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Fish assemblages on reefs in the Hunter Marine Park and adjacent waters

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Project D3- Preparing for and implementing monitoring of CMR's and the status of marine biodiversity assets on the continental shelf

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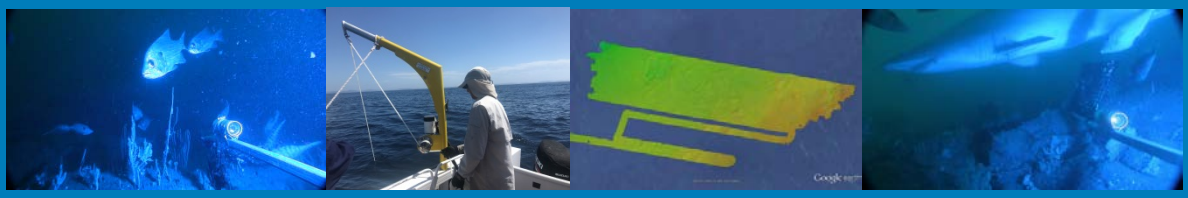
Milestone 9 – Completion of initial survey report from Hunter Marine Park (2017)



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EXECUTIVE SUMMARY

Rocky reefs form an important habitat on Australia's continental shelf and are recognised as a Key Ecological Feature (KEF) in the Marine Bioregional Plans of which developing the Australian Marine Parks was one objective. Despite the national significance of rocky habitat on Australia's continental shelf, very little is known about these systems beyond their value to the fishing industry.

The Hunter Marine Park (HMP) located in the Temperate East management zone is situated between Port Stephens and Foster in New South Wales. The HMP is unique in that it borders the State-managed Port Stephens – Great Lakes Marine Park (PSGLMP), with the HMP extending from the state waters boundary at 3 nm offshore to across the continental shelf. Earlier research has revealed areas of reef in 80-100 m of water (mesophotic zone), within the HMP, although very little is known about the fish assemblages that inhabits reefs at these depths in this region.

Stereo baited remote underwater video (stereo-BRUV) was used to sample the fish assemblages and benthic habitats on rocky reefs within the HMP and PSGLMP. To date we have completed three of the four intended surveys from 2016 to 2018. Preliminary results have shown that the fish assemblages of mesophotic rocky reefs are different to those which were recorded on shallower reefs in the PSGLMP. Despite this significant difference there were some similarities. This included a similar relative abundance of fishery-targeted species in the HMP when compared to the shallower sites within the PSGLMP.

This milestone report outlines the surveys undertaken in the HMP and adjacent reefs in the PSGLMP in 2016 and 2017.

1. INTRODUCTION

The Hunter Marine Park (HMP) is located within the Temperate East region and covers an area of 6,857 km^2, with an area of 1,307 km^2 (19 %) on the continental shelf (<200 m; Monk et al 2017). The HMP is continuous with a section of the Port Stephens-Great Lakes Marine Park (PSGLMP) at the State coastal waters boundary. To date, approximately 19 % of the shelf region has been mapped at high resolution. These data have been derived from both RV Southern Surveyor acoustic transects, and more recently, swath acoustic surveys as part of the NESP Marine Biodiversity Hub D3 project (Davies et al. 2016). Mapping of the distribution of shelf rocky reefs has allowed targeted surveys of the rocky reef assemblages within the Hunter Marine Park. Previous benthic surveys in the HMP have been conducted as part of the monitoring program with the PSGLMP, where sites in Commonwealth waters have been used as control sites (Jordan et al. 2011).

Anecdotal evidence from the ocean trap and line commercial fishery suggests that there are expanses of reef within the HMP, which is supported by Davies et al (2016). This reef is within the mesophotic zone, which is characterised by middle to low levels of light (Baker et al. 2016, Tuner et al. 2017). To date, much of the research on rocky reefs on the inner shelf in this region has been focused in the depths <30 m, reflecting the use of SCUBA and the targeting of reefs in the PSGLMP (Harasti et al. 2016). The identification of adjacent mesophotic reefs highlighted the need to evaluate the benthic assemblages on these reefs within the HMP in order to better understand the environmental assets in the marine park, but also to establish a baseline of information that could be used to assess changes through time.

This study, conducted during 2017 as part of the MBH D3 project, used stereo-baited remote underwater video (stereo-BRUVs; Langlois et al. 2006, 2018, Cappo et al. 2007) to quantify the spatial distribution and relative abundance of benthic fish assemblages. The BRUV imagery was also evaluated in order to provide a preliminary measure of habitat structure and composition. The NSW DPI marine park monitoring program provides complementary data on shallow reefs (20-30 m) directly adjacent to the HMP. Therefore this study had two main aims, with this milestone report providing details of the progress of the 2017 surveys:

1. To quantify the fish assemblages on mesophotic reefs in the HMP and compare with reefs located in the adjacent PSGLMP.

2. To describe the benthic habitat structure and composition within the HMP.

2. METHODS

Surveys of fish assemblages within the HMP were limited to areas that had been previously mapped by Jordan et al. (2011) and Davies et al. (2016) (Figure 1), or were part of other monitoring surveys in the PSGLMP region. The area of mapped reef within the HMP is limited, and therefore additional mesophotic reef sites were also selected from mapped reef within the PSGLMP. These sites were within 2 km of the boundary of the HMP, and are likely to be part of a continuous reef system. To allow for a direct comparison of the fish assemblage composition and abundance on inshore shallower reefs (20-30 m) we used data collected from the NSW DPI marine parks monitoring program (Figure 1b).

Mesophotic reef sampling sites were randomly chosen using randomly selected grid references and a 1x1 km grid overlay on swath acoustic data (Figure 1b). Each site consisted of four replicate stereo baited remote underwater video (stereo-BRUV see below) deployments that were selected using 200x200 m grid to ensure each replicate was spatially independent. These methods are the same that are used for the statewide marine park monitoring program. Given the small area of reef that has been mapped and the 200 m separation between stereo-BRUV deployments, there was almost 100 % coverage of rocky reef. GPS coordinates were extracted using ArcGIS. If in the field a replicate was located over an area of soft sediment it was moved to the nearest adjacent area of reef.

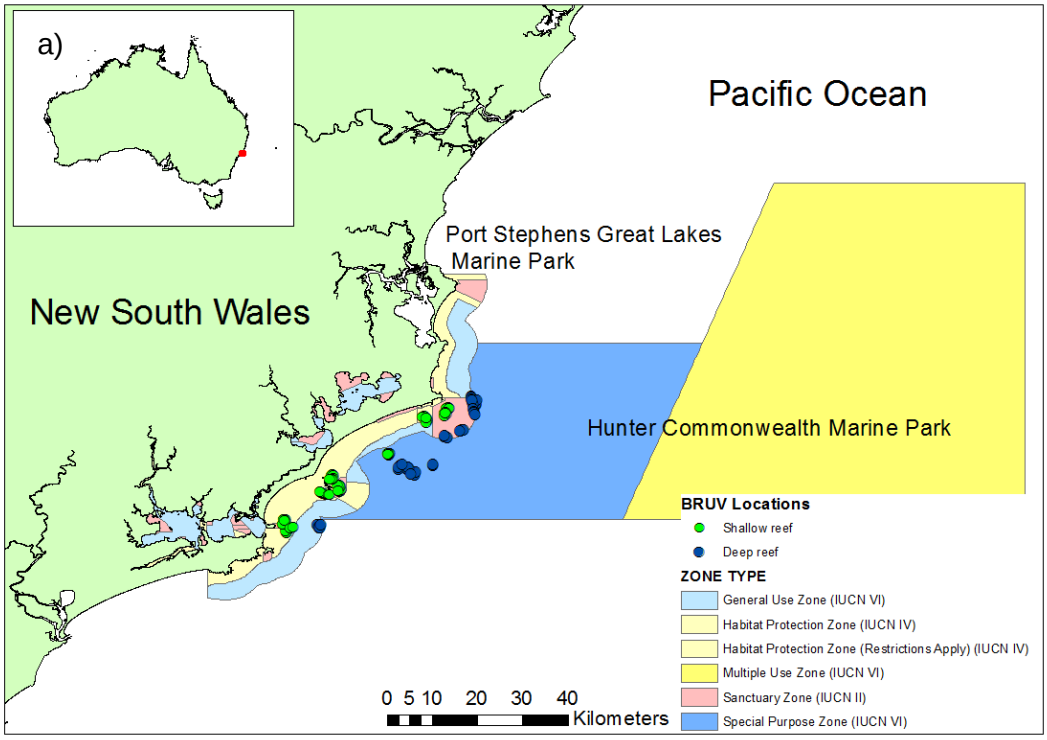
2.1 Sampling Fish Assemblage: Stereo Baited Remote Underwater Video (Stereo-BRUV)

