Eastern Victorian Ocean Scallop Fishery
2020 survey of “Tarwhine” scallop bed

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CONSULTING

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Introduction

The main target species in the Victorian (Ocean) Scallop Fishery is the Commercial Scallop, *Pecten fumatus*, taken by dredging. The scallop fishery is managed using a statutory consultation process that involves fishers, fishery scientists and fishery managers. Information from a range of sources including scientific research, stock assessments and data from other Bass Strait scallop fisheries is considered in setting the annual total allowable commercial catch which is divided equally between each licence holder.

Since the commercial fishery began in the 1970's, catches have varied greatly from year to year. Continued low abundances during the mid- to late-2000's prompted a fishery independent survey during 2009 that showed there were no commercially viable scallop beds in the Fishery (Harrington et al., 2010). As a result, DEDJTR (then DPI) and the scallop industry made a joint decision to set the TACC at zero for the 2010–11, 2011–12 and 2012–13 fishing seasons. A further survey conducted in 2012 (Semmens and Jones, 2012) showed little improvement in the status of the stocks, although there was some indication of recent recruitment of juvenile scallops into the fishery. It was estimated that these recruits should reach commercial size by 2014. The TACC was subsequently set at 136.5 tonnes in 2013/14 and 2014/15 and 135 tonnes for 2015/16.

Based on anecdotal reports of recovery during 2017, the Victorian Fisheries Authority (VFA) considered there was merit in conducting a biomass survey to inform management arrangements for the following season. A broad-area survey was designed based on depth limitations of scallop fishing, GIS habitat layers, past fishing effort and results of past surveys in areas from Point Hicks in the east to Wilsons Promontory in the west, and was conducted during 2017/18. Total biomass in the broad-area stratum was estimated to be 5,107 t (95% confidence intervals (CIs) ranged 2,226 t–14,372 t), and with 89% of the scallops greater than 80 mm length, estimated biomass greater than 80 mm was 4,545 t (95% CI 1,980 t–12,791 t). The overall density was 1.1 kg per 1000 m2, or 0.06 individuals per m^2(Koopman et al. 2018).

Similar anecdotal reports of a high abundance of commercial-sized scallops observed in a very specific area off the Tarwhine oil and gas field were raised by industry during 2019-2020 with concern that the restrictive TAC would limit potential exploration and development of the fishery. Using well-established survey techniques used in Tasmanian and the Commonwealth scallop fisheries, VFA and industry agreed for a very small low-cost survey of these beds to provide an estimate of scallop abundance. This is a brief report on the results.

Objectives

1. Conduct a survey of specific scallop beds in eastern Victoria.
2. Determine the biomass of commercial-sized scallops on these beds.

Figure 1. Location of the "Tarwhine" scallop bed surveyed.

