DRAFT BSCZSF NOVEMBER 2011 SURVEY REPORT

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1. Introduction

This report provides the results of industry-based fishery surveys conducted during November 2011 within selected areas of the BSCZSF. The report provides detailed information concerning the abundance, size distribution and estimated biomass within scallop beds discovered during the survey.

2. Materials and Methods

2.1 The Survey

The surveys were conducted between the 5th and 17th of November, with tows done on the 5th, 11th, 16th and 17th. Two industry vessels participated: the Victorian based Anne B and Northern Star.

In total, 243 dredge tows were conducted during the survey. The tow transects are shown in Figure 1, and show the three distinct major areas (1-3) of scallops (beds) and two smaller areas (limited tows) sampled during the survey. Two hundred and twenty (220) of the dredge tows fell into the three larger areas, which were used for more accurate estimates of scallop biomass for each area. The two small areas shown in Figure 1, one north of Area 1 and one south of Area 2, were not examined for biomass due to the small sample sizes (15 and 8 shots respectively) and the nature of the sampling (clumped) (Figures 1 and 2).
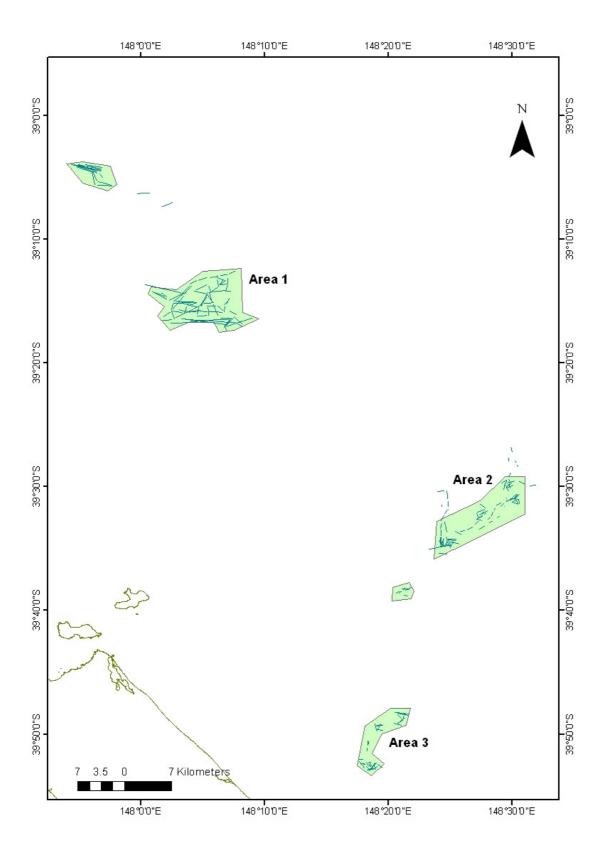
Figure 1: Overview of the locations and tow transects of scallop survey shots undertaken during the November 2011 surveys. The areas labeled 1-3 represent surveyed beds with sufficient coverage for further analysis. The shaded regions bounding areas 1-3 represent the extent of the bed used for biomass estimation. The two small shaded areas, one north of Area 1 and one south of Area 2, were not examined for biomass due to the small sample sizes.

2.2 Data Collection

For each sample tow conducted, the skipper and crew of the survey vessel recorded the start and finish coordinates, depth and an estimation of the total scallop catch as either the kilograms of scallops caught or the number of individual scallops. Electronic measuring boards were then used to measure the shell width (mm) of all scallops caught or, for large catches, a randomly selected subsample of up to 50 scallops.

