfish	Number of bins of:			Total bins bycatch	Bins of Commercial scallops
			Doughboy scallop	Crabs	Molluscs**		
D41	1.50	5.25	2.75	0	0	9.5	3.7
C41	0.50	1.5	0.5	0	0	2.5	0.8
E40	5.50	0	1.5	1.5	0.25	8.75	3.9
E41	3.00	2.00	0	1.75	0.50	7.25	5.5
D40/41*	4.50	7.00	0	0	0	11.5	8
D40	1.50	1.00	0	0	0	2.5	2.3
D40/E40*	0.75	0.50	0	0.50	0	1.75	1.7
Total bins	17.25	17.25	4.75	3.75	0.75	43.75	25.9

*Haul crossed over the boundary of two cells

** Excluding doughboy and commercial scallops

Table 5. Total weight of bycatch collected from commercial scallop hauls, October 2002.
Four hauls were monitored.

Category	Weight (kg) for all monitoring cruises	Weight (kg) of live bycatch as percent of total weight of live bycatch	Weight (kg) as percent of total weight
Sponge	47	17	5
Starfish	212	77	22
Doughboy scallops	10	4	1
Hermit crabs	5	2	0.5
Total live bycatch	274		28.5
Dead shell and rocks	610		63
Commercial scallops	81		8
Total weight	965		

Table 6. Average composition by volume of samples from survey cruises, January and February 2003.
Figures outside brackets are the percentage composition averaged over all hauls sampled. Figures in brackets show the range of values for individual hauls.

Catch and Effort Cell	Number of hauls sampled	Percent dead shell and rock	Percent live bycatch	Percent commercial scallops
D41	15	61 (37 - 95)	25 (0 - 49)	14 (0 - 26)
E40	8	71 (50 - 92)	21 (0 - 42)	8 (0 - 14)

Table 7. Total number of bins of bycatch and of scallops collected during survey cruises, January and February 2003.
Twenty-three hauls were monitored.

Category	Number of bins for all monitoring cruises	Number of bins of live bycatch as percent of all bins of live bycatch	Number of bins as percent of total number of bins
Starfish	3.5	54	6.7
Doughboy scallops	2	31	3.9
Sponges	1	15	1.9
Total live Bycatch	6.5		12.5
Dead shell and rocks	39		75
Commercial scallops	6.5		12.5
Total number of bins	52		

Discussion

Between May and November 2002, 26 boats took part in the scallop-fishing season. The number of boats fishing in any one month varied, ranging from 26 in July to 2 in November. Collectively these boats engaged in 4,975 hours of fishing.

Bycatch monitoring cruises were undertaken solely on the basis that observers were available and that fishing was taking place. During the fishing season monitoring was carried out on 3 boats and encompassed 45 hours of fishing. An additional 17 hours of monitoring was undertaken in January and February 2003. At this time the fishery was closed and monitoring was on cruises to investigate scallop condition.

Monitoring occurred in 5 of the 23 areas (represented by catch and effort cells) fished and included those areas (represented by catch and effort cells D40, D41 and E40 – see Figure 1 and Appendix 2 for locations) which provided the bulk of the scallop catch.

Sixty six species of bycatch were identified as the result of on-board monitoring during the 2002 scallop season although this is a conservative estimate of the number of species taken since sponges appeared frequently as bycatch but were not identified to species. Amongst the most conspicuous and consistent bycatch species were doughboy scallops, *Mimachlamys asperrima*, 11-arm starfish, *Coscinasterias muricata*, black and white starfish, *Luidia australiae*, and spider crabs, *Leptomithrax gaimardii*.

The number of species found is with the range of bycatch species reported in Semmens *et al.* (2000) and Haddon and Semmens (2001). These authors carried out scientific surveys of scallop stocks in an area east of Flinders Island, which is part of the Central Zone scallop fishery. Numbers of bycatch species varied from one part of the area to another but ranged from 39 to 81. Many of the bycatch species found during monitoring in the Victorian Ocean Zone are also amongst the bycatch species found in the Central Zone surveys.

At the beginning of the season fishers were working on a very dense patch of scallops and on-board monitoring indicated that bycatch species constituted around 5% or less of the total material caught in the dredge. Because of the

small size of the scallops in this patch, industry imposed a voluntary closure on the area and subsequently found and fished other patches where scallops were larger. Monitoring on these patches indicated that live bycatch constituted about 23% to 25% of the material in the dredge. The proportion of bycatch was similar for all the hauls monitored and as the volume of scallops taken increased so did the volume of bycatch. Both these facts suggest that all the hauls monitored were taken from areas where the composition of the bottom fauna was similar.

Differences in the proportion of bycatch between the area initially fished and those subsequently fished may be related to differences in scallop density. Anecdotal evidence suggests that the incidence of bycatch is inversely related to scallop density. Fishers prefer to fish areas where scallops are the predominant species and bycatch is low ('clean' areas) because catch rates are higher and less effort is required to sort the catch than in areas where there is a high proportion of bycatch (Butcher *et al.* 1981; Currie and Parry 1996). Semmens *et al.* (2000) and Haddon and Semmens (2001) found that that bycatch provided between 2% and 6% (by number) of the catch in areas where scallops were most abundant, but in areas where scallop abundance was low bycatch species were up to 34 times more numerous than scallops. During the two years over which surveys were conducted numbers of bycatch species were 39 (in 2000) and 28 (in 2001) in areas of high scallop abundance and 54 (in 2000) and 81 (in 2001) in areas of low scallop abundance.

The survival of bycatch species that are returned to the sea was not investigated during the present study, but other work suggests that survival rates are variable and differ between taxa. Based on a study of bycatch collected by beam-trawling in the Irish Sea, Kaiser and Spencer (1995) concluded that starfish, hermit crabs and molluscs are more likely to survive than are fishes, sea urchins and swimmer crabs. However, estimates of survival rates for a particular species may vary greatly. Two studies on the whelk *Buccinum undatum* suggested that this species has almost 100% chance of surviving fishing impact while a third study suggested a

mortality rate as high as 80% following disturbance (Ramsay and Kaiser 1998).