Stereo baited remote underwater video (stereo-BRUV) was used to sample the fish assemblages targeting both mesophotic reefs (80-110 m) and shallow reefs (20-40 m). A deployment was considered successful if the stereo-BRUV landed on or immediately adjacent to rocky reef structure, and when both the reef/benthos and water column could be viewed clearly. In spring 2016, 13 successful deployments were conducted on mesophotic reef within the Hunter Marine Park (HMP) special purpose zone (IUCN VI), 22 on mesophotic reef within a Port Stephens – Great Lakes Marine Park (PSGLMP) sanctuary zone (IUCN II) and four successful deployments of mesophotic reef outside all marine parks. All shallow reef deployments were located within the PSGLMP (IUCN IV n=30, IUCN II n=24), with the exception of eight deployments that occurred at Outer Gibber, a shallow patch reef (28-40 m) located within the HMP. Outer Gibber has been used as an outside reference site for the ongoing PSGLMP monitoring program. A list of species that have been observed at Outer Gibber since it was first sampled with stereo-BRUVs is presented in Appendix Table 1A.

Each stereo-BRUV unit consisted of two Canon HG21 video cameras each with a wide angle lens housed in two custom made SeaGIS Pty Ltd housings (http://www.seagis.com.au). Approximately one kilogram of pilchard (*Sardinops* sp.) was crushed in a plastic mesh bait bag and attached to the stereo-BRUV frame using 1.5 m long PVC pole. Due to the low light levels at depths >80 m a Raytech subsea light was mounted to the centre of each stereo-BRUV frame. Blue light was used as the 450-465 nm wavelength is thought to be below the spectral sensitivity range of many fish species and therefore likely to have minimal effect on the fish assemblage and its associated behaviour (Fitzpatrick et al. 2013). On occasion,

white light was used to confirm identifications of fish species and to collect qualitative habitat type data.

Stereo-BRUVs were deployed for a period of 60 minutes as recommended by the NESP Marine Biodiversity Hub field manuals (Langlois et al. 2018). However, the first 30 and 60 minutes of each video was analysed. This is to allow for direct comparisons with data collected from the PSGLMP monitoring program which uses 30 minute deployments. The 30 minute deployments were consistent with soak time that has been assessed as being optimum and cost effective (Harasti et al. 2015).



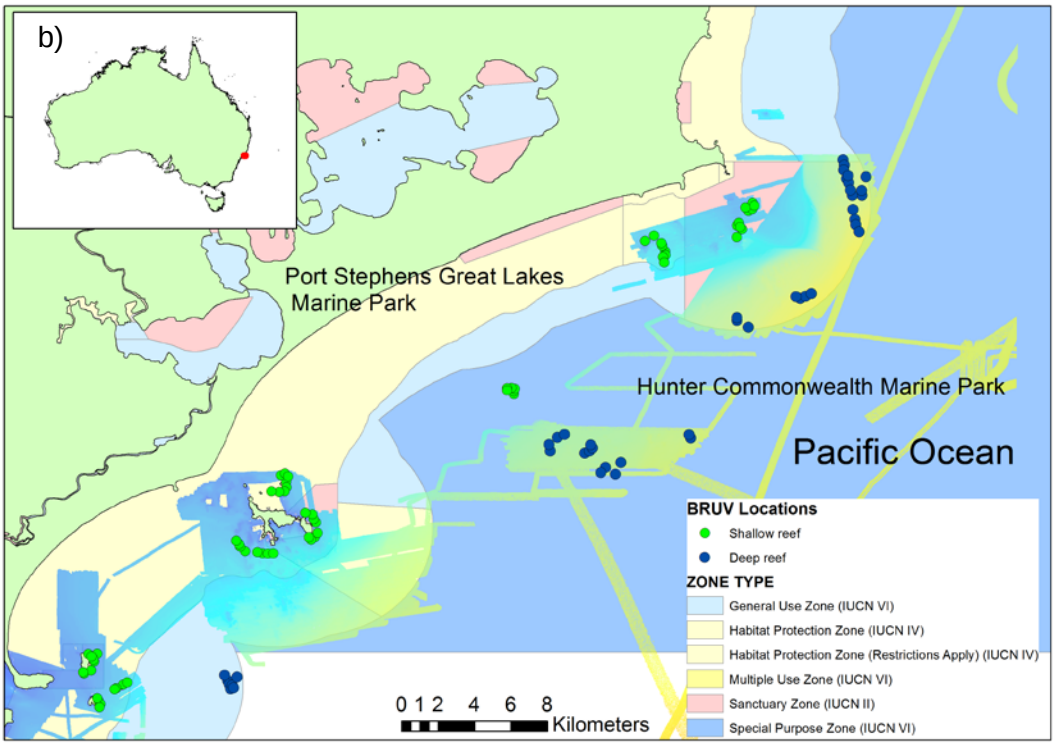


Figure 1. a) Map of the Hunter Marine Park in relation to the Port Stephens – Great Lakes Marine Park. b) Locations of the stereo-BRUV deployment sites. Blue dots represent stereo-BRUV locations at mesophotic rocky reef within and near the Hunter Marine Park and green dots represent sites sampled as part of the NSW DPI marine park monitoring program. The bathymetric data collected by the RV Southern Surveyor and Davies et al (2016) is overlayed as the blue to yellow shading.

Video collected by stereo-BRUVs was scored using standard metrics including scoring relative abundance (MaxN) as the maximum number of fish occurring in any one frame for each species. MaxN is now widely accepted as the best method for estimating relative abundance from video footage (Cappo et al. 2007). All fish were identified to the lowest taxonomic level possible, ideally species level. All stereo-BRUV video analysis and scoring was done using the software EventMeasure (www.seagis.com). The video footage was also used to categorise the dominant substrate type (reef, sediment etc.) and habitat type (algae dominated, invertebrate dominated etc.) as factors in an attempt to relate species and species assemblage data to the environment and habitat. In most cases the habitat classes were at a higher level than the CATAMI class of biota as they represented groupings of all sessile invertebrates. See Table 1 for a description of each substrate and habitat type.

2.2 Data analysis

The Spatial Analyst tool and Benthic Terrain Modeller add-on in ArcGis v10.3.1 were used to analyse the cleaned bathymetric data. A 50 m and 100 m radius buffer around each individual stereo-BRUV was used to calculate the mean, standard deviation and range for relief, rugosity, ruggedness, curvature and slope. The 200 m separation between each stereo-BRUV deployment ensured there was no overlap in buffer distances. Pearson's correlation was used to assess data obtained from the 50 m and 100 m radius for correlation between the two buffer distances.

Redundancy analysis (RDA) was used to relate habitat, substrate and reef structure to the species assemblage. RDA is related to principal components analyses (PCA) and is based on Euclidean distance, implying that each species is an axis orthogonal to all other species, and sites are points in this multidimensional space. All species were Hellinger transformed before using a forward stepwise model selection using the same explanatory variables that were used in the below mentioned GAMMs. Permutation tests were used to test for the statistical significance of each marginal term. A triplot was used to visually determine and display the strength of the relationship between species assemblages and the environmental gradients that were driving the variation in species assemblage between stereo-BRUV deployments.

To investigate the spatial distribution of the fish assemblage across shallow and mesophotic reefs we used generalised additive mixed models (GAMMs). A suite of response variables was chosen a priori and these included species richness, total relative abundance, the most speciose families (Labridae, Monocanthidae and Carangidae) and species that are either abundant or are harvested (pink snapper *Chrysophrys auratus*, blue morwong *Nemadactylus douglasii*, silver trevally *Pseudocaranx georgianus* and velvet leatherjacket *Meuschenia scaber*). We also modelled the relative abundance of all recreationally and commercially targeted species pooled together. Recreationally targeted species were determined by the New South Wales recreational fishing survey report to establish species that were highly caught and retained (West et al. 2015), while commercially targeted species were selected from the ocean trawl fishery assessment report (New South Wales Department of Primary Industries 2017a) and the ocean trap and line fishery assessment report (New South Wales Department of Primary Industries 2017b). A complete list of explanatory variables and their descriptions can be found in Table 1. Site, a cluster of four stereo-BRUV deployments, was used as the random factor.