2.3 Data Analysis

2.3.1   Scallop Abundance

The vessels participating in this survey used different dredge widths and conducted sample tows of different lengths / durations. Therefore, scallop abundance estimates needed to be standardised to allow a direct comparison of scallop catches between all survey vessels and tows. The distance of each sample tow was calculated from the start and finish tow locations. The area swept (A) during each sample tow was then calculated by multiplying the tow distance (L) by the width of the dredge used (W).

$$A = L \times W$$

The estimated catch of scallops per 1000m^2 standardised tow ($C^{Standardised}$) was then calculated by dividing the estimated catch in a sample tow (C) by the area swept (A) (note this equals the catch of scallops per m^2) and multiplying by 1000.

$$C^{standardised} = (C / A) * 1000$$

2.3.2   Size Frequencies

Length – frequency plots were used to compare the population structure of scallops caught within different areas of the survey region. Because the larger catches were sub-sampled for size frequency (i.e. not all scallops from a particular sample tow were measured), the ratio of the sub-sample to total catch was used to scale the numbers in each size class to total catch. To characterise the properties of the resulting size distributions the length frequencies were plotted as histograms, with data grouped into 2 mm size classes to reduce noise. The number of scallops in each size class was represented as a % of the total catch. The proportion of scallops less than the legal minimum size (90 mm shell diameter) was calculated from the length frequencies to provide an estimate of the potential discard rates within different survey regions.

2.3.3 Biomass Estimates

Biomass estimates were calculated for Areas 1-3. It must be noted that all scallop catch data (i.e. legal and sub-legal size scallops combined) were used for the biomass estimate calculations.

The average estimated biomass (B) within each of the three Areas and associated 95% confidence limits (CL) were estimated as follows:

Estimated biomass (B) (tonnes) = Av.D x A / 1000

Upper 95% CL (tonnes) = (Av.D + (t_{n-1} x $StErr_N$)) x A / 1000

Lower 95% CL (tonnes) = (Av.D - (t_{n-1} x $StErr_N$)) x A / 1000

Where Av.D = average density of scallops per m^2 swept area; A = total stratum area (m^2); t_{n-1} is from the t-distribution; and $StErr_N$ = standard error of the average kg scallops caught per $1m^2$. The above biomass estimations assume 100% dredge efficiency. As per previous biomass estimates (see Harrington, Semmens & Haddon 2008) these estimates were then multiplied by 3.03 assuming 33% efficiency. In this report all biomass estimates are reported at 33% efficiency.

2.4 Incorporation of July survey data

For the southern protected area, Area 3, scallop catch data from the July 2011 survey were added to data from November to give an updated biomass estimate. The larger number of sample shots allowed a more accurate estimate to be made, however due to the time difference between surveys, the size data were not grouped together.

3. Results

Scallop abundances varied greatly from no scallops to a maximum recorded estimate of 110 kg scallops per $1000m^2$ sample tow (Figure 2). The majority of scallops located in the three major areas fell within the 90 mm to 110 mm size classes, and the discard rate varied between 6.8 and 26 % according to the different areas. Biomass and length frequencies analysis was conducted separately for each area and the results are detailed below.
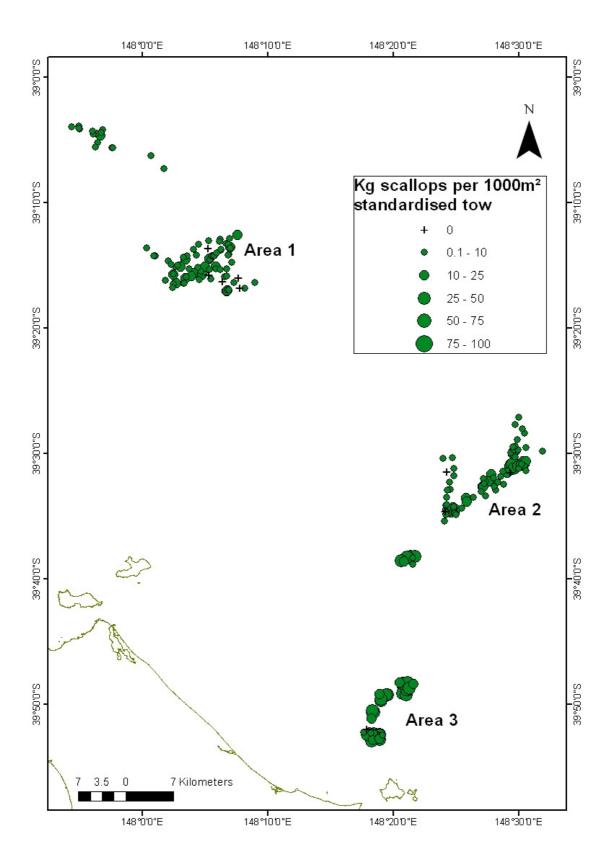
Figure 2: Overview of scallop density (kg scallops per 1000m^2) for the shots conducted during the November 2011 survey.