Within Victoria, Currie and Parry (1999) investigated the effects on the benthic fauna of scallop fishing in Port Phillip Bay. Amongst the epifaunal bycatch very few oysters (*Ostrea angasi*) or ascidians (*Pyura stolonifera*, *Cnemidocarpa etheridgii*) were damaged but a high proportion of giant spider crabs (*Leptomithrax gaimardii*) were. They considered that mortality amongst discarded spider crabs was likely to be high. Survival rates of oysters would probably depend on their orientation once they reached the seafloor again. For ascidians, even though they showed little damage, mortality rates were probably high. Observations of ascidians returned to the seafloor showed that although initial survival rates were high only 12% of *Pyura stolonifera* and 2% of *Herdmania momus* were able to re-attach themselves and storms dispersed most of the experimental animals out of the study area.

On-board monitoring of bycatch provides data only on those species which are actually taken by the fishing gear. A broader definition of bycatch (Ministerial Council on Forestry Fisheries and Aquaculture 1999) also includes as bycatch individuals of non-target species that are impacted by fishing gear but not actually taken. Ramsay and Kaiser (1998) found that in areas recently disturbed by scallop dredging the rate at which starfish predated on whelks was high even though the whelks appeared to be undamaged. In laboratory experiments, whelks which had been rolled to simulate contact with fishing gear took longer to right themselves, when placed upside down, and took longer to perform an escape response, when faced with a starfish, than did whelks which had not been rolled. It therefore appears that demersal fishing may increase whelk mortality because those that are impacted by fishing gear may become more susceptible to predation even though they may show no obvious signs of damage. Jenkins *et al.* (2001) found that some non-target species suffered more damage if they were impacted but not collected than if they were actually taken in a scallop dredge; and because scallop dredges are relatively inefficient, they damage far more non-target individuals than they collect.

Based on the monitoring carried out in the Victorian Ocean Zone in 2002, the amount of bycatch collected was 1.7 times the amount of scallops when estimated by volume (Table 3) and 3.4 times when estimated by weight (Table 5).

The total shell weight of scallops taken during the season was 658 tonnes. If we assume that the amount of bycatch taken is 2.6 (the mean of 1.7 and 3.4) times the amount of scallops taken, then about 1711 tonnes of bycatch will have been landed on sorting trays and an equal or greater amount of bycatch is likely to have been impacted but not taken during fishing. However, the effects of scallop fishing should be judged not by the absolute quantities of bycatch taken; rather, they should be judged by whether the species affected are likely to be endangered by fishing and by the extent of the area fished.

The species identified as the result of bycatch monitoring all have a wide distribution along the southern and eastern coasts of Australia, and some have a distribution that extends beyond Australia. It is unlikely that the survival of any of these species will be threatened as the result of scallop fishing in the Victorian Ocean Zone, although local depletion of populations might occur in areas where fishing is intense. Many of the species taken as bycatch in the Victorian zone are also taken as bycatch in the Bass Strait Central Zone scallop fishery, which is under the jurisdiction of the Australian Fisheries Management Authority. A recent review of the Central Zone scallop fishery (AFMA 2002) concluded that no bycatch species were threatened by scallop fishing in that area.

Fishing occurred from just east of Lakes Entrance to Wilsons Promontory and there is therefore the potential for bycatch species to be taken or impacted by fishing gear throughout this whole area. However, while some fishing was carried out in areas represented by most of the catch and effort cells between Lakes Entrance and Wilsons Promontory, the actual area fished is much less than this might imply. There are two reasons for this. Firstly the majority of time spent fishing (51%) was recorded from just three cells (D40, D41, E40) to the west of Lakes Entrance. These three cells also provided more than half (59%), by shell weight, of the scallops taken. Secondly, fishing is confined to scallop beds which generally occupy only a small portion of each cell. Using a few basic assumptions, the total area fished during the season can be roughly estimated.

The time spent fishing is recorded on catch and effort returns and was, in total, 4,975 hours. On average each boat made 4 hauls per hour, so the total number of hauls made during the season was 19,900 (4975 x 4).

Towing speed varies from operator to operator and according to the prevailing conditions, but is generally around 3 to 5 knots. If the average tow lasts 15 minutes and an average speed of 4 knots is assumed, the distance covered in one tow is 1 nautical mile or 1852 metres. Dredge width is generally 3.3 or 4.3 metres. If a dredge width of 3.3 metres is assumed then one haul covers an area of 6112 m² (1852 x 3.3) and the total area covered by all the hauls made during the season was 121 km² (6,112 x 19,900/1,000,000). If a dredge width of 4.3 m is assumed, the total area covered during the season was 158 km². The area of one catch and effort cell (10 x 10 nautical miles) is 343 km². The total area directly impacted by scallop fishing during the 2002 season in the Victorian Ocean Zone fishery was therefore equivalent to somewhat less than half of the area represented by one catch and effort cell. The area actually covered by dredging is likely to be even less than that calculated above. Dredges pass over some areas of a scallop bed

more than once while missing others entirely (Currie and Parry 1996).

Estimates of the proportion of bycatch in a haul have been based only on those species which came up in bulk and could readily be measured by volume (fishbins full) or weight (kg). Species which came up in small numbers were counted and their presence was noted but, because of their low volume or weight, were not included when making estimates of the proportion or total amount of bycatch. To improve the accuracy of bycatch estimates in future monitoring, species taken from a haul in small numbers should still be counted but should then be weighed, or their volume taken en masse, so that they can be included in estimating the proportion or total amount of bycatch. Also, for future work observers should be provided with reference collections or training in invertebrate identifications so that more bycatch can be identified to species during onboard monitoring.