Table 1. Description of factors used in both GAMM and RDA modelling.

Factor	Level / Range	Description
Depth	Shallow	BRUV depth 20-40 m
	Mesophotic	BRUV depth 80-110 m
Fished	Fished	Fishing allowed
	No-take	No fishing allowed
Substrate	Consolidated	100 % reef in view
	Mixed	>50 % reef, <50 % sediment
	Unconsolidated	>50 % sediment, <50 % reef
Habitat	Algae	Dominant habitat type is algae
	Algae sediment	Dominant habitat type is algae with sediment in view
	Invertebrates	Sessile invertebrate are dominant
	Invertebrates sediment	Sessile invertebrates are dominant with sediment in view
	Barrens	Urchin barrens, no algae, no sessile invertebrates
	Sediment	Field of view dominated by sediment
Latitude	-32.44 - -32.71	The latitude of each BRUV deployment.
Relief	1.3 - 29.1	The range in bathymetry in the 50 m radius around each BRUV calculated in Spatial Analyst ArcGis
Rugosity	0.0 - 0.5	Arch-chord ratio rugosity index for the 50 m radius around each BRUV calculated in Spatial Analyst ArcGis
Slope	3.6 - 43.6	The rate of change in bathymetry for the 50 m radius around each BRUV calculated in Spatial Analyst ArcGis

3. PRELIMINARY RESULTS AND DISCUSSION

The fish assemblages of the Hunter Marine Park have been sampled on three of the planned four time periods. This includes spring 2016, autumn 2017 and spring 2017. The fourth and final survey period will be completed in autumn 2018 (Table 2).

Table 2. Stereo-baited remote underwater video fieldwork to publication progress for sampling the Hunter MP. The n refers to the number of successful stereo-BRUV deployments during that time period within the Hunter MP or immediately inside the 3 nm state boundary.

Period	Fieldwork	Video processing	Data analysis	Write up / publication
Spring 2016	Completed (n = 43)	Completed	Completed	February 2018
Autumn 2017	Completed (n=50)	February 2018	June 2018	June 2019
Spring 2017	Completed (n=38)	March 2018	June 2018	June 2019
Autumn 2018	April 2018	July 2018	December 2018	June 2019

A total of 107 stereo-BRUVs were successfully completed in spring 2016, with 64 deployments on the shallow reef and 43 deployments on the mesophotic reefs (Table 3). A total of 7,368 individuals (sum of MaxN) from 96 species, representing 53 families were recorded (Table 3, Figure 2 and Appendix B). A total of 79 species were recorded on shallow reef, of which 49 species were unique to the shallow reef (Table 3, Figure 2 and Appendix A). A total of 47 species were recorded on mesophotic reef, of which 17 species were unique to these reefs (Table 3 and Appendix C). Thirty species were found to occur on both shallow and mesophotic reef (Table 3 and Appendix B).

Table 3. A summary of the number of stereoBRUV and species compositions recorded from stereo-BRUV deployed on inner and outer-self reef. The number of rare species equates to species that were seen on less than 3 occasions. Unique species are species there were only observed on deployments within region.

	Shallow (20-40 m)	Mesophotic (80-110 m)
No. of BRUV deployments	64	43
Species richness (SR)	79	47
Mean SR (± SE) per BRUV	19(0.48)	9(0.47)
Family richness	42	35
No. rare species	26	17
No. of species unique to shelf region	49	17

Labridae and Monacanthidae were the most speciose families with nine species each, equating to 19% of the total species richness. On the shallow reefs, *Ophthalmolepis lineolatus* was the most ubiquitous species being recorded on 100% of deployments, followed by *Notolabrus gymnogenis* 94% and *Chrysophurs auratus* 92% of deployments. In comparison, on mesophotic reefs *Centroberyx affinis* was the most ubiquitous species that was recorded on 74% of deployments, followed *by Nemodactylus douglasii* on 72%, and *Trachurus novaezelandiae* on 60% of deployments. Two nationally protected species, *Epinephelus daemelii* and *Carcharias taurus* were also observed on the shallow reef deployments. Examples of the fish assemblages recorded using stereo-BRUVs on reef habitats on the mesophotic reefs is presented in
Figure 3.

Species that are actively targeted and highly retained by both recreational and commercial fishers showed a relatively equal distribution and similar relative abundances across both shallow and mesophotic reefs (Figure 4). Habitat, rugosity and slope best described the variability between sites. Reef dominated by algae and reef edge habitats had the highest abundance of fishery targeted species. While there was a strong positive relationship between fishery targeted species and reef rugosity there was a weak negative relationship with slope.

Other species that were recorded in very low numbers but are of interest included:

- Tiger shark, *Galeocerdo cuvier*
- Sawshark, *Pristiophorus cirratus*
- Teraglin, *Atractoscion aequidens*
- Banded rock cod, *Epinephelus ergastularius*
- Conger eel, *Conger verreauxi*
- Eastern rock lobster, *Sagmariasus verreauxi*

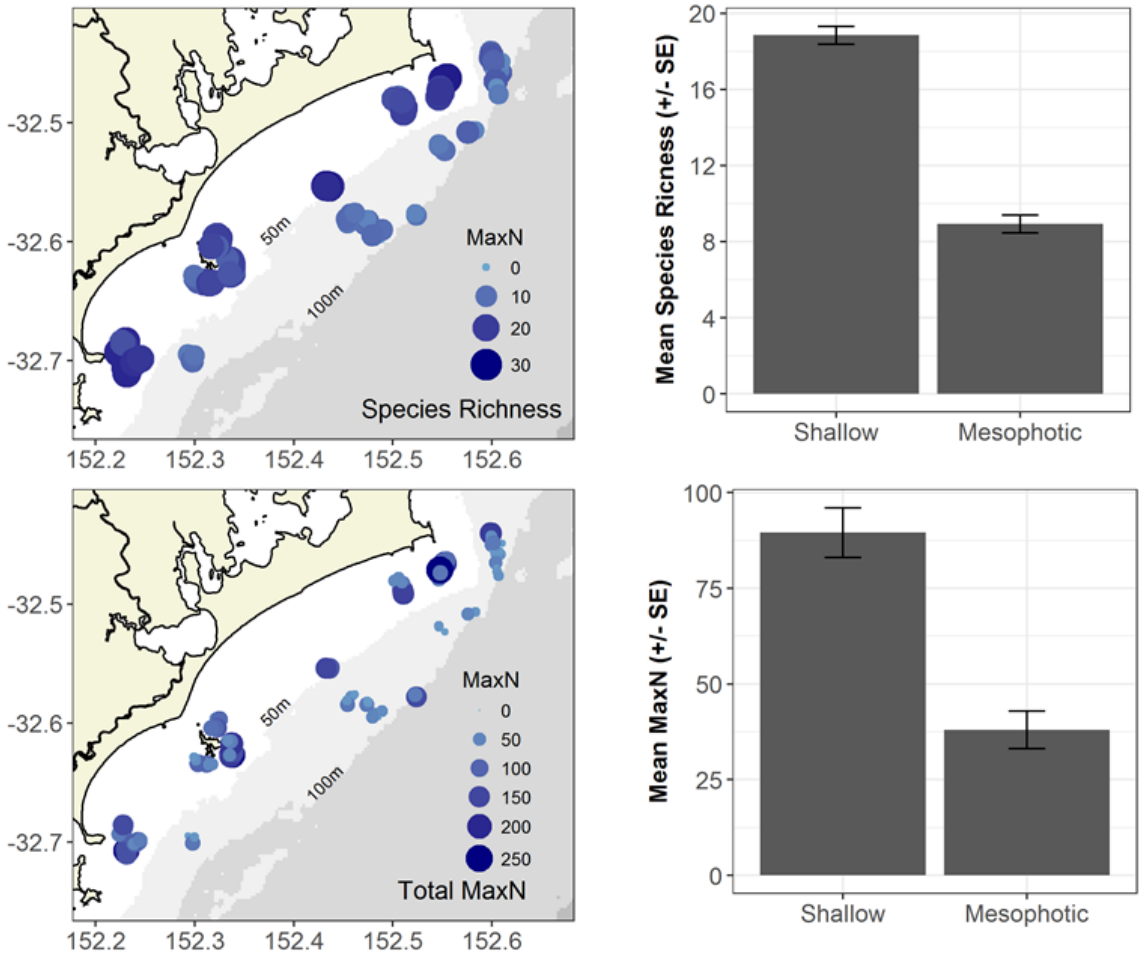


Figure 2. Top left: Distribution of species richness as observed by stereo-BRUVs across the study area. Bubble size and colour represents the species richness for each individual stereo-BRUV deployment. Top right: Mean (+/- SE) species richness across shallow and mesophotic reef. Bottom left: Distribution of total MaxN as observed by stereo-BRUVs across the study area. Bubble size and colour represents the total MaxN for each individual stereo-BRUV deployment. Top right: Mean (+/- SE) total MaxN across shallow and mesophotic reef.