Area 1 (Western Protected Area)

Area 1 was 123 km^2, with an average density for all the shots combined of 6 kg per 1000m^2 (Figure 3). Biomass estimates are shown in Table 1.
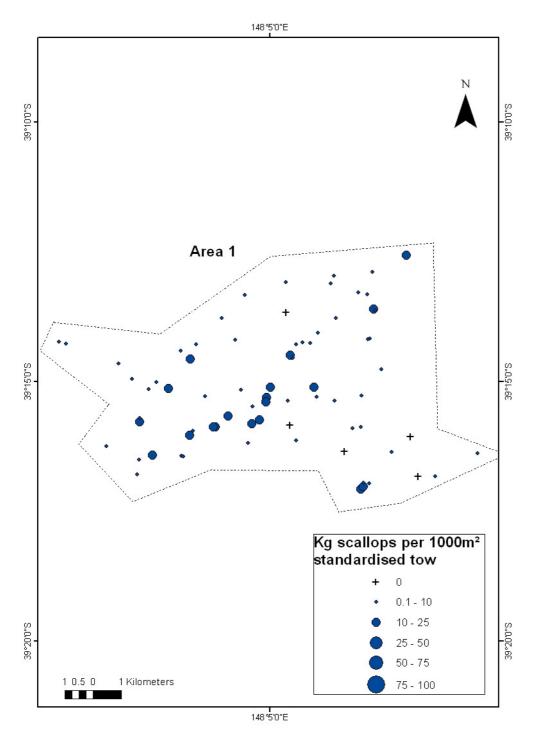

Figure 3: Scallop density (kg scallops per 1000m^2) for each of the 75 shots conducted in Area 1 (Western Protected Area) during the survey. The average density for all the shots in Area 1 combined was 6 kg per 1000m^2. The dotted line represents the boundary used to create the biomass estimate.

Table 1: Biomass estimates, in tonnes (t), for Area 1 (123 km^2), at 33% dredge efficiencies (as used for the 2008 biomass estimates - see Harrington, Semmens & Haddon 2008). The upper and lower 95% refer to the confidence intervals.

upper 95%	2706.6 t
average	**2246.6 t**
lower 95%	1786.6 t

Scallops measured in Area 1 ranged between 80 and 129 mm in length (see figure 4), with a low discard rate. Only 68 of the 965 scallops measured were less than 90 mm in length.
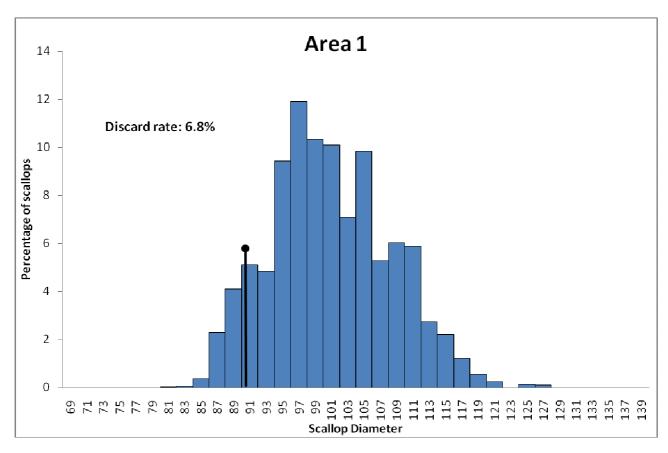

Figure 4: Length frequency distribution for the 965 scallops measured in Area 1 (Western Protected Area).