Conclusions

Bycatch taken by the Victorian Ocean Zone scallop fishery includes a variety of fishes and invertebrates. Sixty-six species were identified as the result of onboard monitoring during the 2002 season although this number is a conservative one since sponges could not be identified to species. All the bycatch species identified are widely distributed throughout southern Australia and it is unlikely that any of them are endangered by scallop fishing in the Victorian Ocean Zone.

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Appendix 1 – List of bycatch species

List of bycatch species identified from scallop fishing off Lakes Entrance, Victoria, during fishing in 2002.

Common name	Scientific name	Distribution
Fish		
Shark egg case		
Swell shark	<i>Cephaloscyllium laticeps</i>	Victoria, Tasmania, New South Wales, South Australia
Sculptured seamoth	<i>Pegasus lancifer</i>	Victoria, Tasmania, South Australia
Spiny gurnard	<i>Lepidotrigla papilio</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Butterfly gurnard	<i>Lepidotrigla vanessa</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Cocky gurnard	<i>Lepidotrigla modesta</i>	Victoria, Tasmania, New South Wales
School whiting	<i>Sillago bassensis</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Hookfish	<i>Foetorepus calauropomus</i>	Victoria, southern Queensland, New South Wales, Tasmania, South Australia; southern Western Australia
Muellers flounder	<i>Arnoglossus muelleri</i>	Victoria, Tasmania, South Australia, Western Australia
Crested flounder	<i>Lophonectes gallus</i>	Victoria, Tasmania, New South Wales, Queensland, South Australia,
Silverbelly	<i>Paequula melbournensis</i>	Victoria, Tasmania, South Australia, Western Australia
Cobbler	<i>Gymnapistes marmoratus</i>	Victoria, New South Wales, Tasmania, South Australia, southern Western Australia
Common gurnard perch	<i>Neosebastes scorpaenoides</i>	Victoria, Tasmania, New South Wales, South Australia
Smooth Stingray	<i>Dasyatis brevicaudata</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Sparsely spotted stingaree	<i>Urolophus paucimaculatus</i>	Victoria, Tasmania
Banded stingaree	<i>Urolophus cruciatus</i>	Victoria, Tasmania, southern New South Wales, South Australia, southern Western Australia
Short finned worm eel	<i>Muraenichthys australis</i>	Victoria, south-east, south and south-west coasts of Australia, New Zealand, Norfolk island, Kermadec Islands
Spiky globe fish	<i>Diodon nichthemerus</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Broad sandfish	<i>Enigmapercis reducta</i>	Victoria, South Australia, New South Wales
Sponges		
Various, unidentified		
Crustaceans		
Hermit crab	<i>Strigopagurus strigimanus</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Giant spider crab	<i>Leptomithrax gaimardii</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Hairy shore crab	<i>Pilumnus tomentosus</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Balmain bug	<i>Ibacus peronii</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Eastern king prawn	<i>Penaeus plebejus</i>	Victoria, Tasmania, New South Wales, Queensland
Barnacle	<i>Balanus trigonus</i>	Victoria, Tropical Australia, Queensland, Western Australia, widespread overseas
Ascidians (Sea squirts)		
Cunjevoi (solitary)	<i>Pyura stolonifera</i>	Victoria, Tasmania, Western Australia, South Australia, New South Wales, Queensland, , South Africa, South America
Solitary ascidian	<i>Herdmania momus</i>	Around Australia, widespread overseas
Sea tulip (solitary)	<i>Pyura</i> sp.	
Colonial ascidian	<i>Polycitor giganteus</i>	Victoria, Western Australia, South Australia, New South Wales.
Cnidarians (Coelenterates)		
Sea pen	<i>Sarcoptilus grandis</i>	Victoria, Tasmania, Western Australia, South Australia, New South Wales, Queensland
Stony coral	sp. indet	

Echinoderms (sea stars)		
11 arm seastar	<i>Coscinasterias muricata</i>	Victoria, Tasmania, Western Australia, South Australia, New South Wales, Queensland, New Zealand
Black and white sea star	<i>Luidia australiae</i>	Victoria, Tasmania, Western Australia, South Australia, New South Wales, Queensland
Sea star	<i>Nectria ocellata</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Sea star	<i>Astropecten pectinatus</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Echinoderms (sea urchins)		
Hat urchin	<i>Peronella peronii</i>	Victoria, Tasmania, Queensland, New South Wales, South Australia, Western Australia
Echinoderms (brittle stars)		
Brittle star	<i>Ophiomyxa australis</i>	Throughout Australia and the Indo-West Pacific
Brittle star	<i>Ophiothrix</i> sp.	
Brittle star	<i>Ophiocrossota multispina</i>	South-east Australia from the Great Australian Bight to Sydney
Cephalopod molluscs		
Octopus	<i>Octopus</i> sp. (Cf. <i>berrima/pallidus</i>)	
Gastropod molluscs		
Spindle shaped volute	<i>Ericusa sowerbi</i>	Victoria, Tasmania, New South Wales
Wavy volute	<i>Amorena undulata</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Tulip shell	<i>Pleuroploca australasia</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Large whelk	<i>Austrosipho maxima</i>	Victoria, Tasmania, New South Wales
Umbilicated cowry	<i>Umbilia hesitata</i>	Victoria, Tasmania, New South Wales
Brazier's auger	<i>Acuminia brazieri</i>	Victoria, Tasmania, New South Wales, South Australia
New Holland spindle shell	<i>Fusus novae-hollandiae</i>	Victoria, Tasmania, South Australia
Pear helmet	<i>Xenogalea pyrum</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia. Also South Africa and New Zealand
Half-grained helmet	<i>Antephalium semigranosum</i>	Victoria, Tasmania, South Australia, Western Australia
Gunn's screw shell	<i>Gazameda gunni</i>	Victoria, Tasmania, New South Wales
Umbilicated top shell	<i>Astele subcarinatum</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
Rock whelk	<i>Cabastena spengleri</i>	Victoria, Tasmania, New South Wales, South Australia, Queensland
Bass triton	<i>Argobuccinum bassi</i>	Victoria, Tasmania
Bivalve molluscs		
Placid venerid	<i>Placamen placidum</i>	Victoria, Tasmania, South Australia
Brooch shell	<i>Neotrigonia margaritacea</i>	Victoria, Tasmania, New South Wales
Striated dog cockle	<i>Glycymeris striatularis</i>	Victoria, Tasmania, South Australia, Western Australia
Fan-like dog cockle	<i>Glycymeris flabellatus</i>	Victoria, Tasmania, South Australia
Little basket shell	<i>Corbula stolata</i>	Victoria, New South Wales
False jingle shell	<i>Myochama anomioides</i>	Victoria, Tasmania, New South Wales, South Australia
False cockle	<i>Venericardia amabilis</i> .	Victoria, South Australia
Fan mussel	<i>Atrina tasmanica</i>	Victoria, Tasmania, South Australia
Doughboy scallop	<i>Mimachlamys asperrima</i>	Victoria, Tasmania, New South Wales, South Australia, Western Australia
King Island crassatella	<i>Eucrassatella kingicola</i>	Victoria, Tasmania, New South Wales
Bryozoans		
	Cf. <i>Adeona cellulosa</i>	
	Cf. <i>Celleporaria</i> sp.	
	Cf. <i>Membranipora perfragilis</i>	(Victoria, South Australia, Heard Island)
	Cf. <i>Bugula</i> sp.	
	Cf. <i>Tricellaria</i> sp.	
	sp. indet.	