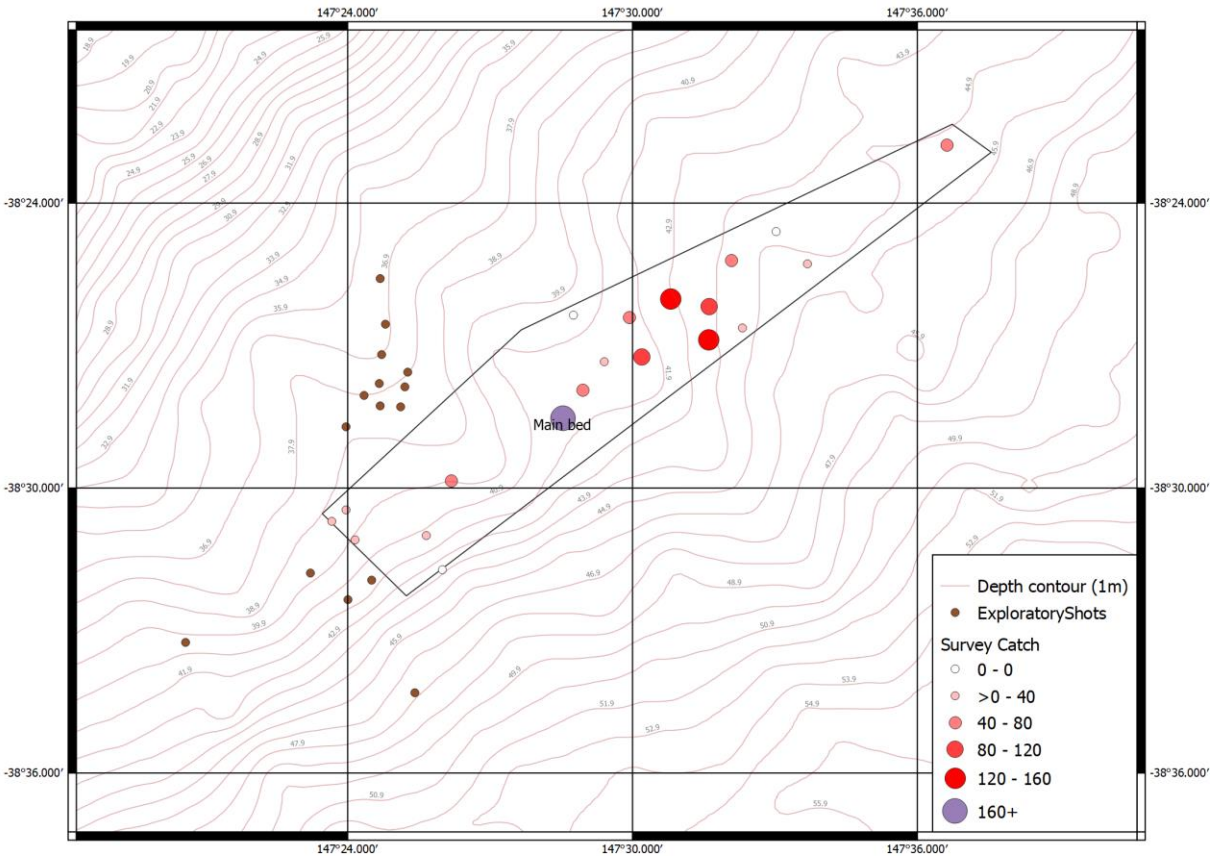

Figure 2. Location of the "Tarwhine" scallop bed showing relative catches of Commercial Scallops.

Methods

Survey methods follow those of (Knuckey *et al.*, 2015), modified from those described in Harrington *et al.* (2009). Specific beds to survey were provided by industry members, the main one being defined by the coordinates shown in Figure 2.

The commercial vessel North Star was used to conduct the survey with Mary-Jo Hanly as the independent scientific observer. We thank the owner Andy Watts and the skipper Jake and the crew for their help and support for the survey.

The survey focussed on the scallop bed to the east of the Tarwhine oil field, here-on referred to as the "Tarwhine" scallop bed (Figure 2). Some exploratory shots were also conducted to the north and south west of this main bed.

For each shot, estimates of weight were made for: total live scallop catch, dead scallop shell and all bycatch by species / species group. Dead scallop shells were further categorised as:

- "Clappers" (both valves still connected at the hinge);
- Old single (single valve – inside appears old and overgrown with epiphytes / epifauna);
- New single (single valve – inside appears new without any epiphytes / epifauna).

A random sample of at least 25 scallops (where available) was collected from each shot before being discarded. The observer measured the length of those scallops using an electronic Scielex Shellfish Measuring Board. Either the first or last (or both) scallop from each shot measured using the measuring board was also measured by hand using callipers or a metal ruler. This was done to ensure accuracy and consistency of the measuring board throughout the survey. The sample weight of scallops measured was also recorded.

Data analysis

All data processing and analysis was undertaken in R (R Core Team, 2017), and density plots were created using the package QGIS (version 2.18.15). Estimates of biomass followed the methods of Semmens and Jones (2014).

Biomass

The internal widths of the dredges used during the survey were measured in accordance with Semmens and Jones (2014). Dredge width used by the Northern Star was 4.02 m. A dredge efficiency of 33% was assumed.

Swept area (S) of each tow was calculated as follows:

$$S=LxW$$

Where L is the tow distance (m) and W is the width of the dredge (m). Tow distance was calculated from the straight-line distance between start and end tow positions for most tows. In two cases the GPS fix was lost, and so distance was calculated from the speed and tow duration.

Scallop catch in each tow ($C^{standardised}$ in kg/1000 m^2) was calculated as follows:

$$C^{standardised} = (C/S)x1000$$

Where C is the estimated catch in a shot (kg).

Assuming a 33% dredge efficiency, biomass (B) in tonnes and 95% confidence limits (CL) were estimated for each stratum (bed) as follows:

$$B = meanD * A * 3.03 / 1000$$

$$\text{Upper 95\% CL} = ((meanD + (t_{n-1} \times SE_{meanD})) \times A)*3.03 / 1000$$

$$\text{Lower 95\% CL} = ((meanD - (t_{n-1} \times SE_{meanD})) \times A)*3.03 / 1000$$

Were meanD is the mean density (kg) of scallops per m^2 swept, t_{n-1} is the t –value for the number of shots (n) -1, SE_{meanD} is the standard error of meanD and A is the total stratum area (m^2). The area of each bed was calculated using the package QGIS (version 2.18.15).