Area 2

Area 2 was 102.3 km^2, with an average density for all the shots combined of 9.9 kg per 1000m^2 (Figure 5). Biomass estimates are shown in Table 2.
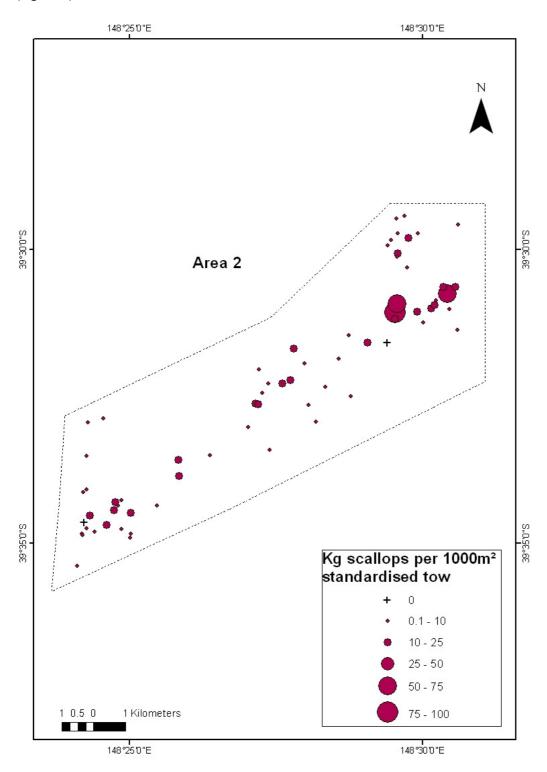
Figure 5: Scallop density (kg scallops per 1000m^2) for each of the 68 shots conducted in Area 2 during the survey. The average density for Area 2 as a whole was 9.9 kg per 1000m^2. The dotted line represents the boundary used to create the biomass estimate.

Table 2: Biomass estimates, in tonnes (t), for Area 2 (102.3 km^2), at 33% dredge efficiencies (as used for the 2008 biomass estimates - see Harrington, Semmens & Haddon 2008). The upper and lower 95% refer to the confidence intervals.

upper 95%	3985.5 t
average	**3068.1 t**
lower 95%	2150.7 t

The scallops in Area 2 ranged between 82 and 130 mm in length (see figure 6), but had a higher discard rate than Area 1 as 17.1% of the 1053 scallops measured were less than 90 mm in length.
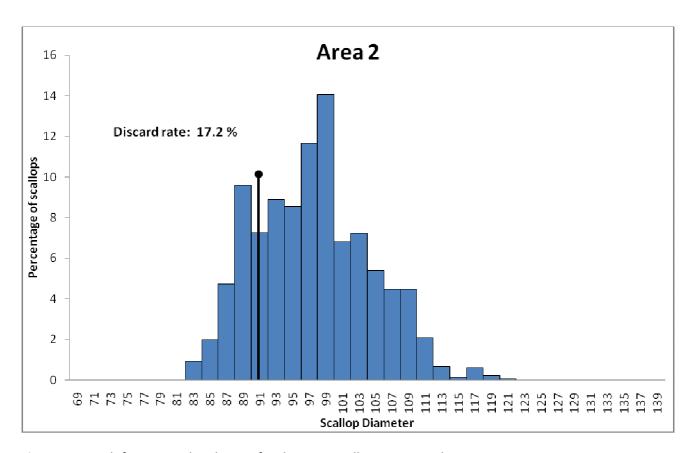

Figure 6: Length frequency distribution for the 1053 scallops measured in Area 2.