Data on the distribution of bycatch species was taken from the following references.

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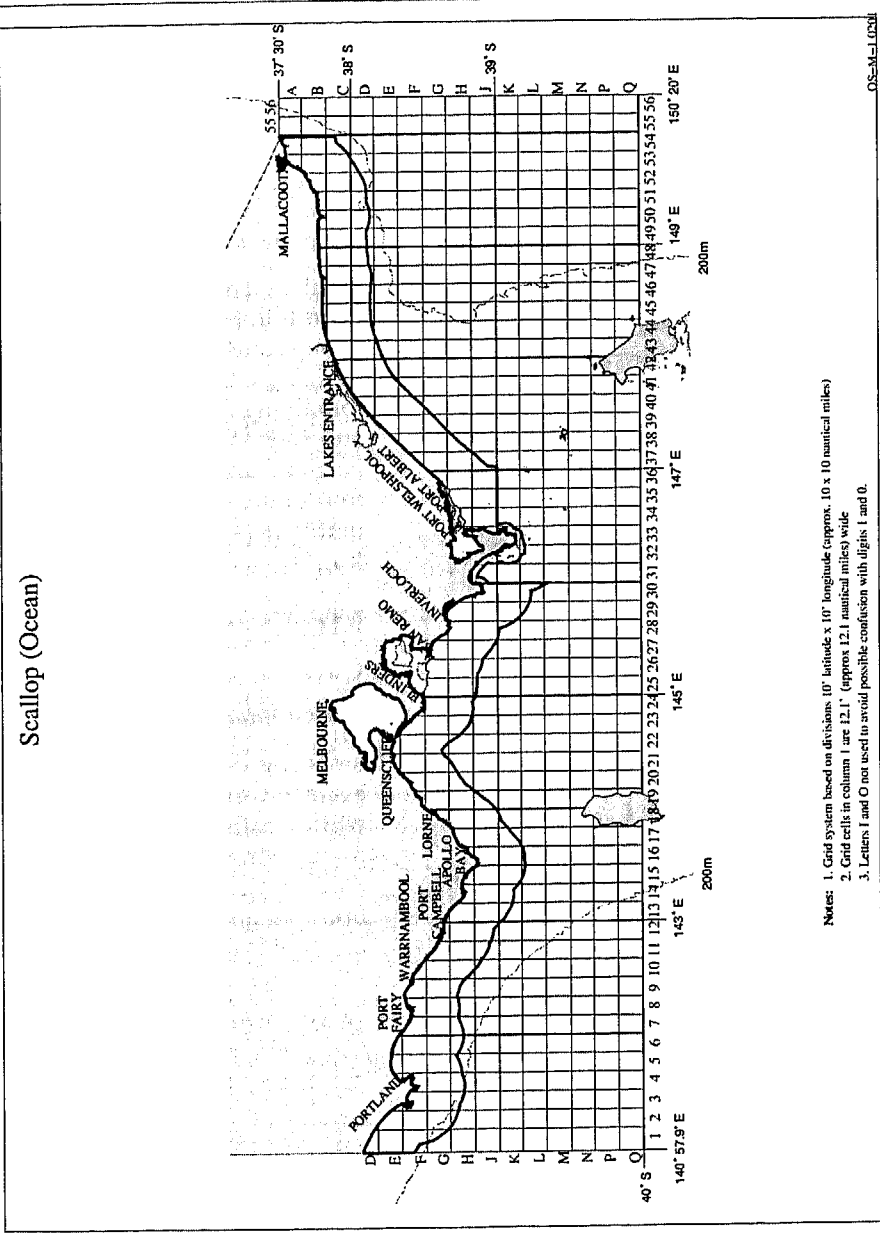
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Appendix 2 – Numbering of Catch and Effort Cells



Appendix 3 – Results from individual cruises

Monitoring during commercial fishing

Monitoring cruises of 14-15 May 2002

Sampling on both days was in catch and effort cell D41. On the 14th material from each dredge haul was tipped on to the tray before material from previous hauls had been completely sorted and the tray emptied. It was therefore difficult to relate the amount of bycatch to individual hauls. However, inspection of the material from each haul as it was tipped from the dredge suggested that live bycatch constituted only a very minor proportion (about 5%) of the total catch, the majority of which consisted of dead shell. Samples of bycatch were kept for subsequent identification.

