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Industry-independent video survey of commercial scallop (*Pecten fumatus)* densities in Great Oyster Bay – May 2017 survey

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Executive Summary

A towed underwater video camera was used to assess scallop densities north of the commercially fished beds in the Great Oyster Bay Shark Refuge Area in May 2017. The primary objective was to determine the presence or absence of a large spawning biomass of scallops outside of the commercially fished zone. Twenty one video tows were conducted over a range of depths and locations. Results show that throughout offshore areas of Great Oyster Bay (>2km from shore) there is general trend of decreasing scallop density with shallowing depths north of the commercial beds, while isolated pockets of high density scallops exist inshore. The video survey did not detect extensive, high density, scallop beds north of the fished area in Great Oyster Bay. Results of the video survey were comparable with the commercial pre-season dredge survey.

A concurrent towed video survey of recreational scallops in the D'Entrecasteaux Channel, which allowed direct comparison with quantitative diver transect methods, indicated a high level of accuracy in scallop density estimates from towed video footage. Comparisons of size structure indicated some bias in the video derived data, in particular in defining the cohort structure in the smaller size classes.

The towed video proved to be a very-cost effective and low impact technique for the rapid assessment of scallop abundance, provides an indication of relative size structure, and hence is an effective methodology for fishery-independent biomass estimation.

Methods

The IMAS towed video camera unit (Fig. 1) was towed approximately 1m above the seafloor at around 1.5 knots. The camera unit incorporates a high definition handycam video camera, LED lighting and 2 parallel scaling lasers at a separation of 150mm (whose beams contact the seafloor in the centre of the video field).

Twenty one video tows were conducted in Great Oyster Bay on 25th and 26th May 2017. Sites surveyed were distributed in Great Oyster Bay such as to include a range of depths, and locations both inside and outside the Shark Refuge Area (Fig. 1). Tows were minimum of 500m in length, with each tow was recorded as a track on the vessel GPS.

Video footage was viewed to determine the abundance of commercial scallops (*Pecten fumatus)* and other benthic taxa using video analysis software Transect Measure (SeaGIS). The start and end time of the benthic footage analysed for each site was recorded from the video time code and was used to truncate the site GPS track to determine the actual length of each transect.

Scallops and other taxa were counted only if:

1. They crossed the centre line of the video frame (i.e. a horizontal line passing through both laser points) and within 500mm on either side of the centre point between the 2 scaling laser points (i.e. 1m transect width) (Fig. 3)
2. They crossed the centre line from beyond the laser points (i.e. mobile species swimming across the line from behind the camera were not counted)

Segments in transects where the video field was less than 1m wide or where the video left the seafloor sufficiently to preclude recognition of scallops were excluded from the analysis to minimise bias. These segments were excised based on their video timecodes cross-referenced to the GPS track to ensure transect areas reflected valid video segments.

In every video frame in which a scallop was counted, a pixel to millimetre calibration was applied using the scaling lasers (150mm) and the length (widest point of the shell, parallel to the hinge) of the scallop was measured in millimetres. Where scallops were orientated with their length parallel to the centre line accurate measurements of their length were possible (Fig. 3). However, where scallops were not orientated in this way, measured lengths would be an underestimate due to the perspective effects produced by the angle of incidence of the camera on the seafloor (approximately 30°). Further, this angle may vary throughout a transect with fluctuations in depth, tow speed, current, and benthic topography. Consequently, to minimise this bias, scallops were measured on either their length or height axis (Figs. 3 and 4) on the basis of which axis was more closely aligned to the video centre line. Height measurements were converted to expected lengths using a height/length linear regression derived from measurements of scallops captured in Great Oyster Bay (Fig. 5) (Semmens *et al.*, 2015).

The density of scallops was calculated as the ratio of the abundance of counted scallops and the transect area (i.e. 1m*transect length). The size structure of counted scallops was estimated from measured lengths and expected lengths (calculated from measured heights).

To enable comparison with the commercial pre-season dredge survey conducted in May 2017 each scallop length from the video survey was converted to an expected weight using a power function derived from length weight scallop data from sampling in the Great Oyster Bay area (N = 1735) (Semmens *et al.*, 2015) (Fig. 6). Densities were calculated from the ratio of the total expected weight and the transect area for each site. For this comparison, dredge derived densities were also weighted by a factor of 3 to allow for an assumed dredge efficiency of 33%, as per Harrington et al. (2009). The density of scallops for each of 73 survey pre-season dredge survey sites was calculated from the ratio of the estimated landed weight of legal sized scallops (length >90mm), and the dredge tow area (estimated from start and finish geographic coordinates).

A survey of scallops in the D'Entrecasteaux Channel using towed video and diver transects was also conducted in June 2017 and allowed the accuracy of video-derived estimates of scallop density and size structure to be measured. This study has demonstrated that the towed video has substantial time-benefits over traditional diver surveys and, despite limitations in its ability to resolve detailed cohort structure, especially in the smaller size groups, it appears well suited as a rapid assessment tool to determine overall scallop densities. This is crucial information that can inform decision-making on the need for more comprehensive diver-based surveys if significant densities are encountered.

Figure 1. IMAS towed video camera unit.