Area 3 (Southern Protected Zone)

Area 3 (Southern Protected Area) was 42.6 km^2, with an average density for all the shots combined of 31.3 kg per 1000m^2 (Figure 5). Biomass estimates are shown in Table 3.
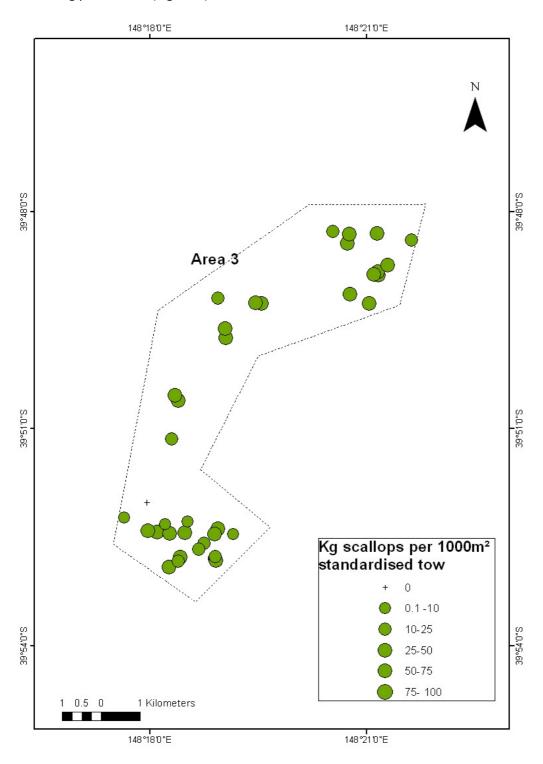
Figure 7: Scallop density (kg scallops per 1000m^2) for each of the 39 shots conducted in Area 3 during the survey. The average density for Area 3 as a whole was 31.3 kg per 1000m^2. The dotted line represents the boundary used to create the biomass estimate.

Table 3: Biomass estimates, in tonnes (t), for Area 3 (42.6 km2), at 33% dredge efficiencies (as used for the 2008 biomass estimates - see Harrington, Semmens & Haddon 2008). The upper and lower 95% refer to the confidence intervals.

upper 95%	4921.9 t
average	**4042.8 t**
lower 95%	3163.7 t

Area 3 (Southern Protected Area) had the smallest maximum size and the measurements ranged from 79 to 111 mm in length (see figure 8), and the discard rate was higher than the other areas: 27.5% of the 694 scallops measured were less than 90 mm in length. Notably, a large number of the undersized scallops were in the 89 mm class.
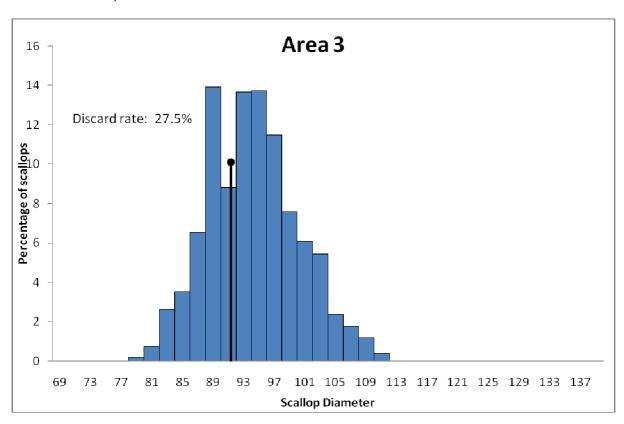

Figure 8: Length frequency distribution for the 694 scallops measured in Area 3 (Southern Protected Zone).

Re-analysis of Area 3 (Southern Protected Zone) using shots from the July 2011 survey.