The same area was fished on May 15th. As on the previous day the greatest proportion of each dredge haul consisted of dead shell and live bycatch was estimated to constitute a very small portion (5% or less) of the catch. In some cases the sorting tray was cleared between one haul and the next and it was possible to remove all the obvious bycatch from a single haul. Individuals were identified as far as possible and, where appropriate, material was kept for subsequent identification. The quantity and identity of bycatch species appeared to be similar in all hauls.

Haul 1. The dredge was approximately half full, mainly of dead scallop shell. Bycatch consisted of 1.5 fish bins of 11-arm starfish and 24 spider crabs.

Haul 3. The dredge was approximately one third full. Bycatch consisted of about half a fishbin of sponge fragments plus small numbers of starfish, ascidians and whelks, an octopus, a scorpion fish and a stingray.

Haul 11 The dredge was approximately one third full. Bycatch consisted of a small number of sponge fragments, small numbers of crustaceans (balmain bug, hermit crabs, spider crabs), small numbers of molluscs (wavy volute, false cockle, octopus, doughboy scallops, whelk), starfish and ascidians totalling about half a fishbin full.

Haul 25. The dredge was approximately one third full. Bycatch consisted of a few pieces of sponge and compound ascidian, together totalling a little over one tenth of a fishbin. The remaining bycatch filled just under half a fishbin and consisted of small numbers of spider crabs, hermit crabs and other crustaceans, starfish (all four of the species listed in Appendix 1), molluscs (spindle shell, whelks, rock whelk) and fragments of bryozoan.

Monitoring cruise of 26 May 2002 Catch and effort cell D41

About 18 bins of material taken from 3 hauls was sorted (Table 1). The majority of the material (9 bins) was dead shell. About 5.5 bins of live bycatch were taken. Major items were black and white starfish and 11 arm starfish (2.25 bins in total) sponges (1 bin) and doughboy scallops (2.25 bins). There were 3.25 bins of scallops. Two flounder and 1 sparsely-spotted stingaree were taken plus a few unidentified shells and crabs.

Table 1. Bycatch monitoring results from fishing in catch and effort cell D41, 26 May 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *) Numbers in column headings are latitude and longitude for the start (top) and end (bottom) of the haul and are in decimal degrees.

Haul/Bycatch	1 38.00.34S/147.48.86E 38.00.68S/147.46.23E	2 38.02.61S/147.42.01E 38.02.95S/147.41.51E	3 38.03.22S/147.41.32E 38.02.44S/147.40.92E
Sponge	*	1	
Starfish	1	0.5	0.75
Doughboys	0.5	1	0.75
Fish	*		
Total live bycatch	1.5 (27%)	2.5 (67%)	1.5 (18%)
Scallops	1 (18%)	0.75 (20%)	1.5 (18%)
Dead shell	3 (55%)	0.5 (13%)	5.5 (65%)
TOTAL BINS	5.5	3.75	8.5
Percent of haul examined	30	33	33

Catch and effort cell C41

About 7 bins of material taken from 3 hauls were sorted (Table 2). The majority of the material was dead shell (4 bins, which includes 0.5 bin rocks). About 2.5 bins of live bycatch

were taken. Major items were black and white starfish and 11 arm starfish (1.5 bins in total) sponges (0.5 bin) and doughboy scallops (0.5 bins). There were 0.75 bins of scallops. Seven sparsely-spotted stingarees were taken plus a few crabs.

Table 2. Bycatch monitoring results from fishing in catch and effort cell C41, 26 May 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *). Numbers in column headings are latitude and longitude for the start (top) and end (bottom) of the haul and are in decimal degrees.

Haul/Bycatch	5 37.59.90S/147.48.84E 37.59.77S/147.48.53E	6 37.59.77S/147.48.53 37.59.49S/147.49.01E	7 37.58.57S/147.49.63E 37.58.49S/147.51.15E
Sponge	0.5		
Doughboys	0.5		
Starfish	1	0.5	
Fish	*	*	
Total live bycatch	2 (50%)	0.5 (24%)	0
Scallops	0.5 (13%)	0.13 (6%)	0.13 (11%)
Dead shell	1.5 (38%)	1.5 (71%)	1 (89%)
TOTAL BINS	4	2.13	1.13
Percent of haul examined	100	100	100

Monitoring cruise of 23-24 June 2002

Catch and effort cell E40

About 59 bins of material were taken from 8 hauls and sorted (Table 3). The majority of the material (46 bins) was dead shell. About 8 bins were of live bycatch. The majority of this (5.5

bins) was sponge. The remainder was mostly spider crabs, hermit crabs, doughboy scallops and whelks. Seven fish were recorded. These were 2 hookfish, 1 electric ray, 1 flounder, 1 banded stingaree, 1 stingaree (unspecified), 1 skate (unspecified). An octopus and starfish were also recorded.

Table 3. Bycatch monitoring results from fishing in catch and effort cell E40, 23 June 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *).

Haul/Bycatch	1	2	3	4	5	6	10	11
Sponge	1	0.5	*	1	1	1	1	
Doughboys	1	0.5	*					
Whelks				*	0.25	0.25		*
Hermit crabs					0.25	0.25		*
Spider crabs						0.25		0.5
Starfish					*			*
Fish				*	*	*		
Total live bycatch	2 (16%)	1 (7%)	0	1 (13%)	1.5 (33%)	1.75 (37%)	1 (100%)	0.5 (4%)
Scallops	0.2 (2%)		0.5 (33%)	0.5 (7%)	1 (23%)	1 (21%)		0.7 (6%)
Dead shell	10 (82%)	14 (93%)	1 (67%)	6 (80%)	2 (44%)	2 (42%)		11 (90%)
TOTAL BINS	12.2	15	1.5	7.5	4.5	4.75	1	12.2
Percent of haul examined	100	100	100	50	50	25	100	50