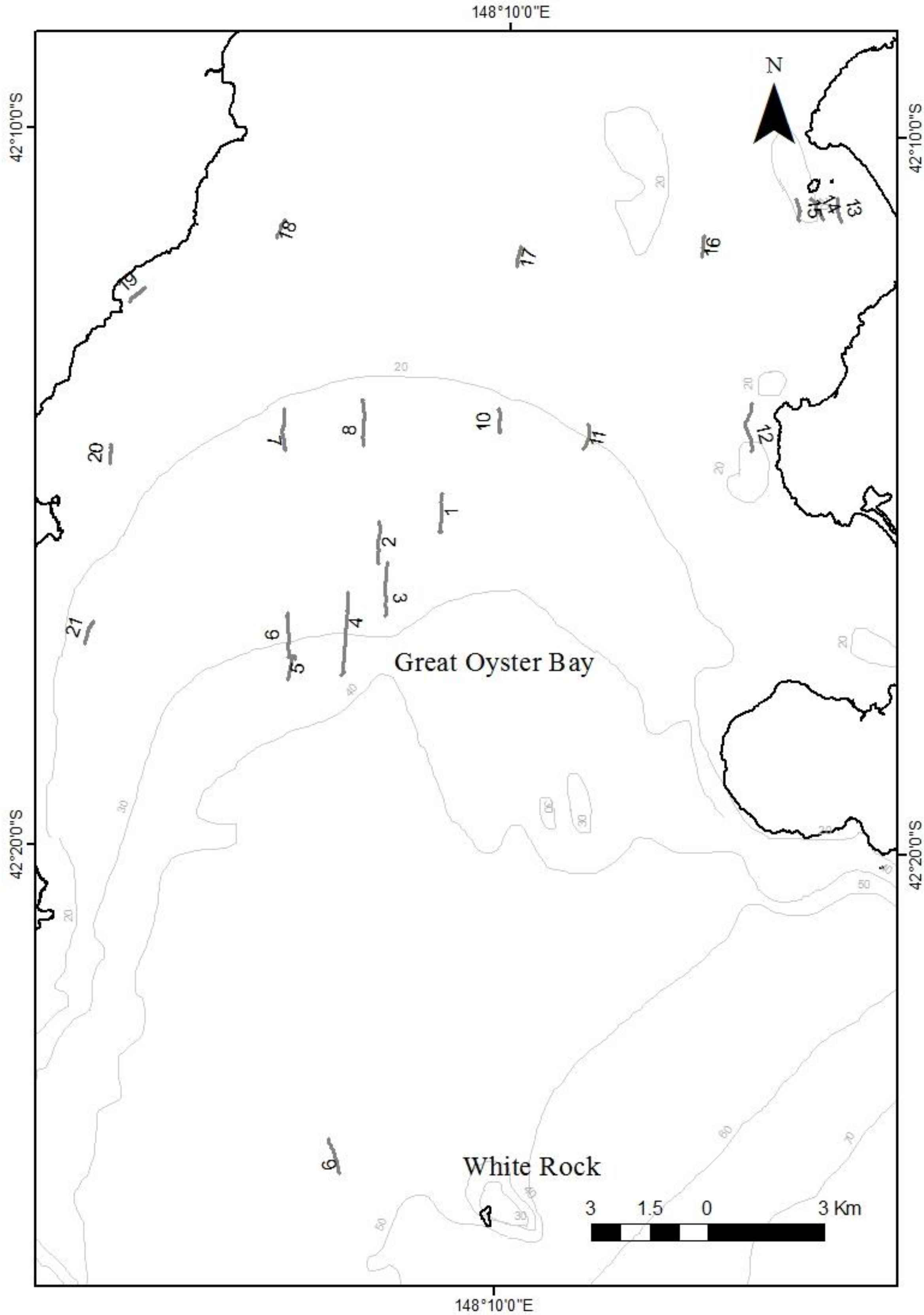

Figure 2. Video survey tows (with site numbers) conducted in May 2017 in the White Rock and Great Oyster Bay areas.

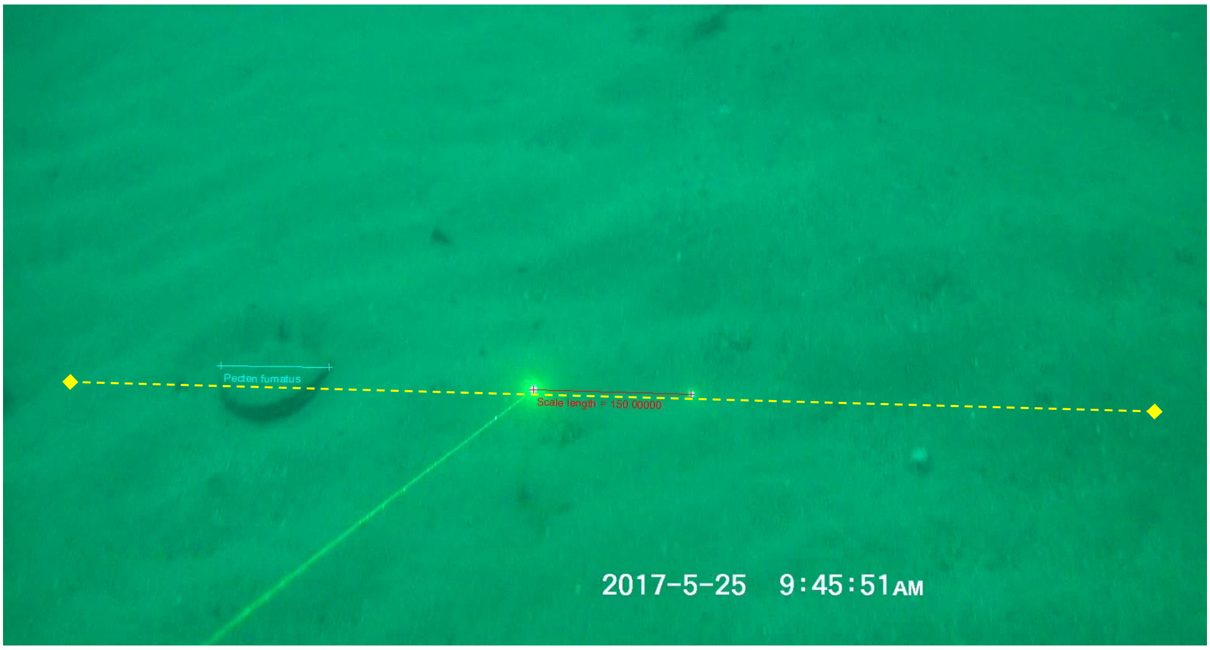

Figure 3: Frame from video footage showing scaling lasers (green dots), pixel to millimetre calibration (red line), video centre line (dashed yellow), transect width (dashed yellow line is 1m long and centred at the centroid of the scaling lasers), and a scallop length measurement (blue line) orientated parallel to the centre line.