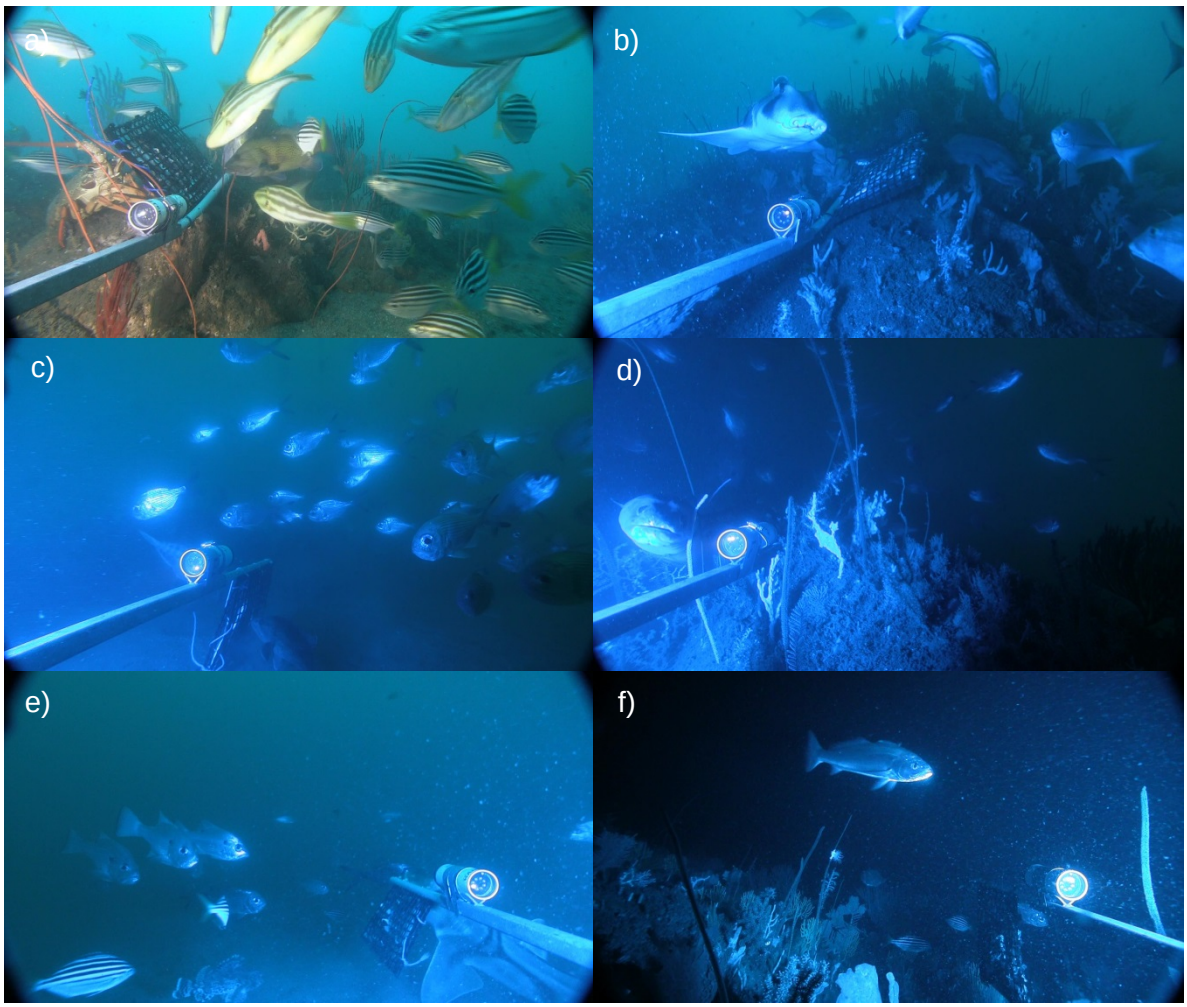


Figure 3. Examples of the fish assemblages recorded using stereo-BRUV on reef habitats in 80-100 m of water in the Hunter Marine Park. a) An example of mado (*Atypichthys strigatus*) and ocean leatherjacket (*Nelusetta ayraudi*). b) An example of Port Jackson shark (*Heterodontus portusjacksoni*) and silver sweep (*Scorpis lineolata*). c) An example of a school of nannygai (*Centroberyx affinis*) and an eastern wirrah (*Acanthistius ocellatus*). d) A conger eel (*Conger verreauxi*) and a school of nannygai (*Centroberyx affinis*). e) An example of a school of pearl perch (*Glaucosoma scapulare*), mado (*Atypichthys strigatus*), and Port Jackson shark (*Heterodontus portusjacksoni*). f) An example of a teraglin (*Atractoscion aequidens*).

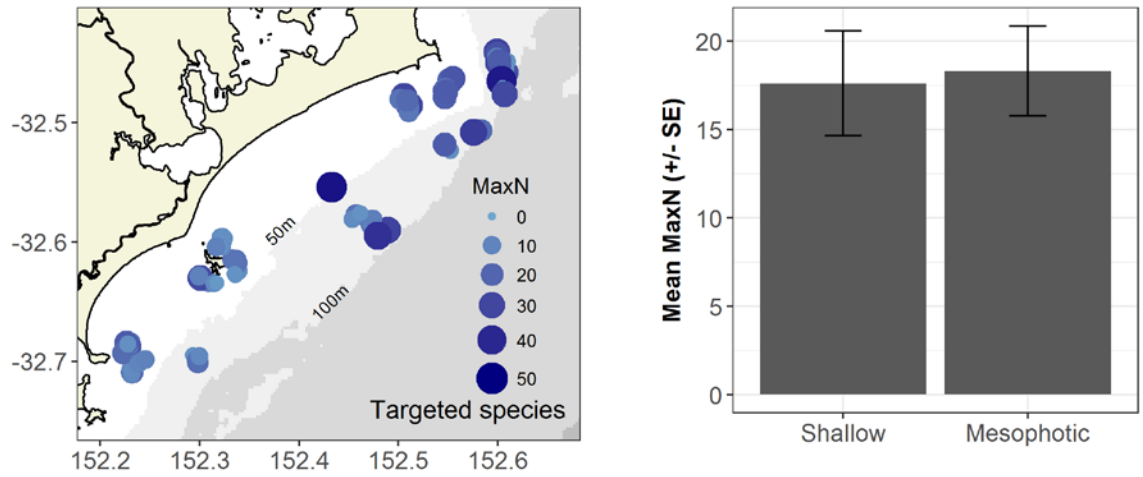


Figure 4. left: Distribution of all targeted species as observed by stereo-BRUV across the study area. Bubble size and colour represents the total MaxN for each individual stereo-BRUV deployment. Right: Mean (+/- SE) all target species across shallow and mesophotic reef.