The data from the current survey (November) of the Southern Protected Area and that conducted in July by the Brid Voyager was combined to produce an overall biomass estimate for the area (79 km^2) (Figures 9 and 10, Table 4).
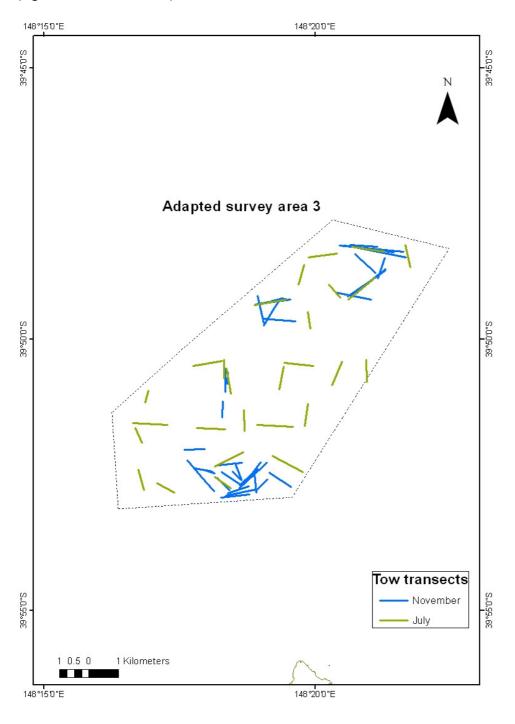
Figure 9: Tow transects of scallop survey shots undertaken during the November and July 2011 Southern Protected Zone surveys. The survey area (dotted line) is a combination of the two survey areas adapted for the combined biomass estimates.
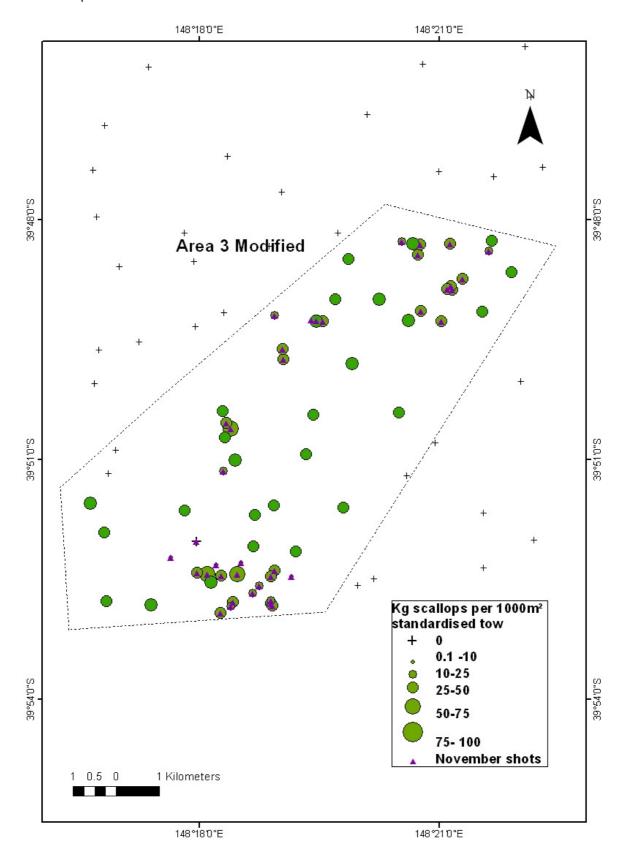
Figure 10: Scallop density (kg scallops per 1000m^2) for each of the November shots in Area 3 (Southern Protected Zone) combined with the shots from the July 2011 survey. All November shots are designated with an additional triangle. The dotted line represents the area used for biomass estimates (79 km^2).

Table 4: Biomass estimates, in tonnes (t), for the combined surveys (July and November 2011) in Area 3 (total 79 km^2), at 33% dredge efficiencies (as used for the 2008 biomass estimates - see Harrington, Semmens & Haddon 2008). The upper and lower 95% refer to the confidence intervals.