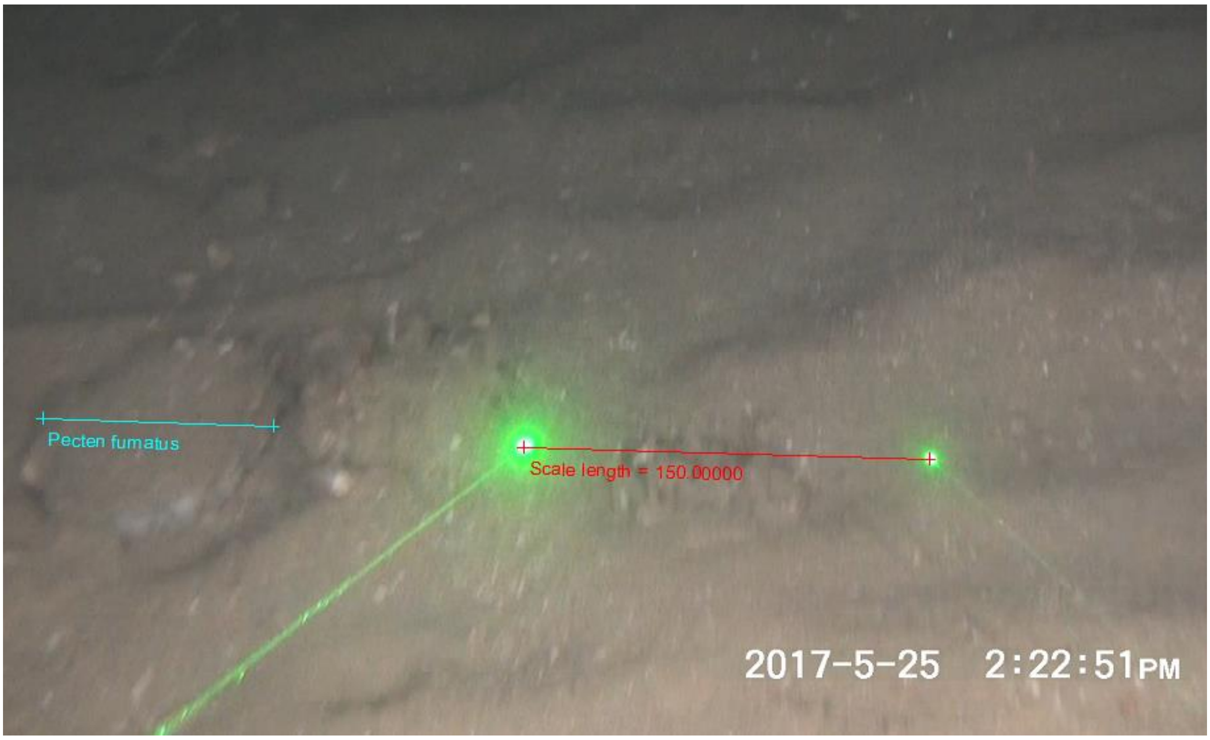

Figure 4: Close-up from a frame of video footage showing a scallop height measurement (blue line) orientated parallel to the centre line.

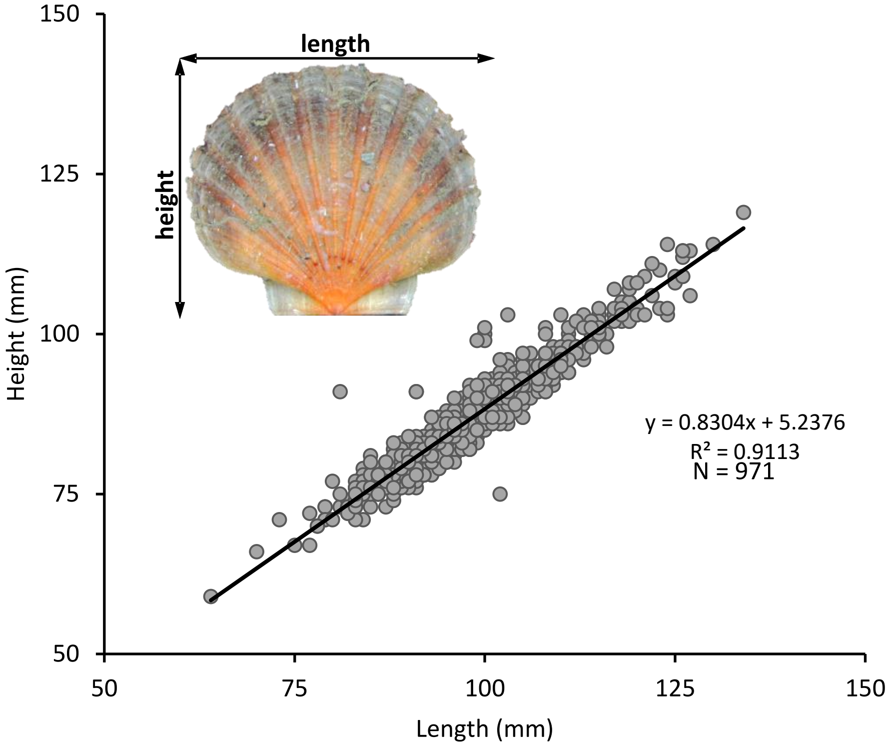

Figure 5: Linear regression of height against length for *Pecten fumatus* used to calculate expected lengths from measured heights.