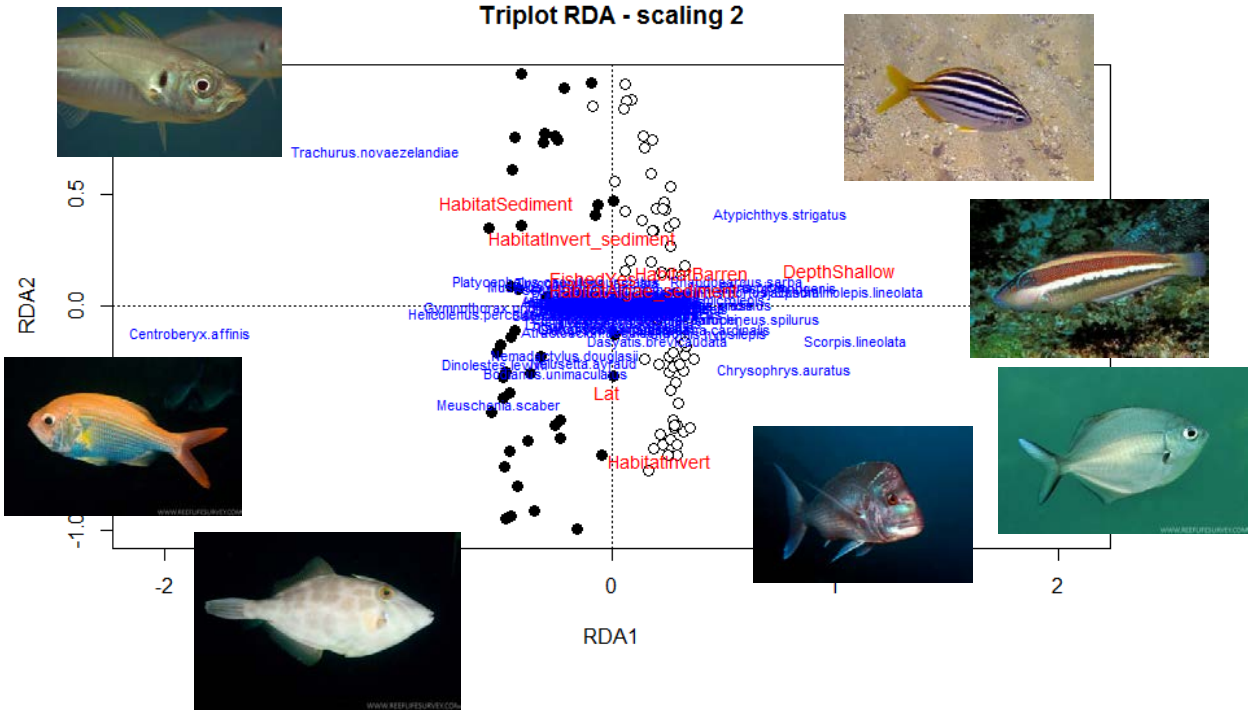


Figure 5. An RDA triplot ordination of transformed relative abundance data constrained by depth, latitude, marine park zoning and habitat. Filled circles represent mesophotic reef BRUV deployments and open circles represent shallow reef BRUV deployments.

This study has demonstrated that stereo-BRUV is a useful tool for collecting fish assemblage and habitat data on mesophotic reefs, particularly for the collection of baseline data for the HMP. Overall, both MaxN and species richness on reefs within the HMP were less than half of those on shallow reefs within the PSGLMP. From the preliminary results we have demonstrated that the fish assemblages on mesophotic reefs are uniquely different to the adjacent shallow reefs located within the PSGLMP, including those sites in the HMP (Figure 5). However, there are some distinct similarities including the fact that a similar relative abundance of fishery targeted species occur on both shallow (PSGLMP) and mesophotic reef (HMP). These results demonstrate the importance of mesophotic reefs to fishery targeted species and therefore have implications for informing the management of these fishery resources on shelf rocky reefs.

There was also no obvious spatial pattern in the distribution of abundance and richness parameters on the mesophotic reefs, although further assessment of the differences in fish assemblages on such reefs in the HMP will require further sites to be surveyed.

Further investigation is needed to determine if there is temporal variation in the fish assemblage at mesophotic depths. Hence, sampling is being conducted in autumn (warm water period) and spring (cold water period) over two years. There is also a need to investigate fine scale habitat structure and complexity by quantifying habitat using the imagery from the stereo-BRUVs and analysis of the swath acoustic bathymetry. This includes filling in the gaps by mapping stereo-BRUV sites that currently do not have any bathymetric data.

The current surveys have provided preliminary information that could support the development of a coordinated monitoring program across PSGLMP and the HMP. The PSGLMP monitoring program uses stereo-BRUVs to sample the fish assemblages during winter in two consecutive years, every four years. The data collected from this study will need to be used to establish if there is adequate power to detect change from ~50 stereo-BRUV deployments within the HMP. It should also be noted that the additional bathymetry data that is to be collected within the HMP in autumn 2018 will identify other potential reef locations. This would allow the expansion of the spatial coverage of this study to assess spatial variation in the fish assemblages of the HMP. We also recommend incorporating other technologies; such as remotely operate vehicles (ROVs), as a complementary tool to survey fish assemblages in the HMP. ROVs have the ability to survey passively and collect data on some species that are not captured using stereo-BRUVs. This is important if an aim of the monitoring program is to assess changes in the diversity of fish assemblages.

4. OUTPUTS

Joel Williams presented these results at the Indo Pacific Fish Conference in October 2017. The data and findings from the 2016 surveys are currently being prepared for publication. This paper is currently titled ‘Taking a deeper look: Quantifying the differences in fish assemblages between shallow and mesophotic temperate rocky reefs’. It is expected this manuscript will be finalised for submission by mid-2018. A second publication using two years of BRUVs data will focus on disentangling the patterns observed in 2016 while adding a temporal component. Results of this study will also be presented as an oral paper at the 2018 Australian Marine Sciences Association Conference in July 2018.

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APPENDIX A

A summary of the relative abundance (mean MaxN) of fishes recorded on stereo BRUV deployments from 2011 to 2016 at Outer Gibber, a reference site for the Port Stephen Great Lakes Marine Park monitoring program that is located within the Hunter AMP as undertaken by the Department of Primary Industries NSW.

			Mean MaxN			
Family	**Species name**	**Common name**	**2011**	**2013**	**2015**	**2016**
Acanthuridae	*Prionurus microlepidotus*	Australian sawtail	0.5	2.0	0.4	0.7
Aplodactylidae	*Aplodactylus lophodon*	Rock cale	0.2	0.1	0.1	0.0
Aulopidae	*Aulopus purpurissatus*	Sergeant baker	0.3	0.5	0.5	0.3
Berycidae	*Centroberyx affinis*	Nannygai	5.3	0.1	0.0	0.7
Brachaeluridae	*Brachaelurus waddi*	Blind shark	0.2	0.0	0.0	0.0
Callanthiidae	*Callanthias australis*	Splendid perch	0.5	0.0	0.3	0.7
Carangidae	*Caranx sexfasciatus*	Bigeye trevally	0.0	1.0	0.0	0.0
	Pseudocaranx dentex	Silver trevally	1.0	8.4	4.3	8.2
	Seriola hippos	Samsonfish	0.0	0.3	0.0	0.0
	Seriola rivoliana	Amberjack	0.2	0.0	0.0	1.2
	Trachurus novaezelandiae	Yellowtail scad	32.8	5.8	2.3	8.8
Chaetodontidae	*Amphichaetodon howensis*	Lord Howe Isd. Butterflyfish	0.0	0.4	0.0	0.0
	Chaetodon guentheri	Gunthers butterflyfish	0.0	0.1	0.3	0.0
	Chelmonops truncatus	Eastern Talma	0.3	0.3	0.3	0.3
Cheilodactylidae	*Cheilodactylus fuscus*	Red morwong	1.5	4.8	6.6	0.8
	Nemadactylus douglasii	Blue morwong	1.3	0.6	0.9	0.8
Dasyatidae	*Dasyatis brevicaudata*	Smooth stingray	0.2	0.0	0.3	0.3
Dinolestidae	*Dinolestes lewini*	Longfin pike	0.7	0.3	2.0	1.0
Enoplosidae	*Enoplosus armatus*	Old wife	1.3	1.6	0.5	0.7
Glaucosomatidae	*Glaucosoma scapulare*	Pearl perch	0.0	0.0	0.1	0.0
Heterodontidae	*Heterodontus portusjacksoni*	Port Jackson shark	2.0	1.0	0.5	1.2
Kyphosidae	*Atypichthys strigatus*	Mado	55.0	33.1	37.6	35.3