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 1	38.14.37S/147.39.29E 38.14.69S/147.38.75E	Haul 5	38.10.31S/147.39.09E 38.12.96S/147.37.74E
Haul 2	38.14.75S/147.38.48E 38.14.38S/147.38.99	Haul 6	38.16.06S/147.34.28E 38.16.87S/147.35.30E
Haul 3	37.17.60S/147.35.83E 38.18.42S/147.33.71E	Haul 10	38.10.88S/147.35.86E 38.09.15S/147.28.46E
Haul 4	38.14.31S/147.36.12E 38.13.96S/147.36.51E	Haul 11	38.13.63S/147.36.91E 38.13.83S/147.36.80E

Catch and effort cell E41

About 14 bins of material were sorted from 2 hauls (Table 4). Of these approximately 4 bins were of dead shell and 5.5 bins were of live

bycatch. Two bins of bycatch were of sponge. The remaining material was mostly hermit crabs, spider crabs, crabs (unspecified) and starfish (2 bins in one haul). A few whelks were taken and 1 hook fish.

Table 4. Bycatch monitoring results from fishing in catch and effort cell E41, 23 June 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *). Numbers in column headings are latitude and longitude for the start (top) and end (bottom) of the haul and are in decimal degrees.

Haul/Bycatch	7 38.17.05S/147.41.57E 38.17.38S/147.41.13E	13 38.11.10S/147.42.13E 38.11.07S/147.42.21
Sponge	1	1
Whelks		
Hermit crabs	0.25	
Spider crabs	0.25	
Crabs (unspecified)		1
Starfish		2
Fish	*	
Total live bycatch	1.5 (30%)	4 (44%)
Total scallops	0.5 (10%)	4 (44%)
Total dead shell	3 (60%)	1 (11%)
TOTAL BINS	5	9
Percent of haul examined	50	25

Catch and effort cells D40 and D41

About 30 bins of material were sorted from 3 hauls (Table 5). About 10.5 bins were dead shell

(including some rocks) and 11.5 bins were live bycatch of which 4.5 bins were of sponge. There were 7 bins of starfish and 5 of these were of 11-arm starfish. A few whelks, hermit crabs and spider crabs were taken and an octopus.

Table 5. Bycatch monitoring results from fishing in catch and effort cell D40 and D41, 23-24 June 2002

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *). Numbers in column headings are latitude and longitude for the start (top) and end (bottom) of the haul and are in decimal degrees.

Haul/Bycatch	14 (D40) 38.05.71S/147.38.80E 38.06.28S/147.38.01E	12 (D41) 38.08.12S/147.41.46E 38.08.66/147.40.77E	15 (D41) 38.08.28S/147.40.26E 38.07.64S/147.41.20E
Sponge	1	0.5	3
Whelks	*	*	*
Hermit crabs	*		*
Spider crabs		*	
Starfish	2	1	4
Total live bycatch	3 (33%)	1.5 (25%)	7 (47%)
Scallops	3 (33%)	2 (33%)	3 (20%)
Dead shell	3 (33%)	2.5 (42%)	4 (27%)
Rocks			1 (6%)
TOTAL BINS	9	6	15
Percent of haul examined	25	50	25

Monitoring cruise of 11 July 2003

For many hauls the amount of bycatch on this cruise appeared to be less than in previous cruises. Few bycatch species were collected in terms of bins full. Most were collected only as small numbers of individuals. Rocks and dead shell were prevalent in some hauls.

Catch and effort cell D41

Approximately 12 bins of material from 4 hauls were examined (Table 6). Rocks composed a high proportion of the catch in all hauls examined and dead shell was conspicuous in 2 hauls. One fish, a spiky globe, was collected.

Table 6. Bycatch monitoring results from fishing in catch and effort cell D41, 11 July 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *)

Haul/Bycatch	1	2	3	4
Sponge	0.5			
Doughboys		0.5		
Shells (other)		*		*
Hermit crabs			*	
Starfish	3	*	*	*
Urchins			*	
Finfish	*			
Total live bycatch	3.5 (74%)	0.5 (33%)		
Scallops	0.25 (5%)		*	0.2 (12%)
Dead shell			0.5 (11%)	0.5 (29%)
Rocks	1 (21%)	1 (66%)	4 (89%)	1 (59%)
TOTAL BINS	4.75	1.5	4.5	1.7
Percent of haul examined	100	100	100	100

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 1	38.02.83S/147.42.32E	Haul 3	38.04.66S/147.40.70E
	38.02.94S/147.42.14E		38.04.33S/147.40.58E
Haul 2	38.02.84S/147.42.09E	Haul 4	38.04.79S/147.40.58E
	38.02.80S/147.42.16E		38.04.66S/147.40.70E

Catch and effort cell D40

Approximately 28 bins of material from 6 hauls were examined (Table 7). Rocks and dead shell constituted most of the catch. The most voluminous items of bycatch were sponges and starfish although other categories of bycatch

appeared in small numbers. The relatively large numbers of starfish in haul 6 were mainly 11-arm starfish plus some black and white starfish. Fish collected from the hauls were smooth stingray (11), sparsely-spotted stingaree (1), flounder (2), cocky gurnard (3), flathead (2) and school whiting (6).