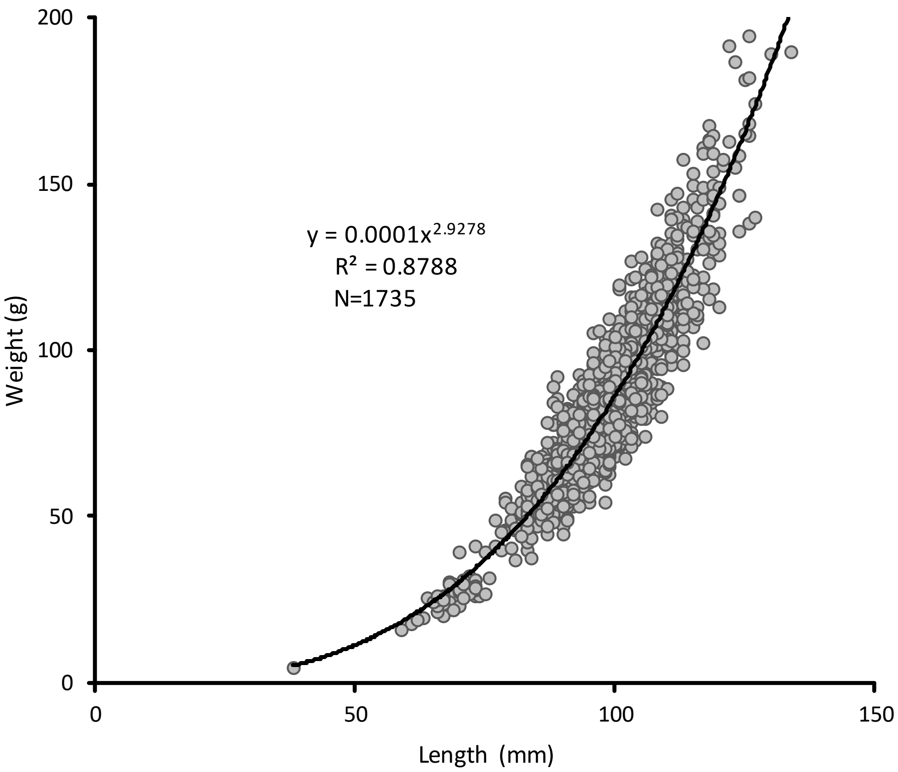

Figure 6: Power curve fitted to length and weight data from prior surveys for *Pecten fumatus* used to calculate expected weights from video measured lengths.

Results and discussion

Video survey scallop densities

The ground-truthing survey indicated that the towed video technique provides highly accurate estimates of scallop abundance and density (Ewing et al., 2017).

A total of 746 scallops were counted and measured across 21 video transects surveyed. Five transects had at least one segment of video excised due to variations in height above the seafloor, and one transect (site 13) had segments excised as a sub-sampling strategy due to high abundance of scallops. Transect areas assessed from transect lengths are presented by in Table 1.

Scallop abundances were high at the inshore sites on the Freycinet Peninsula coast (sites 12, 13, and 14) with a mean abundance of 392 scallops/1000 m^2 (Table 1, Fig. 7). However abundance was generally low across the rest of Great Oyster Bay with a mean abundance of 20.2 scallops/1000 m^2 for remaining sites (including 4 sites that yielded zero scallops) (Table 1, Fig.7).

Proximity to a shoreline appears to influence scallop abundance as the three sites with the highest abundance (sites 12,13 and 14) were the closest to the Freycinet peninsula (each within 2km of the shore). However, the site with the closest proximity to a shoreline, site 19 on the Swansea shoreline, yielded no scallops.

Table 1: Transect area and commercial scallop density reported as abundance per 1000m^2 and kilograms of commercial sized scallops per 1000m^2. Legal sized scallops are >90mm length.

Site	Mean depth (m)	Transect Area (m^2)	Scallop density (scallops/1000m^2)	Legal scallop density (Kg/1000m^2)
1	24.9	428	18.7	1.49
2	25.8	539	48.2	2.39
3	27.7	1073	43.8	3.80
4	30.4	2045	46.5	4.11
5	32.6	567	37.0	3.81
6	29.2	952	56.7	6.63
7	20.3	906	2.2	0.06
8	21.1	949	0	0
9	47.5	788	11.4	0.73
10	20.5	467	8.6	1.07
11	20.5	534	18.7	4.45
12	26.5	924	211	23.9
13	9.9	122	854	120.1
14	15.5	475	111	9.44
15	21	411	53.5	4.48
16	15	389	2.6	0.22
17	15.5	374	8.0	1.04
18	15.5	368	0	0
19	14	320	0	0
20	17	332	0	0
21	22	476	8.4	0.46

Across all surveyed sites, depth does not appear to influence scallop abundance as the four most abundant sites included the shallowest site and two sites deeper than the mean depth of all sites (Figs 7, 8). Further, the second shallowest site (site 19) was among the four sites that yielded zero scallops. However, at sites within central Great Oyster Bay (excluding inshore (# 12 – 15, 19) and White Rock (# 9) sites) a clear relationship of increasing density with depth is observed (Fig. 8).