Family	Species name	Common name	Mean MaxN			
			2011	2013	2015	2016
	Girella elevata	Rock blackfish	0.0	0.0	0.1	0.0
	Kyphosus sydneyanus	Silver drummer	0.2	0.1	0.0	0.0
Labridae	*Labridae sp*	Wrasse	0.2	0.0	0.0	0.0
	Achoerodus viridis	Eastern blue groper	0.8	0.9	0.9	0.7
	Bodianus unimaculatus	Pugfish	0.0	0.1	0.0	0.0
	Coris picta	Comb wrasse	1.3	0.6	1.4	1.8
	Coris sandeyeri	Sandager's wrasse	0.0	0.0	0.0	0.2
	Notolabrus gymnogenis	Crimsonband wrasse	0.8	0.8	0.9	0.8
	Ophthalmolepis lineolatus	Southern maori wrasse	3.0	3.4	2.9	3.8
	Pseudolabrus luculentus	Orange wrasse	0.3	0.4	0.0	0.5
Latridae	*Latridopsis forsteri*	Bastard trumpeter	0.0	0.0	0.1	0.0
Monacanthidae	*Eubalichthys bucephalus*	Black reef leatherjacket	0.3	0.0	0.0	0.0
	Eubalichthys mosaicus	Mosaic leatherjacket	0.3	0.1	0.4	0.0
	Meuschenia freycineti	Sixspine leatherjacket	1.5	1.6	0.8	0.8
	Meuschenia scaber	Velvet leatherjacket	13.3	13.1	6.8	5.8
	Meuschenia trachylepis	Yellowfin leatherjacket	0.2	0.4	0.3	0.5
	Meuschenia venusta	Stars-and-stripes leatherjacket	0.3	0.1	0.0	0.0
	Nelusetta ayraudi	Ocean leatherjacket	0.5	1.3	0.0	0.5
Moridae	*Lotella rhacina*	Largetooth Beardie	0.3	0.0	0.3	0.0
Mullidae	*Parupeneus spilurus*	Black-spot goatfish	2.2	1.9	5.0	3.5
	Upeneichthys lineatus	Bluestriped goatfish	0.5	0.3	0.4	0.2
Muraenidae	*Gymnothorax prasinus*	Green moray	1.5	0.9	0.8	1.3
	Gymnothorax prionodon	Saw-tooth moray	0.2	0.0	0.0	0.0
Myliobatidae	*Myliobatis australis*	Southern eagle ray	0.0	0.0	0.0	0.2
Odontaspididae	*Carcharias taurus*	Grey nurse shark	0.0	0.1	0.0	0.0
Orectolobidae	*Orectolobus halei*	Banded carpet shark	0.0	0.1	0.1	0.0
	Orectolobus maculatus	Spotted wobbegong	0.2	0.1	0.3	1.3

Family	Species name	Common name	Mean MaxN			
			2011	2013	2015	2016
	Orectolobus sp	Wobbegong	0.0	0.0	0.1	0.0
Ostraciidae	*Anoplocapros inermis*	Eastern smooth boxfish	0.3	0.0	0.0	0.0
Pomacentridae	*Chromis hypsilepis*	One-spot puller	0.7	2.8	0.5	3.5
	Mecaenichthys immaculatus	Immaculate damsel	0.2	0.4	0.0	0.5
	Parma microlepis	White ear	1.2	0.6	1.0	0.7
Pomatomidae	*Pomatomus saltatrix*	Tailor	0.0	1.3	0.0	0.0
Scorpaenidae	*Scorpaena cardinalis*	Eastern red scorpionfish	1.3	1.3	0.5	1.0
Scorpididae	*Scorpis lineolata*	Silver sweep	5.2	5.4	7.8	3.8
Serranidae	*Acanthistius ocellatus*	Eastern wirrah	0.8	0.5	0.3	0.2
	Hypoplectrodes annulatus	Blackbanded seaperch	0.0	0.0	0.0	0.2
	Hypoplectrodes maccullochi	Halfbanded seaperch	0.2	0.4	0.1	0.7
	Hypoplectrodes nigroruber	Banded seaperch	0.2	0.0	0.0	0.0
Sparidae	*Chrysophrys auratus*	Pink snapper	1.8	5.8	7.4	6.3
	Rhabdosargus sarba	Tarwhine	0.7	3.5	3.0	1.8
Sphyraenidae	*Sphyraena sp*	Barracuda	0.0	0.0	0.0	1.7
Tetraodontidae	*Torquigener pleurogramma*	Weeping toadfish	0.0	0.0	0.1	0.0

APPENDIX B

A summary of all species recorded during 106 stereo-BRUV samples on rocky reefs off the Port Stephens coast.

			Shallow Reef				Mesophotic Reef				OVERALL			
Family	Species name	Common Name	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)
Acanthuridae	*Prionurus microlepidotus*	Australian sawtail	16	7	0.9(0.1)	14	0	0	0	0	16	7	0.1(0.7)	8
Aplodactylidae	*Aplodactylus lophodon*	Rock cale	12	2	0.4(0.1)	17	0	0	0	0	12	2	0.1(0.3)	10
Aulopidae	*Aulopus purpurissatus*	Sergeant baker	36	3	0.7(0.1)	45	12	2	0.3(0.5)	26	48	3	0.4(0.6)	37
Berycidae	*Centroberyx affinis*	Nannygai	5	3	0.4(0.1)	5	450	60	10.5(15.2)	74	455	60	4.3(10.8)	33
Brachaeluridae	*Brachaelurus waddi*	Blind shark	8	2	0.4(0.0)	11	0	0	0	0	8	2	0.1(0.3)	7
Callanthiidae	*Callanthias australis*	Splendid perch	4	3	0.4(0.0)	3	0	0	0	0	4	3	0.0(0.3)	2
Carangidae	*Pseudocaranx dentex*	Silver trevally	116	33	4.6(0.6)	63	81	20	1.9(4.0)	35	197	33	1.8(4.4)	51
	Seriola lalandi	Yellowtail kingfish	6	4	0.5(0.1)	5	0	0	0	0	6	4	0.1(0.4)	3
	Seriola rivoliana	Amberjack	10	3	0.5(0.1)	11	0	0	0	0	10	3	0.1(0.4)	7
	Trachurus novaezelandiae	Yellowtail scad	443	138	21.4(2.7)	36	481	130	11.2(24.0)	60	924	138	8.6(22.5)	46
Carcharhinidae	*Carcharhinus sp*	Requiem shark	3	2	0.3(0.0)	3	0	0	0	0	3	2	0.0(0.2)	2
	Galeocerdo cuvier	Tiger Shark	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
Chaetodontidae	*Chaetodon guentheri*	Gunther's butterflyfish	3	2	0.3(0.0)	3	0	0	0	0	3	2	0.0(0.2)	2
	Chelmonops truncatus	Eastern talma	22	2	0.7(0.1)	19	0	0	0	0	22	2	0.2(0.6)	11
Cheilodactylidae	*Cheilodactylus fuscus*	Red morwong	32	3	0.7(0.1)	39	2	1	0.0(0.2)	5	34	3	0.3(0.6)	25
	Cheilodactylus vestitus	Crested morwong	9	1	0.4(0.0)	14	0	0	0	0	9	1	0.1(0.3)	8
	Nemadactylus douglasii	Blue morwong	76	8	1.3(0.2)	73	53	6	1.2(1.2)	72	129	8	1.2(1.3)	73
Chironemidae	*Chironemus marmoratus*	Kelpfish	2	1	0.2(0.0)	3	0	0	0	0	2	1	0.0(0.1)	2
Dasyatidae	*Dasyatis brevicaudata*	Smooth stingray	30	4	0.8(0.1)	31	1	1	0.0(0.2)	2	31	4	0.3(0.7)	20
Dinolestidae	*Dinolestes lewini*	Long-finned pike	48	11	2.0(0.3)	23	55	7	1.3(1.8)	44	103	11	1.0(2.0)	32
Enoplosidae	*Enoplosus armatus*	Old wife	41	15	2.0(0.2)	27	4	1	0.1(0.3)	9	45	15	0.4(1.6)	20
Fistulariidae	*Fistularia commersonii*	Smooth flutemouth	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Gempylidae	*Thyrsites atun*	Barracouta	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
Glaucosomatidae	*Glaucosoma scapulare*	Pearl Perch	10	3	0.5(0.1)	11	7	3	0.2(0.6)	9	17	3	0.2(0.5)	10
Heterodontidae	*Heterodontus portusjacksoni*	Port Jackson shark	116	9	1.6(0.2)	86	4	1	0.1(0.3)	9	120	9	1.1(1.5)	55