Table 7. Bycatch monitoring results from fishing in catch and effort cell D40, 11 July 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *)

Haul/Bycatch	5	6	8	9	13	14
Sponge		0.5		0.5		0.5
Shells (other)	*			*		
Hermit crabs					*	
Spider crabs		*		*		
Crabs (unspecified)	*		*		*	*
Starfish	*	1	*	*	*	*
Finfish	*	*	*	*	*	*
Total live bycatch		1.5 (58%)		0.5 (9%)		0.5 (10%)
Scallops	0.5 (5%)	0.5 (19%)	0.2 (28%)	0.5 (9%)	0.3 (7%)	0.3 (6%)
Dead shell	2 (19%)	0.5 (19%)		4 (73%)	3 (70%)	2 (42%)
Rocks	8 (76%)	0.1 (4%)	0.5 (72%)	0.5 (9%)	1 (23%)	2 (42%)
TOTAL BINS	10.5	2.6	0.7	5.5	4.3	4.8
Percent of haul examined	50	50	50	50	25	25

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 5	38.05.20S/147.39.18E	Haul 9	38.10.22S/147.34.36E
	38.05.71S/147.38.72E		38.09.71S/147.35.00E
Haul 6	38.07.11S/147.37.36E	Haul 13	38.06.74S/147.38.09E
	38.06.81S/147.38.08E		38.07.24S/147.37.47E
Haul 8	38.09.94S/147.34.72E	Haul 14	38.06.76S/147.38.04E
	38.09.86S/147.34.42E		38.06.48S/147.38.00E

Catch and effort cells D40 and E40

Approximately 12 bins of material from 3 hauls at the border of catch and effort cells D40 and

E40 were examined (Table 8). There was relatively little bycatch, the major items being sponge, starfish and spider crabs. The fish collected were swell shark (2), stargazer (1) flounder (3) and smooth stingray (5)

Table 8. Bycatch monitoring results from fishing at the border of catch and effort cells D40 and E40, 11 July 2002.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *). Numbers in column headings are latitude and longitude for the start (top) and end (bottom) of the haul and are in decimal degrees.

Haul/Bycatch	10 38.10.24S/147.34.30E 38.09.58S/147.36.40E	11 38.10.23S/147.34.40E 38.09.65S/147.34.55E	12 38.10.02S/147.35.38E 38.09.36S/147.35.22E
Sponge	*	0.5	0.25
Molluscs (other)	*		
Hermit crabs		*	*
Spider crabs		0.5	*
Starfish	0.5	*	*
Finfish	*	*	*
Total live bycatch	0.5 (14%)	1 (19%)	0.25 (7%)
Scallops	1 (29%)	0.2 (4%)	0.5 (13%)
Dead shell	2 (57%)	4 (77%)	3 (80%)
TOTAL BINS	3.5	5.2	3.75
Percent of haul examined	25	25	50

Monitoring cruise of 6 October 2002

Catch and effort cell D41

The bulk of the bycatch, which on this cruise was measured by weight instead of by volume,

consisted of sponge and starfish (Table 9). The molluscs consisted of 5 blue ring octopus and the finfish caught were 3 smooth stingrays.

Table 9. Bycatch monitoring results from fishing in catch and efforts cells C41 and D41, 6 October 2002.

Items were measured in kg. * indicates that items were present in small numbers (and not weighed). Figures in brackets are catch as a percent of all items measured (except those marked *). Weight of scallops was calculated from the number of scallops by assuming 100 meats to the kg and a recovery rate of 11%

Haul/Bycatch	1 (C41)	2 (D41)	3 (D41)	4 (D41)
Sponge		10	32	5
Doughboy scallops		5	5	*
Molluscs (other)		*	*	*
Hermit crabs	*	5	*	*
Starfish	32		100	80
Finfish		*		
Total live bycatch	32 (20%)	20 (14%)	137 (38%)	85 (28%)
Scallops	26 (16%)	13 (9%)	23 (6%)	19 (6%)
Dead shell	80 (51%)	60 (42%)	50 (14%)	100 (33%)
Rocks	20 (13%)	50 (35%)	150 (42%)	100 (33%)
TOTAL KG	158	143	360	304
Percent of haul examined	50	50	25	25

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 1	37.57.39S/147.47.35E	Haul 3	38.01.69S/147.43.60E
	37.59.64S/147.47.13E		38.01.28S/147.44.27E
Haul 2	38.08.71S/147.40.69E	Haul 4	38.01.24S/147.44.82E
	38.04.29S/147.40.31E		38.00.51S/147.35.37E

Monitoring during surveys of scallop condition

Survey cruise January 6 2003

Catch and effort Cell D41

About 18 bins of material from 8 hauls made in catch and effort cell D41 were examined (Table 11). As in monitoring during commercial

fishing, the most consistent bycatch species were 11-arm and black and white starfish, with doughboy scallops and sponges being conspicuous in some hauls. Small numbers of fin fish were collected in most of the hauls and these consisted (in total) of 3 hookfish, 1 sparsely spotted stingaree, 3 flounder, 1 spiky globe fish and 2 cobblers. Red sea weed was also present in all of the hauls.

Table 10. Bycatch monitoring results from survey in catch and effort cell, D41, 6 January 2003.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except those marked *)

Haul/Bycatch	1	2	3	4
Sponge				
Doughboy scallops	0.5	1		
Molluscs (other)		*	*	
Hermit crabs	*			*
Starfish, 11-arm		*	*	*
Starfish, b & w	0.25	*	*	
Finfish	*	*	*	
Total live bycatch	0.75 (13)	1 (24)		
Scallops	0.33 (6)	0.66 (16)	0.15 (18)	0.33 (24)
Red sea weed	0.5 (9)	*	0.33 (41)	0.5 (38)
Dead shell	4 (72)	2.5 (60)	0.33 (41)	0.5 (38)
Rocks				
TOTAL BINS	5.58	4.16	0.81	1.33
Percent of haul examined	100	33	10	25
Haul/Bycatch	5	6	8	9
Sponge	0.12	0.12		*
Doughboy scallops	*			
Molluscs (other)		*		
Hermit crabs	*			
Starfish, 11-arm	0.12	0.25	0.25	0.12
Starfish, b & w	*	0.25		*
Finfish	*		*	*
Total live bycatch	0.24 (24)	0.62 (29)	0.25 (19)	0.12 (9)
Scallops	0.25 (26)	0.25 (12)	0.33 (25)	0.25 (18)
Red sea weed	0.12 (12)	0.25 (12)	*	0.12 (9)
Dead shell	0.25 (26)	0.75 (35)	0.75 (56)	0.75 (55)
Rocks	0.12 (12)	0.25 (12)		0.12 (9)
TOTAL BINS	0.98	2.12	1.33	1.36
Percent of haul examined	10	25	15	5