These data suggest that throughout offshore areas of Great Oyster Bay (>2km from shore) there is general trend of decreasing scallop density with shallowing depth, while inshore areas have isolated pockets of high-density scallops. Although limited sample data, the position of the shoreline in Great Oyster Bay is also likely to be important in influencing near-shore scallop densities. The observed patterns of scallop density, and historic fluctuations in density, may be explained by temporal and spatial variation in supply of larval settlers due to complex localised hydrodynamic processes, driven by the interaction of east coast tidal and oceanographic currents across the mouth of Great Oyster Bay.

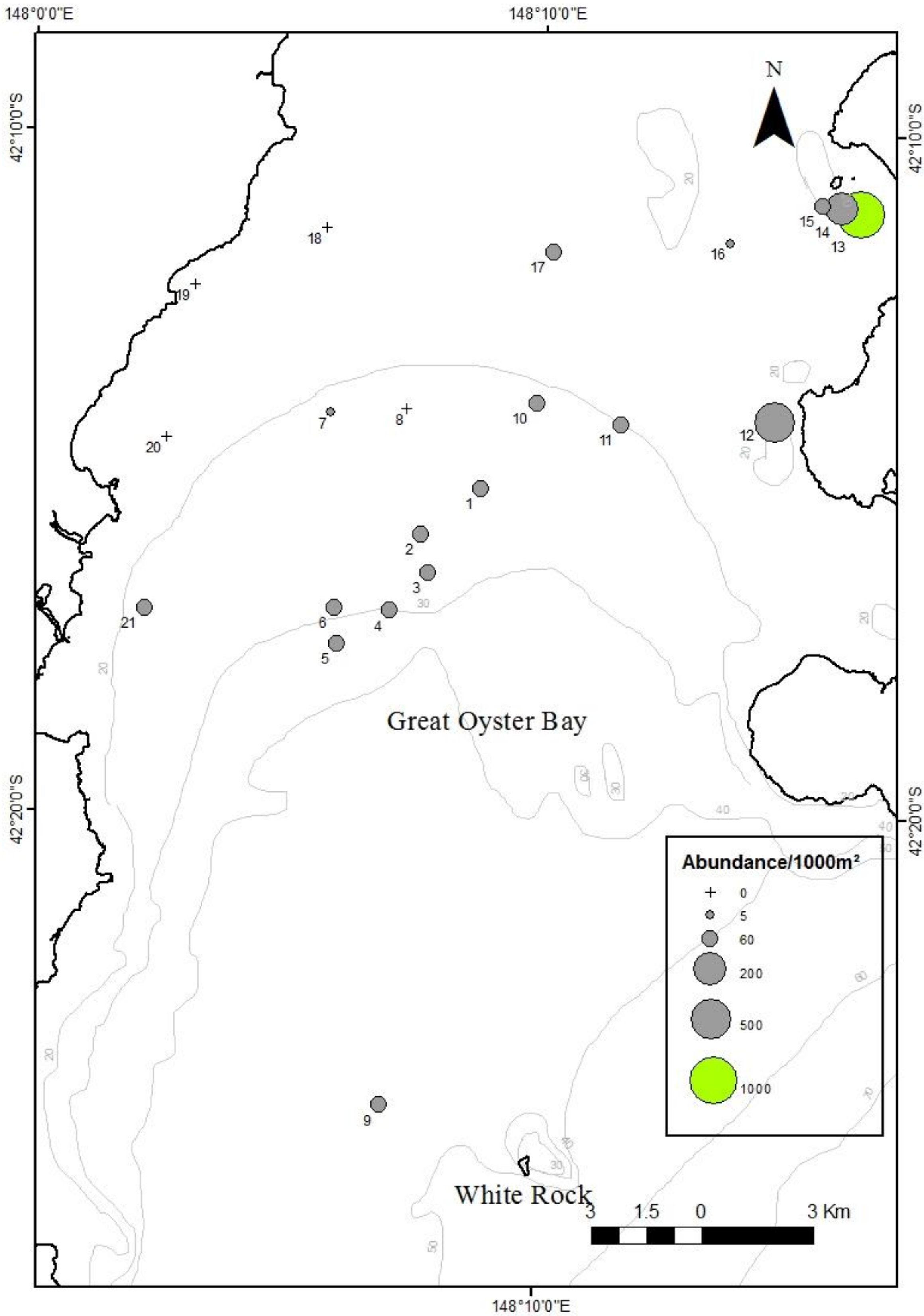

Figure 7: Video survey scallop transects (blue lines) and density (circles) by transect. Density is presented as abundance of scallops per $1000m^2$.