			Shallow Reef				Mesophotic Reef				OVERALL			
Family	Species name	Common Name	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)
Kyphosidae	*Atypichthys strigatus*	Mado	1637	178	38.5(4.8)	58	124	40	2.9(7.4)	40	1761	178	16.5(32.1)	50
	Girella elevata	Rock blackfish	14	7	0.9(0.1)	11	0	0	0	0	14	7	0.1(0.7)	7
	Girella tricuspidata	Luderick	166	162	20.2(2.5)	3	0	0	0	0	166	162	1.6(15.7)	2
	Kyphosus sydneyanus	Silver drummer	4	2	0.3(0.0)	5	0	0	0	0	4	2	0.0(0.2)	3
Labridae	*Achoerodus viridis*	Eastern blue groper	49	2	0.6(0.1)	70	0	0	0	0	49	2	0.5(0.6)	42
	Bodianus perditio	Goldspot pigfish	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
	Bodianus unimaculatus	Eastern pigfish	0	0	0	0	20	3	0.5(0.8)	33	20	3	0.2(0.6)	13
	Coris dorsomacula	Pinklined Wrasse	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
	Coris picta	Combfish	132	18	2.7(0.3)	73	0	0	0	0	132	18	1.2(2.3)	44
	Coris sandeyeri	Sandager's wrasse	4	2	0.3(0.0)	5	0	0	0	0	4	2	0.0(0.2)	3
	Notolabrus gymnogenis	Crimsonband wrasse	115	4	0.9(0.1)	94	0	0	0	0	115	4	1.1(1.1)	56
	Ophthalmolepis lineolatus	Southern Maori wrasse	284	10	2.2(0.3)	100	0	0	0	0	284	10	2.7(2.8)	60
	Pseudolabrus luculentus	Luculent wrasse	10	2	0.5(0.1)	9	0	0	0	0	10	2	0.1(0.4)	6
Latridae	*Latridopsis forsteri*	Bastard trumpeter	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
Lutjanidae	*Paracaesio xanthura*	Yellowtail blue snapper	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Microcanthidae	*Microcanthus strigatus*	Stripey	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Monacanthidae	*Acanthaluteres vittiger*	Brown leatherjacket	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
	Eubalichthys bucephalus	Black reef leatherjacket	7	3	0.4(0.1)	8	0	0	0	0	7	3	0.1(0.3)	5
	Eubalichthys mosaicus	Mosaic leatherjacket	11	2	0.4(0.1)	16	0	0	0	0	11	2	0.1(0.3)	9
	Meuschenia flavolineata	Yellowstriped leatherjacket	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
	Meuschenia freycineti	Sixspine leatherjacket	34	3	0.8(0.1)	39	1	1	0.0(0.2)	2	35	3	0.3(0.7)	24
	Meuschenia scaber	Velvet leatherjacket	42	13	2.2(0.3)	17	47	3	1.1(1.2)	56	89	13	0.8(1.8)	33
	Meuschenia trachylepis	Yellowfin leatherjacket	26	2	0.6(0.1)	34	0	0	0	0	26	2	0.2(0.5)	21
	Meuschenia venusta	Stars-and-stripes leatherjacket	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
	Nelusetta ayraudi	Ocean leatherjacket	3	3	0.4(0.0)	2	38	12	0.9(2.8)	19	41	12	0.4(1.8)	8
Moridae	*Lotella rhacina*	Largetooth beardie	2	1	0.2(0.0)	3	10	1	0.2(0.4)	23	12	1	0.1(0.3)	11
Mullidae	*Parupeneus spilurus*	Blacksaddle goatfish	165	23	4.0(0.5)	78	3	2	0.1(0.3)	5	168	23	1.6(3.4)	49
	Upeneichthys lineatus	Bluestriped goatfish	13	1	0.4(0.1)	20	1	1	0.0(0.2)	2	14	1	0.1(0.3)	13

			Shallow Reef				Mesophotic Reef				OVERALL			
Family	Species name	Common Name	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)
Muraenidae	*Gymnothorax prasinus*	Green moray	94	5	1.2(0.1)	78	6	1	0.1(0.4)	14	100	5	0.9(1.1)	52
	Gymnothorax prionodon	Sawtooth moray	0	0	0	0	27	3	0.6(0.8)	44	27	3	0.3(0.6)	18
Myliobatidae	*Myliobatis australis*	Southern eagle ray	15	2	0.5(0.1)	22	0	0	0	0	15	2	0.1(0.4)	13
Odontaspididae	*Carcharias taurus*	Grey nurse shark	3	2	0.3(0.0)	3	0	0	0	0	3	2	0.0(0.2)	2
Orectolobidae	*Orectolobus halei*	Banded carpet shark	2	1	0.2(0.0)	3	0	0	0	0	2	1	0.0(0.1)	2
	Orectolobus maculatus	Spotted wobbegong	19	7	1.0(0.1)	16	4	1	0.1(0.3)	9	23	7	0.2(0.8)	13
	Orectolobus ornatus	Ornate wobbegong	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Ostraciidae	*Anoplocapros inermis*	Eastern smooth boxfish	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Palinuridae	*Sagmariasus verreauxi*	Eastern rock lobster	0	0	0	0	7	2	0.2(0.5)	12	7	2	0.1(0.3)	5
Parascylliidae	*Parascyllium collare*	Collared carpetshark	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
Pempheridae	*Pempheris affinis*	Blacktip bullseye	4	4	0.5(0.1)	2	0	0	0	0	4	4	0.0(0.4)	1
Pinguipedidae	*Parapercis ramsayi*	Spotted grubfish	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Platycephalidae	*Platycephalus caeruleopunctatus*	Eastern bluespot flathead	6	3	0.5(0.1)	5	16	2	0.4(0.6)	30	22	3	0.2(0.5)	15
Pomacentridae	*Chromis hypsilepis*	Onespot puller	246	100	13.8(1.7)	33	0	0	0	0	246	100	2.3(10.8)	20
	Mecaenichthys immaculatus	Immaculate damsel	3	2	0.3(0.0)	3	1	1	0.0(0.2)	2	4	2	0.0(0.2)	3
	Parma microlepis	White-ear	61	2	0.7(0.1)	75	0	0	0	0	61	2	0.6(0.7)	45
	Parma unifasciata	Girdled scalyfin	18	7	1.0(0.1)	11	0	0	0	0	18	7	0.2(0.8)	7
Pristiophoridae	*Pristiophorus cirratus*	Common sawshark	0	0	0	0	3	1	0.1(0.3)	7	3	1	0.0(0.2)	3
Rhinobatidae	*Aptychotrema rostrata*	Eastern shovelnose ray	2	1	0.2(0.0)	3	5	1	0.1(0.3)	12	7	1	0.1(0.2)	7
	Trygonorrhina fasciata	Eastern fiddler ray	2	1	0.2(0.0)	3	6	2	0.1(0.4)	12	8	2	0.1(0.3)	7
Sciaenidae	*Atractoscion aequidens*	Teraglin	0	0	0	0	4	1	0.1(0.3)	9	4	1	0.0(0.2)	4
Scombridae	*Sarda australis*	Australian bonito	8	6	0.8(0.1)	5	0	0	0	0	8	6	0.1(0.6)	3
Scorpaenidae	*Scorpaena cardinalis*	Eastern red scorpionfish	75	5	1.0(0.1)	78	5	1	0.1(0.3)	12	80	5	0.7(0.9)	51
Scorpididae	*Scorpis lineolata*	Silver sweep	719	104	18.1(2.3)	72	23	14	0.5(2.3)	12	742	104	6.9(15.0)	48
Scyliorhinidae	*Asymbolus analis*	Australian spotted catshark	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
Sebastidae	*Helicolenus percoides*	Reef ocean perch	0	0	0	0	48	6	1.1(1.6)	51	48	6	0.4(1.2)	21
Serranidae	*Acanthistius ocellatus*	Eastern wirrah	39	3	0.8(0.1)	42	12	2	0.3(0.5)	23	51	3	0.5(0.7)	35
	Caesioperca lepidoptera	Butterfly perch	0	0	0	0	3	3	0.1(0.5)	2	3	3	0.0(0.3)	1