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 1	38.00.24S/147.45.77E	Haul 5	38.00.47S/147.45.51E
	38.00.49S/149.45.43E		38.00.93S/147.45.06E
Haul 2	38.00.59S/147.45.22E	Haul 6	38.03.65S/147.41.66E
	38.01.04S/147.44.93E		38.04.40S/147.41.11E
Haul 3	38.01.13S/147.44.81E	Haul 8	38.01.11S/147.44.76E
	38.00.98S/147.45.14E		38.00.99S/147.45.22E
Haul 4	38.00.83S/147.44.46E	Haul 9	38.00.68S/147.45.47E
	38.01.01S/147.45.02E		38.00.23S/147.46.03E

Survey cruise February 9 2003

Catch and effort cell D41

Approximately 20 bins of material from 7 hauls in catch and effort cell D41 were examined (Table 11) and 25 bins of material were

examined from 8 hauls in catch and effort cell E40 (Table 12). The major items collected by volume were sponges, 11-arm and black and white starfish and doughboy scallops, but few items were collected in any quantity.

Table 11. Bycatch monitoring results from survey in catch and effort cell D41, 9 February 2003.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except, unless otherwise indicated, for those marked *).

Haul/Bycatch	1	2	3	4
Sponge				0.33
Doughboy scallops		*		
Molluscs (other)	*	*	*	
Hermit crabs				
Starfish, 11-arm	0.16	*	0.66	
Starfish, black/white	0.16	*	*	
Finfish				
Total live bycatch	0.32 (11)	0.5 ¹ (13)	0.66 (12)	0.33 (49)
Scallops	*	*	0.66 (12)	0.1 (14)
Red sea weed				
Dead shell	0.75 (24)	2.5 (63)	2 (38)	0.25 (37)
Rocks	2 (65)	1 (25)	2 (38)	*
TOTAL BINS	3.07	4	5.32	0.68
Percent of haul examined	50	33	33	100

¹ Estimated volume of items marked *.

Haul/Bycatch	13	14	15
Sponge			
Doughboy scallops			
Molluscs (other)	*	*	*
Hermit crabs	*		
Starfish, 11-arm	*	0.33	0.9
Starfish, black/white			0.1
Finfish			
Total live bycatch		0.33 (21)	1 (34)
Scallops	0.12 (5)	0.25 (16)	0.66 (23)
Red sea weed		*	
Dead shell	2.25 (78)	1 (63)	1 (34)
Rocks	0.5 (17)	*	0.25 (9)
TOTAL BINS	2.87	1.58	2.91
Percent of haul examined	100	50	50

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 1	37.59.94S/147.46.54E	Haul 13	38.02.56S/147.44.86E
	38.00.19S/147.46.14E		38.02.20S/147.44.99E
Haul 2	38.00.28S/147.45.99E	Haul 14	38.01.71S/147.44.52E
	38.00.56S/147.45.60E		38.01.41S/147.44.39E
Haul 3	38.00.85S/147.44.99E	Haul 15	38.00.84S/147.44.79E
	38.01.19S/147.44.56E		38.00.87S/147.44.47E
Haul 4	38.08.86S/147.43.00E		
	38.09.48S/147.42.82E		

Catch and Effort Cell E 40

Table 12. Bycatch monitoring results from fishing in catch and effort cell E40, 9 February 2003.

Items were measured as fishbins full. * indicates that items were present in small numbers. Figures in brackets are catch as a percent of all items measured (except, unless otherwise indicated, for those marked *).

Haul/Bycatch	5	6	7	8
Sponge	*	*		
Doughboy scallops	*	0.5		
Molluscs (other)	*			
Hermit crabs	*	*	*	*
Spider crab		*		*
Starfish, 11-arm				
Starfish, b & w				
Starfish (other)	*			
Finfish				
Total live bycatch	0.75 ¹ (25)	0.75 ¹ (15)		0.33 ¹ (14)
Scallops	0.25 (9)	0.25 (5)	0.16 (8)	0.33 (14)
Red sea weed				
Dead shell	2 (66)	4 (80)	1.75 (92)	1.66 (72)
Rocks				
TOTAL BINS	3	5	1.91	2.32
Percent of haul examined	50	50	100	50
Haul/Bycatch	9	10	11	12
Sponge	0.5	*	*	
Doughboy scallops	*	*	*	*
Molluscs (other)		*	*	*
Hermit crabs	*		*	*
Spider crabs	*	*	*	*
Starfish, 11-arm		*		
Starfish, b & w				
Finfish				
Total live bycatch	1.25 ¹ (42)	0.66 ¹ (22)	0.5 ¹ (18)	1 ¹ (26)
Scallops	0.25 (8)	0.33 (11)	0.25 (9)	0.33 (9)
Red sea weed				
Dead sea shell	1.5 (50)	2 (67)	2 (73)	2.5 (65)
Rocks				
Total bins	3	2.99	2.75	3.83
Percent of haul examined	100	100	100	100

¹ Estimated volume of items marked * (included in total)

Start (top) and end (bottom) latitude and longitude for hauls in decimal degrees.

Haul 5	38.17.14S/147.36.96E	Haul 9	38.18.07S/147.35.96E
	38.17.32S/147.36.68E		38.18.14S/147.35.84E
Haul 6	38.17.27S/147.37.98E	Haul 10	38.17.77S/147.35.16E
	38.17.35S/147.36.91E		38.17.91S/147.34.81E
Haul 7	38.17.80S/147.36.18E	Haul 11	38.17.92S/147.34.45E
	38.17.88S/147.36.37E		38.18.18S/147.34.07E
Haul 8	38.17.89S/147.36.11E	Haul 12	38.17.52S/147.35.13E
	38.18.06S/146.36.38E		38.17.28S/147.35.46E