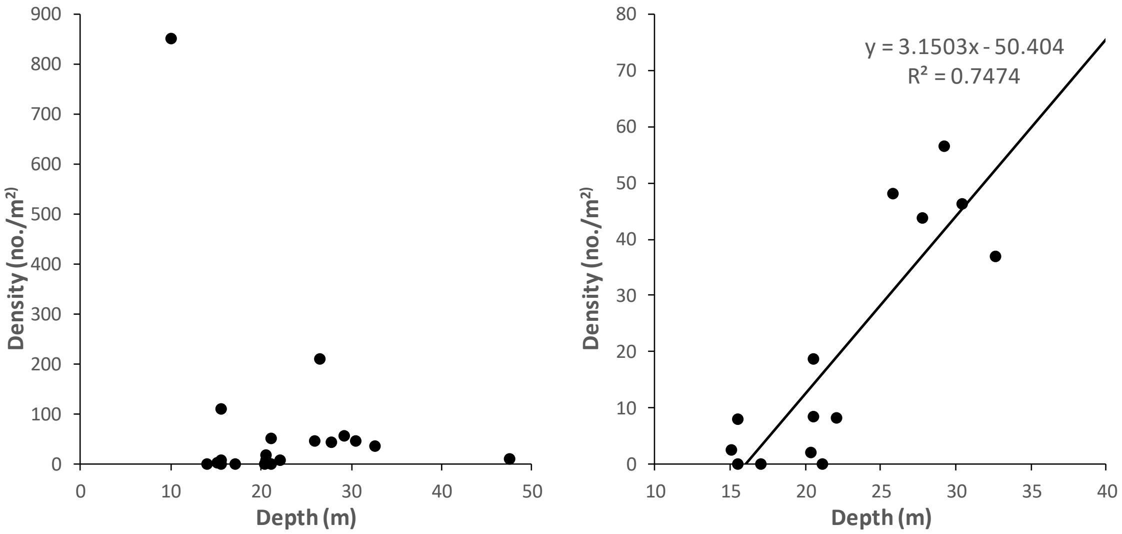

Figure 8: Scallop densities (no/m2) at depth across all sites (left) and sites within central Great Oyster Bay (all sites excluding inshore sites (# 12 – 15, 19) and the White Rock site (# 9) right).

Scallop size structure

The ground-truthing survey indicated that video-derived estimates of scallop size structure are likely to accurately portray the range of scallop sizes, but are also likely to incorporate some under-sizing bias, which may interfere with the definition of cohort structure in smaller size classes (Ewing et al., 2017).

Every scallop observed in a valid video segment yielded an estimate of size either by a direct measurement of length or by conversion of a height measurement. The scallop size distribution was skewed to the larger individuals, with the greatest proportion of the population occurring around 80-110mm (Fig. 9A). Apparent length cohorts occurred at around 40mm, 60mm, and 95mm and cohort structure appears clearer in the offshore size distribution (>2km from the nearest shoreline) (Fig. 9B). The frequency of scallops <90 mm was higher in the area adjacent to the dredging (discard rate = 39%) than that across offshore sites (34%) and all sites (37%).

Comparison with the 2017 pre-season dredge survey

The distribution of scallops from the video survey, when expressed in kilograms of legal size scallops per 1000m^2 (dark circles in Fig. 10), showed similar densities to the dredge survey results (light circles in Fig. 9). The consistency of scallop densities in the region where both video and dredge surveys were conducted suggest that video and dredge survey methods yield comparable results.

A sub-group of 12 sites from the 2017 commercial pre-season dredge survey that were adjacent to sites in the video survey (sub-group of 5 sites) were selected to allow a comparison of the size structure between these survey methods (see sites encompassed in the black oval Fig. 10). The size structure from the dredge sub-group (Fig. 9D) is truncated compared to that of the video sub-group (Fig. 9C). This variation may be due to the under-sizing bias in the video technique, but is more likely to be due to the dredge size-selectivity excluding smaller size classes from capture.