upper 95%	6379.7 t
average	**5181.4 t**
lower 95%	3983.1 t

The size frequency distributions of scallops caught in the July and November surveys were compared (Figure 11), with both distributions similar, but showing differences at the extremes of the distributions i.e. young and older animals. It should be noted that the two surveys sampled different portions of the area.
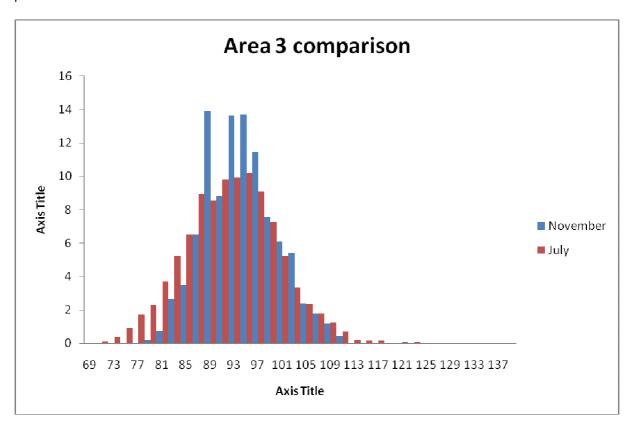

Figure 11: Comparison of the length frequency distributions for scallops caught in the Southern Protected Area during the November and July surveys.

Limited sampling areas

The limited sampling areas in the Northwest (Top Small) and Southeast (Mid Small) (unlabeled areas in Figure 1) had 15 and 8 shots conducted respectively. The NW area had an average density of 5.4 kg per 1000m^2 and the SE 27.2 kg per 1000m^2. Only 137 and 151 scallops were measured for the NW and SE areas respectively, so the length frequency distributions need to be interpreted with caution (Figures 12 and 13).
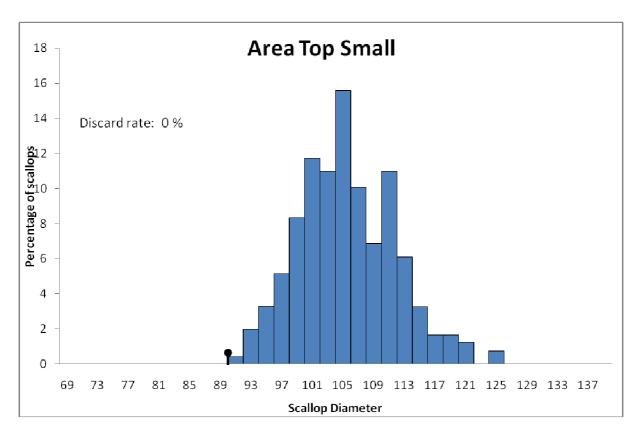

Figure 12: Length frequency distribution for the 137 scallops measured in Area Top Small (see northwest Figures 1 and 2).
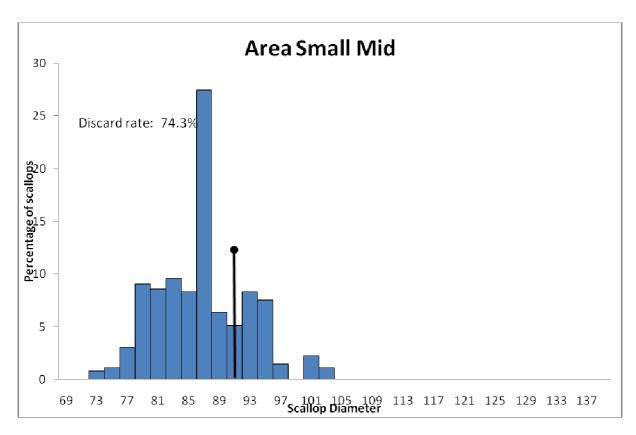
Figure 13: Length frequency distribution for the 151 scallops measured in Area Small Mid (see southeast Figures 1 and 2).

4. Summary

- Areas 1(Western Protected Zone) and 2 had scallops under the 20% discard rate (6.8% and 17.2% respectively), but had relatively low average scallop densities (6 and 9.9 kg per 1000m^2 respectively).
- Area 3 (Southern Protected Zone) had the smallest maximum size, scallops ranged from 79 to 111 mm in length and the discard rate was higher than the other areas at 27.5%. Notably, however, a large number of the undersized scallops were in the 89 mm class.
- Area 3 had an average scallop density of 31.3 kg per 1000m^2 (November data only). This equates to approximately 0.3 scallops per m^2 of the benthos.