Biomass and upper and lower 95% CL of scallops greater than 80 mm were calculated as follows:

$B_{>80mm}$ = B * (1-discard rate)

Upper 95% $CL_{>85mm}$ = Upper 95% CL * (1-discard rate)

Lower 95% $CL_{>85mm}$ = Lower 95% CL * (1-discard rate)

where the discard rate was calculated using catch weighted length frequencies converted to weight.

Densities of Commercial Scallops in the broad-area survey were heavily positively skewed, and so bias-corrected 95% CL were calculated using the boot.ci function of the R package "boot" (Cantly and Ripley, 2017) using 1000 bootstrap replicates.

An estimate of density in individuals per square metre (*I*) was obtained as follows

$$I = \sum_{len} WLf \; / \; S$$

Were *WLf* is the weighted length frequency for each length class *len*, and *S* is the swept area (m^2).

All densities (kg / m^2 and individuals per m^2) reported have been adjusted for the 33% assumed dredge efficiency.

Results

There was a report of smaller scallops outside the main area so exploratory tows with half of the dredge covered in small mesh were conducted outside the Tarwhine bed (indicated by the brown dots in Figure 2). These shots yielded few scallops and a lot of debris and broken scallop shell. It was decided that these areas did not warrant a formal survey.

The time and location of each of the randomly-placed tows and the estimated scallop density is provided in Table 1, with detailed estimates of overall abundance and density in Table 2 and abundance and density of legal-sized (≥80mm) scallops in Table 3. Initial shots on the bed were conducted with the small mesh cover on half the dredge but negligible numbers of small scallops were caught. The cover was subsequently removed for the second day of the survey.

The estimated biomass of legal-sized scallops within the Tarwhine scallop bed is 7,876 t but this estimate is uncertain with 95% confidence limits ranging from about 4,000 t to 12,000 t. The mean density of legal-sized scallops is 1.15 individuals per square metre.

A summary of the scallop category (Commercial scallop, Clappers, New Single and Old Single) is in Table 4 and the size frequency of the commercial scallops on Table 5 and Figure 4. Most scallops ranged between 85 and 105mm with a mode around 98mm. No other biological information was collected. Scallop meat weight was estimated to be about 80/kg although this was not formally measured.

Table 1. Summary of shots undertaken on the main bed.

Set Number	Start Date	Start Time	Start Latitude	Start Longitude	Green Weight (kg)	Average Depth (m)	Shot Duration (mins)	Tow Speed (kts)	Tow distance (m)	Scallop Density (kg/sq m)
1	15/12/2020	15:33:01	-38.5287	147.4332	0	40	0:03:59	3.20	393*	0.000
2	15/12/2020	15:51:02	-38.5182	147.4025	4.5	38	0:05:12	3.20	589	0.006
3	15/12/2020	16:28:53	-38.5117	147.3943	3.1	37	0:03:07	3.20	366	0.007
4	15/12/2020	17:01:00	-38.5077	147.3993	5.5	38	0:06:18	3.20	538	0.008
5	15/12/2020	17:46:01	-38.5167	147.4275	0.2	40	0:05:08	3.20	483	0.000
6	15/12/2020	18:16:23	-38.4975	147.4363	65	39	0:04:37	3.10	485	0.104
7	15/12/2020	19:18:18	-38.4755	147.4755	179.8	40	0:05:01	3.10	481	0.290
8	15/12/2020	20:01:03	-38.4657	147.4825	78	40	0:04:57	3.10	449	0.135
9	15/12/2020	21:08:19	-38.4202	147.5347	68	42	0:04:55	3.10	439	0.120
10	21/12/2020	6:47:48	-38.3797	147.6103	57	46	0:06:24	3.20	563	0.079
11	21/12/2020	7:33:38	-38.41	147.5503	0	43	0:05:23	3.20	452	0.000
12	21/12/2020	7:57:09	-38.4213	147.5613	0.9	45	0:05:52	3.20	382	0.002
13	21/12/2020	8:22:04	-38.4438	147.5385	28.5	43	0:05:07	3.10	446	0.050
14	21/12/2020	8:57:06	-38.448	147.5267	130.05	43	0:05:40	3.12	480	0.211
15	21/12/2020	9:28:03	-38.454	147.5032	118.1	42	0:05:56	3.00	528	0.174
16	21/12/2020	10:01:40	-38.4557	147.49	34.44	42	0:04:47	3.00	413	0.065
17	21/12/2020	10:44:01	-38.4393	147.4792	0	40	0:04:24	3.12	387	0.000
18	21/12/2020	11:14:07	-38.4402	147.4988	43.49	42	0:05:07	3.12	429	0.079
19	21/12/2020	11:45:30	-38.4337	147.5133	126.32	42	0:04:43	3.00	382	0.257
20	21/12/2020	12:17:36	-38.4363	147.5268	103.2	42	0:06:09	3.00	618	0.130

- There was an obvious error in the start or end position, resulting in a very large tow distance measures from start and end position. In this case, tow distance was calculated from tow duration and tow speed.