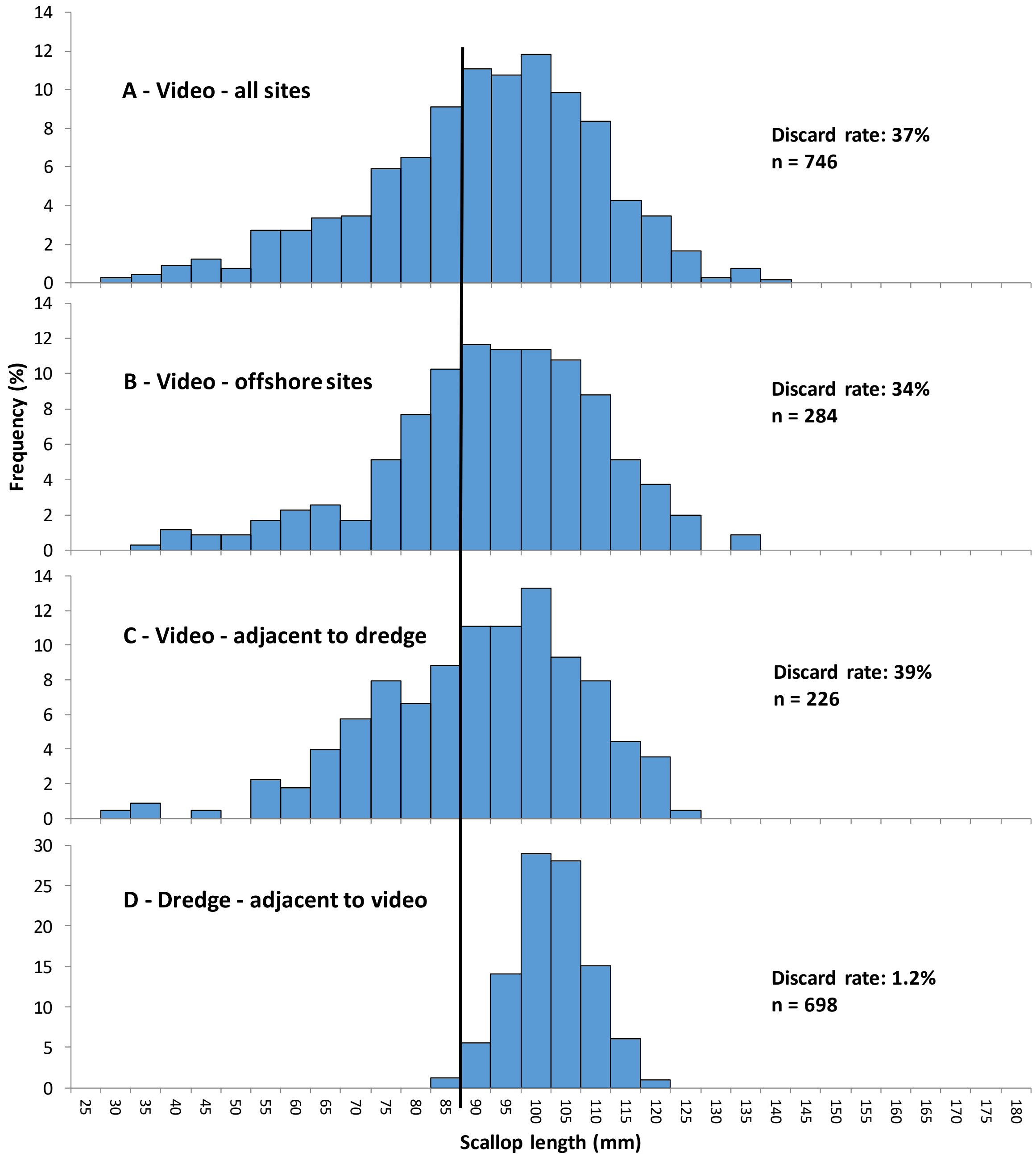

Figure 9: Scallop size structure from all video sites (A) and from offshore video sites (B) (>2km from nearest shoreline). Size structure for comparison between video and dredge surveys is presented in C (video sites adjacent to dredge sites) and D (dredge sites adjacent to video sites) (Fig. 8). Discard rates refer to the proportion of scallops <90mm length The vertical line shows the 90mm minimum legal length.

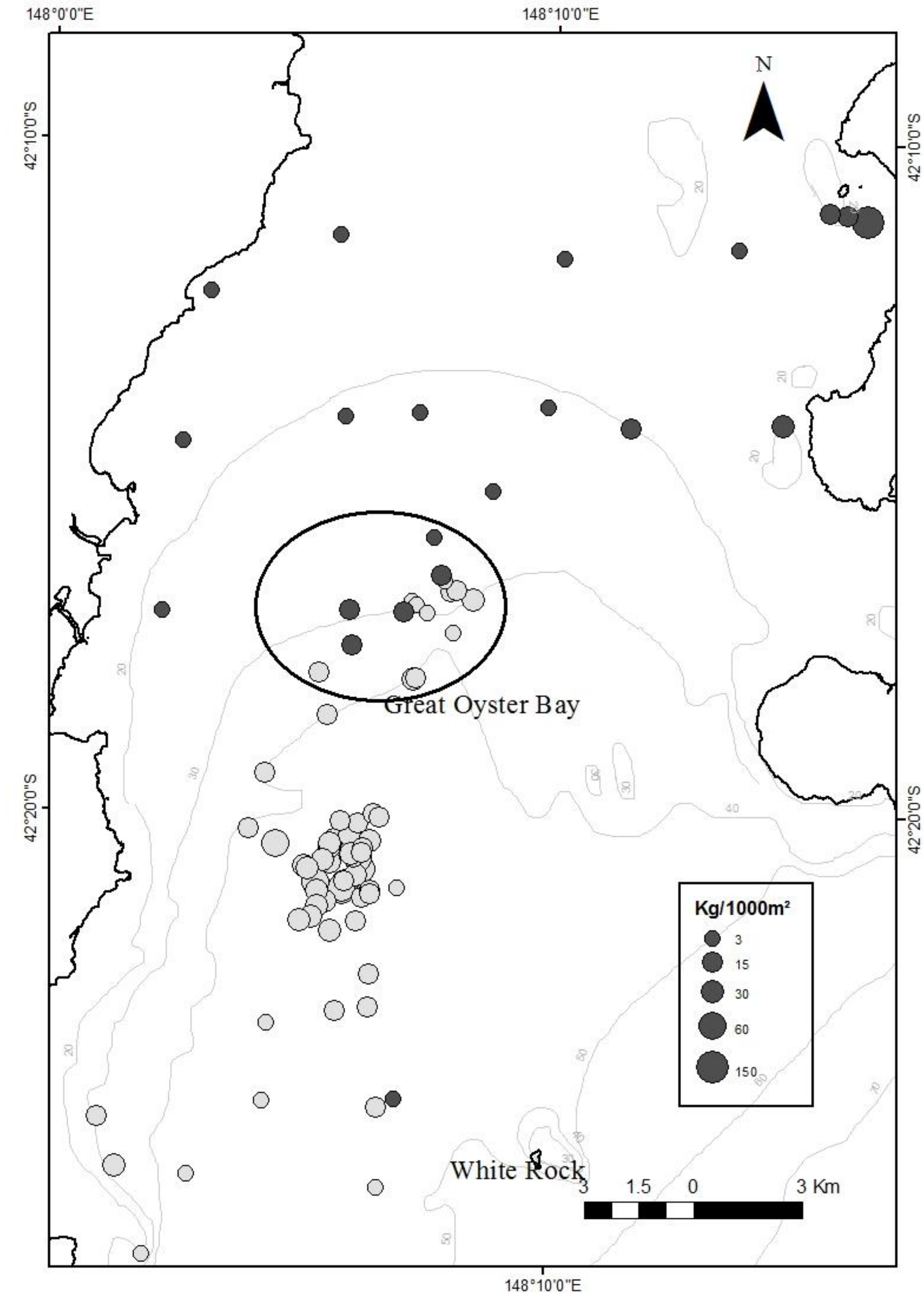

Figure 10: Comparison of video survey (dark circles) and adjusted commercial dredge (light circles) scallop densities. Density is displayed as kg (of scallops >90mm) per 1000m2.

Other taxa

Commercial scallops were the most abundant animals that were consistently identifiable in video footage (Table 2). The other invertebrate taxa present in significant density and across Great Oyster Bay were 11-arm searstars (*Coscinasterias muricata*) (Table 2). Ascideans (probably *Ascidia sydneiensis*), were also present throughout Great Oyster Bay, and particularly in finer sand substrates.

Commercial scallops and 11-arm seastars often co-occurred, however their abundance by site was not significantly correlated (P < 0.001) (Fig. 11).