Family	Species name	Common Name	Shallow Reef				Mesophotic Reef				OVERALL			
			Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)	Total MaxN	Max MaxN	Mean MaxN (SE)	Prev. (% drops)
	Epinephelus daemelii	Black rockcod	2	1	0.2(0.0)	3	0	0	0	0	2	1	0.0(0.1)	2
	Epinephelus ergastularius	Banded rockcod	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
	Hypoplectrodes annulatus	Banded seaperch	2	1	0.2(0.0)	3	0	0	0	0	2	1	0.0(0.1)	2
	Hypoplectrodes maccullochi	Halfbanded seaperch	42	3	0.8(0.1)	47	7	2	0.2(0.4)	14	49	3	0.5(0.7)	34
	Hypoplectrodes nigroruber	Blackbanded seaperch	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Siganidae	*Siganus nebulosus*	Foxface	3	2	0.3(0.0)	3	0	0	0	0	3	2	0.0(0.2)	2
Sparidae	*Acanthopagrus australis*	Silver bream	7	2	0.4(0.1)	8	0	0	0	0	7	2	0.1(0.3)	5
	Chrysophrys auratus	Pink Snapper	404	26	5.7(0.7)	92	41	4	1.0(1.1)	53	445	26	4.2(5.2)	77
	Rhabdosargus sarba	Tarwhine	168	24	4.4(0.6)	61	0	0	0	0	168	24	1.6(3.6)	36
Sphyraenidae	*Sphyraena sp*	Barracuda	10	5	0.9(0.1)	3	0	0	0	0	10	5	0.1(0.7)	2
Tetraodontidae	*Canthigaster callisterna*	Clown toby	1	1	0.1(0.0)	2	0	0	0	0	1	1	0.0(0.1)	1
Triakidae	*Mustelus antarcticus*	Gummy shark	0	0	0	0	12	2	0.3(0.5)	26	12	2	0.1(0.3)	10
Triglidae	*Pterygotrigla polyommata*	Latchet	0	0	0	0	2	1	0.0(0.2)	5	2	1	0.0(0.1)	2
Urolophidae	*Trygonoptera testacea*	Common stingaree	0	0	0	0	1	1	0.0(0.2)	2	1	1	0.0(0.1)	1
	Urolophus kapalensis	Kapala stingaree	0	0	0	0	2	2	0.0(0.3)	2	2	2	0.0(0.2)	1

APPENDIX C

A summary of species observed using stereo BRUVs to sample rocky reefs in 80-110 m of water at the two locations: Hunter Marine Park and Port Stephens - Great Lakes Marine Park. Mean MaxN refers to the relative abundance of the species and is calculated by taking the mean of the maximum number of a particular species observed on a single video frame per a BRUV deployment. Percent prevalence (Prev.) is the overall contribution of that species to that location.

			Hunter MP (IUCN VI; 80-110 m)			Port Stephen- Great Lakes MP (IUCN II; 80-110 m)		
Family	Species	Common Name	Mean MaxN	Prev. (%)	Rank	Mean MaxN	Prev. (%)	Rank
Aulopidae	*Aulopus purpurissatus*	Sergeant baker	0.69	1.44	11	0.18	0.37	27
Berycidae	*Centroberyx affinis*	Nannygai	18.46	38.40	1	7.23	14.53	3
Callanthiidae	*Callanthias australis*	Splendid perch	0.00	0.00	45	0.05	0.09	47
Carangidae	*Pseudocaranx dentex*	Silver trevally	0.38	0.80	13	3.59	7.22	4
	Trachurus novaezelandiae	Yellowtail scad	11.69	24.32	2	10.55	21.21	2
Carcharhinidae	*Galeocerdo cuvier*	Tiger shark	0.00	0.00	29	0.05	0.09	41
Cheilodactylidae	*Cheilodactylus fuscus*	Red morwong	0.00	0.00	30	0.09	0.18	34
	Nemadactylus douglasii	Blue morwong	1.69	3.52	6	1.41	2.83	7
Congridae	*Conger verreauxi*	Conger eel	0.08	0.16	27	0.00	0.00	48
Dasyatidae	*Dasyatis brevicaudata*	Smooth stingray	0.08	0.16	25	0.09	0.18	33
Dinolestidae	*Dinolestes lewini*	Longfin pike	3.00	6.24	3	0.18	0.37	26
Enoplosidae	*Enoplosus armatus*	Old wife	0.15	0.32	20	0.09	0.18	32
Glaucosomatidae	*Glaucosoma scapulare*	Pearl perch	0.31	0.64	16	0.45	0.91	15
Heterodontidae	*Heterodontus portusjacksoni*	Port Jackson shark	0.31	0.64	17	0.36	0.73	17
Kyphosidae	*Atypichthys strigatus*	Mado	0.00	0.00	42	10.68	21.48	1
Labridae	*Bodianus unimaculatus*	Pigfish	0.92	1.92	8	0.64	1.28	12
Latridae	*Latridopsis forsteri*	Bastard trumpeter	0.00	0.00	31	0.05	0.09	42
Monacanthidae	*Meuschenia freycineti*	Sixspine leatherjacket	0.00	0.00	32	0.05	0.09	43
	Meuschenia scaber	Velvet leatherjacket	2.62	5.44	4	1.18	2.38	8
	Nelusetta ayraudi	Ocean leatherjacket	0.00	0.00	33	2.18	4.39	6
Moridae	*Lotella rhacina*	Bearded rock cod	0.38	0.80	14	0.27	0.55	21
Mullidae	*Parupeneus spilurus*	Black-spot goatfish	0.15	0.32	21	0.05	0.09	39

			Hunter MP (IUCN VI; 80-110 m)			Port Stephen- Great Lakes MP (IUCN II; 80-110 m)		
Family	Species	Common Name	Mean MaxN	Prev. (%)	Rank	Mean MaxN	Prev. (%)	Rank
	Upeneichthys lineatus	Blue-lined goatfish	0.00	0.00	34	0.05	0.09	44
Muraenidae	*Gymnothorax prasinus*	Green moray	0.23	0.48	18	0.36	0.73	18
	Gymnothorax prionodon	Saw-tooth moray	2.23	4.64	5	0.27	0.55	20
Orectolobidae	*Orectolobus maculatus*	Ornate wobbegong	0.08	0.16	26	0.27	0.55	23
Palinuridae	*Sagmariasus verreauxi*	Eastern rock lobster	0.62	1.28	12	0.64	1.28	13
Parascylliidae	*Parascyllium collare*	Collared carpetshark	0.00	0.00	35	0.09	0.18	35
Platycephalidae	*Platycephalus caeruleopunctatus*	Bluespot flathead	0.15	0.32	22	0.86	1.74	11
	Platycephalus longispinis	Longspine flathead	0.00	0.00	36	0.05	0.09	45
Pomacentridae	*Mecaenichthys immaculatus*	Immaculate damsel	0.00	0.00	37	0.05	0.09	46
Pristiophoridae	*Pristiophorus cirratus*	Common sawshark	0.00	0.00	38	0.14	0.27	31
Rhinobatidae	*Aptychotrema rostrata*	Eastern shovelnose ray	0.00	0.00	39	0.27	0.55	24
	Trygonorrhina fasciata	Eastern fiddler ray	0.15	0.32	23	0.23	0.46	25
Sciaenidae	*Atractoscion aequidens*	Teraglin	0.00	0.00	40	0.32	0.64	19
Scombridae	*Scomber australasicus*	Blue mackerel	0.00	0.00	41	0.41	0.82	16
Scorpaenidae	*Scorpaena cardinalis*	Eastern red scorpionfish	0.23	0.48	19	0.14	0.27	30
Scorpididae	*Scorpis lineolata*	Silver sweep	0.00	0.00	43	1.05	2.10	10
Scyliorhinidae	*Asymbolus analis*	Australian spotted catshark	0.08	0.16	28	0.05	0.09	40
Sebastidae	*Helicolenus percoides*	Reef ocean perch	1.23	2.56	7	1.09	2.19	9
Serranidae	*Acanthistius ocellatus*	Eastern wirrah	0.77	1.60	10	0.55	1.10	14
	Caesioperca lepidoptera	Butterfly perch	0.00	0.00	44	0.18	0.37	29
	Epinephelus ergastularius	Banded rockcod	0.00	0.00	46	0.09	0.18	36
	Hypoplectrodes maccullochi	Halfbanded seaperch	0.15	0.32	24	0.18	0.37	28
Sparidae	*Chrysophrys auratus*	Pink Snapper	0.85	1.76	9	2.55	5.12	5
Triakidae	*Mustelus antarcticus*	Gummy shark	0.38	0.80	15	0.27	0.55	22
Triglidae	*Pterygotrigla polyommata*	Latchet	0.00	0.00	47	0.09	0.18	37
Urolophidae	*Urolophus kapalensis*	Kapala ray	0.00	0.00	48	0.09	0.18	38

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