Table 2. Summary scallop densities and biomass estimates.

Estimate	Value
Mean Density (kg/sq m)	0.086
Mean Density (kg/ha)	910
Number of Shots	20
SE Density	0.020
Area (sq km)	93.5
Biomass (t)	8018
Upper95 (t) (Bias corrected)	12000 (12020)
Lower95 (t) (Bias corrected)	4037 (4706)
Mean Density (individuals per sq m)	1.2
Maximum Density (individuals per sq m)	3.4

Table 3. Summary densities and biomass estimates including 80 mm size limit.

Estimate	Value
Percent of catch weight >80 mm	98.2
Percent of catch weight <80 mm	1.8
Biomass >80 mm (t)	7876
Upper95 (t) (Bias corrected)	11788 (11807)
Lower95 (t) (Bias corrected)	3966 (4623)
Mean Density (individuals per sq m)	1.15*

* This is the density in individuals per sq m multiplied by the proportion scallop numbers greater than 80 mm (95.7%)

Table 4. Catch by scallop category.

Species	Catch (kg)
Commercial scallop	1052.85
Clappers	2
New Single	19
Old Single	470

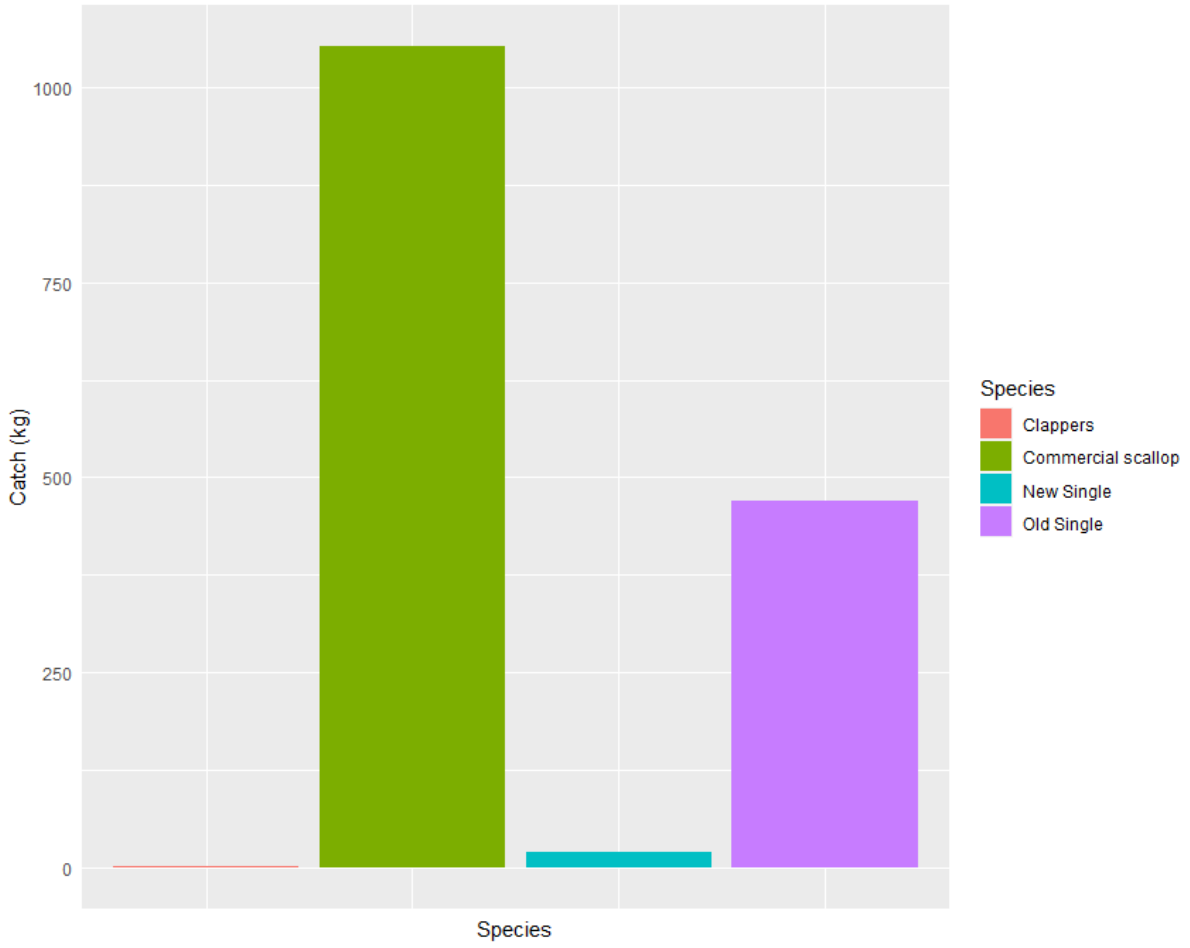

Figure 3. Catch by scallop category.

Table 5. Summary of size frequency data.

Number of records	540
Mean Length (mm)	92.2
Median Length (mm)	93.5
SD Length	8.2
SE Length	0.4

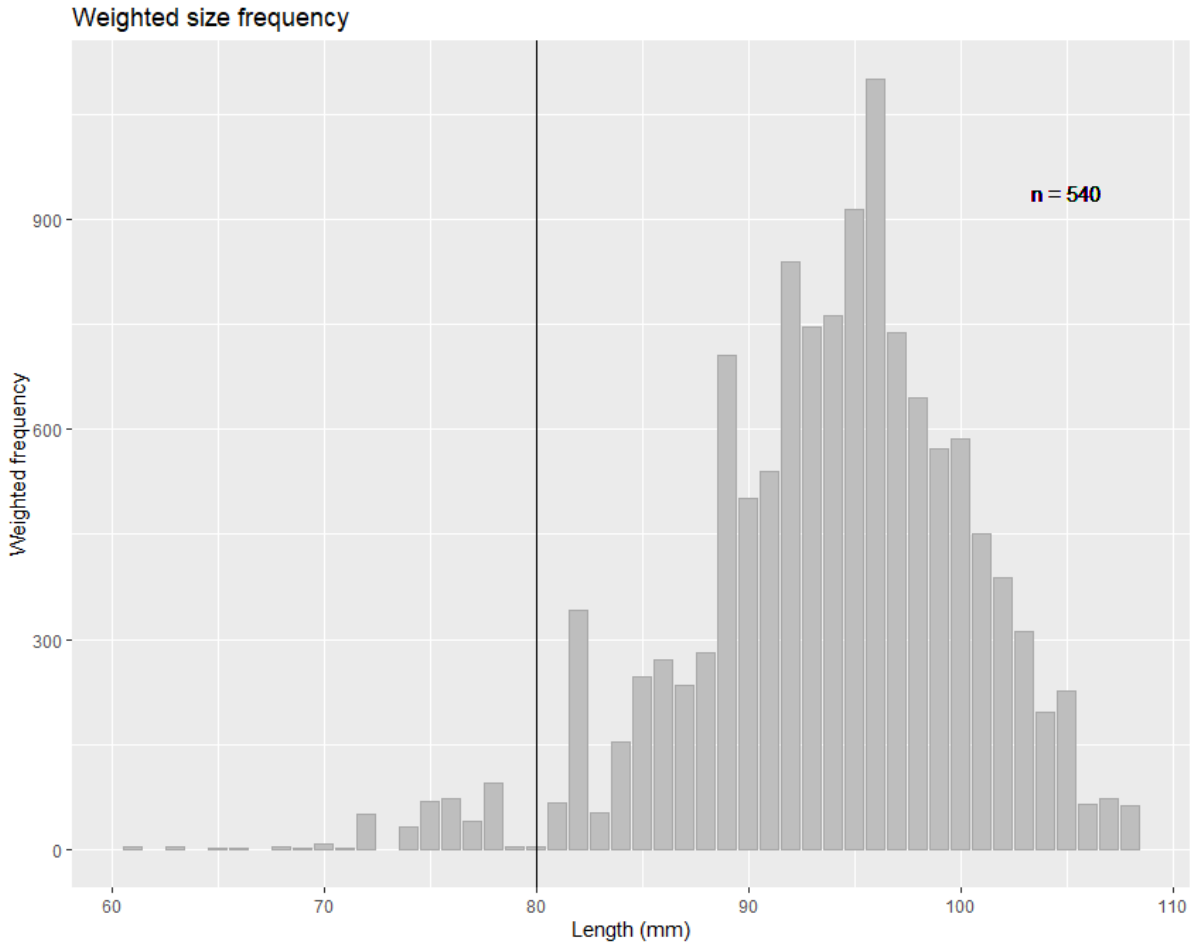

Figure 4. Weighted size frequency distribution.

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