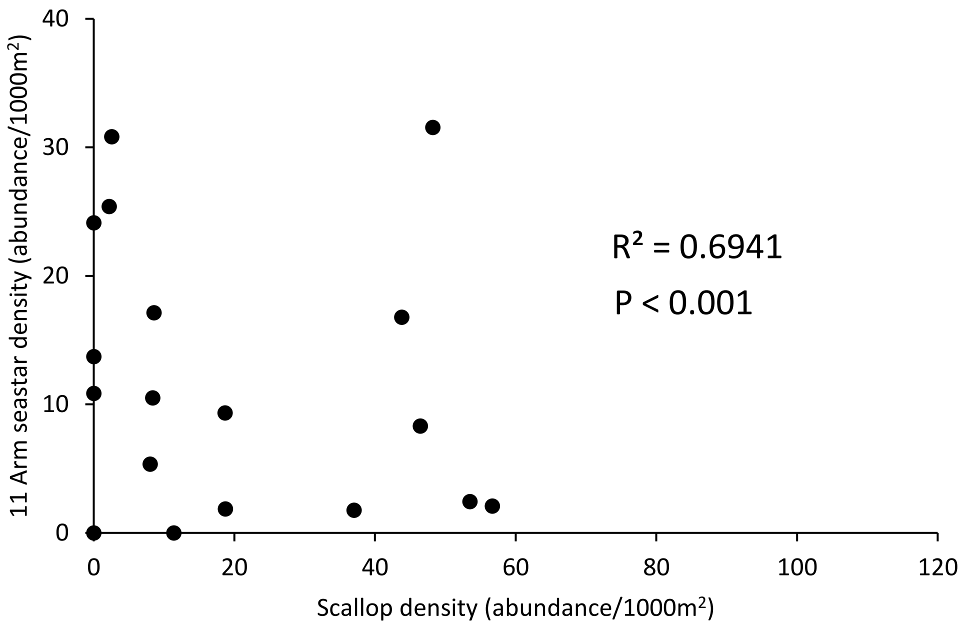

Figure 11: Scatter-plot of scallop density against 11 arm seastar abundance by site. This correlation is not statistically significant (t-test P < 0.001).

Table 2: Abundance of invertebrate taxa encountered in video footage from Great Oyster Bay.

Category	Common Name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Bivalves	Commercial Scallop	*Pecten fumatus*	8	26	47	95	21	54	2	0	9	4	10	196	189	54	23	1	3	0	0	0	4	**746**
	Queen Scallop	*Equichlamys bifrons*												21	85	1	1							**108**
	Doughboy scallop	*Mimachlamys asperrimus*												3										**3**
	Mud Oyster	*Ostrea angasi*												7										**7**
Crustaceans	Spider Crab	*Leptomithrax gaimardii*									2		1	9										**12**
Seastars	11-Arm Seastar	*Coscinasterias muricata*	4	17	18	17	1	2	23	13		8	1	7	15	3	1	12	2	4		8	5	**161**
	Granular seastar	*Uniophora granifera*														3	2	5						**10**
Fish	Greenback Flounder	*Rhombosolea tapirina*					1																	**1**
	Longfin pike	*Dinolestes lewini*										100												**100**
	Sand flathead	*Platycephalus bassensis*		1		1			2	1	5	1		4			2	1			1	4	7	**30**
	Lachet	*Lepidotrigla vanessa*									2													**2**
	Shaw's Cowfish	*Aracana aurita*						1																**1**
Sharks skates and rays	Tasmanian Numbfish	*Narcine tasmaniensis*				2		1			1													**4**
	Carpet shark	*Parascyllium sp.*							1		1													**2**
	Melbourne skate	*Dipturus whitleyi*									1													**1**
	Banded Stingaree	*Urolophus cruciatus*	1					2			1													**4**
Marine mammals	Aus. fur seal	*Arctocephalus pusillus*									1													**1**
Total abundance			**13**	**44**	**65**	**115**	**23**	**60**	**28**	**14**	**23**	**113**	**12**	**247**	**289**	**61**	**29**	**19**	**5**	**4**	**1**	**12**	**16**	**1193**

Conclusions

The video survey work conducted in Great Oyster Bay in May 2017 concluded there are no large scale, high density, commercial scallop (*Pecten fumatus*) beds north of the commercially fished area. Rather, scallops are present in low density, decreasing in abundance with shallowing depths, away from the fished area, with the exception of isolated high-density patches in close proximity to the Freycinet Peninsula coast.

The ground-truthing survey indicated that the towed video method yields accurate scallop density estimates and explains the conformance of this video survey data to the pre-season dredge survey densities. Despite exhibiting some biases in scallop size structure estimates, video surveys are likely to provide a more informative indication of the stock composition than dredge surveys, which are compromised by significant size biases due to gear selectivity and efficiency. Further, these dredge biases are likely to vary with changes in scallop density.

Fishery-independent video surveys techniques are a highly cost-effective, low impact alternative to commercial dredge surveys for pre-season scallop assessment and will provide a more informative indication of stock structure.

References

Ewing, G., Lyle, J. 2017. D'Entrecasteaux Channel scallop survey and stock status update: 2017. Institute for Marine and Antarctic Studies Report. University of Tasmania, Hobart.

Semmens, J.M., Ovenden, J.R., Jones, N.A.R., Mendo, T.C., Macbeth, M., Broderick, D., Filardo, F., Street, R., Tracey, S.R., Buxton, C.D., 2015. Establishing fine-scale industry based spatial management strategies for the commercial scallop in south east Australia, Fisheries Research and Development Corporation Final Report, Project Number 2008/022. Institute for Marine and Antarctic Studies, University of Tasmania.