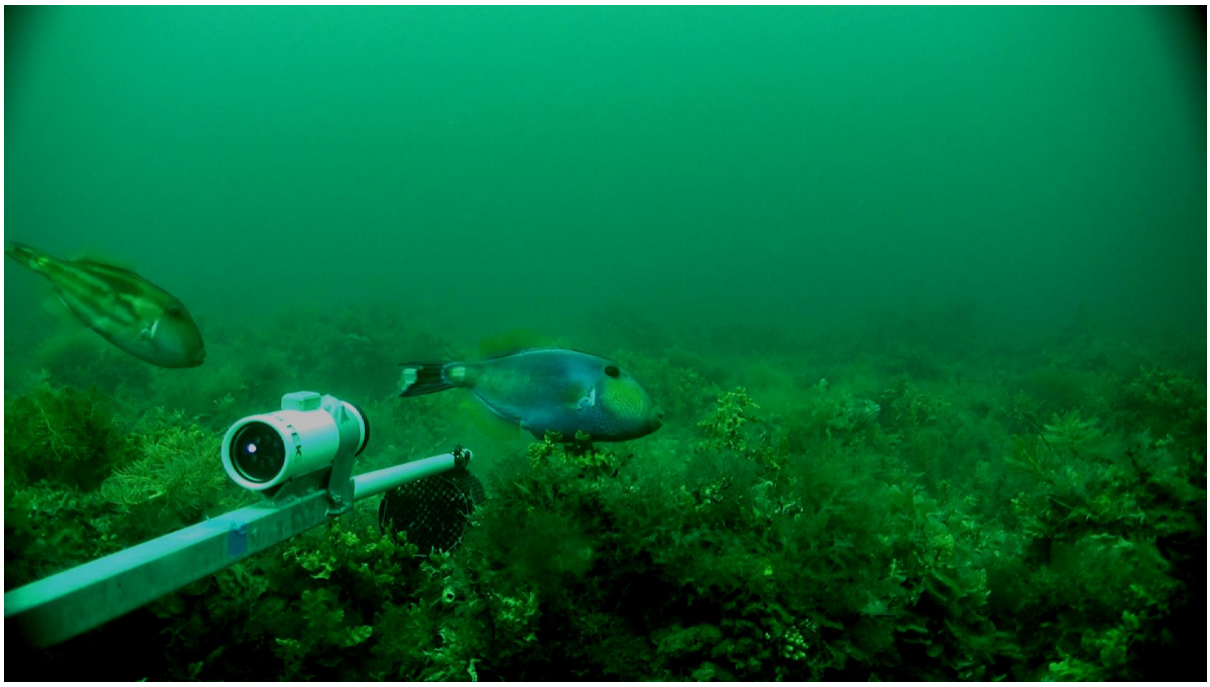
An assessment of Fish Assemblages adjacent Port Stanvac

Interim Field Summary to Adelaide Aqua for the
Adelaide desalination plant project
Summer 2012 (March)



Marine Parks Project
Department of Environment and Natural Resources

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Summary

A seawater desalination plant at the former Mobil oil refinery site at Port Stanvac is nearing completion with sporadic discharges of saline concentrate occurring over the last six months during the commissioning phase. As part of an environmental monitoring program associated with this project, the Department of Environment and Natural Resources (DENR) was commissioned to undertake a study to collect data on fish assemblages within two major habitat types (reef and soft sediment) present in the vicinity of the proposed saline outfall.

During the construction phase (2009 to 2011), the DENR study involved the collection of data using baited remote underwater video systems (BRUVS) encompassing four seasons over a period of two years (8 seasons in total). Video footage was analysed to provide data on species type, relative abundance and fish length. The two years of data represents a baseline against which any change observed after commissioning of the plant can be assessed. The current survey represents a summer sampling during the commissioning phase.

Results from this sampling were carried out in early March 2012 found that a total of 25 fish species representing 23 families were observed. Overall, 2806 fish were counted and 96 individuals were measured for length.

No obvious differentiation between fish assemblages at the four sites was observed for the 2012 summer sampling period. Ordination of assemblages showed a high degree of overlap and no statistical differences were found. No consistent patterns were observed in fish length data between sites, although individuals from a number of species were considerably smaller than maximum adult length suggesting a high proportion of juvenile or sub adult fish in the area.

The present Interim Field Summary details results from the 2012 summer sampling period of an extended monitoring program. It is suggested that this monitoring continues in the future.

1. Introduction

In late 2009 the Department of Environment and Natural Resources (DENR) Marine Parks Project (then known as the Coast and Marine Conservation Branch) was contracted by Adelaide Aqua to conduct a baseline survey of fish assemblages as part of the environmental assessment process associated with the Adelaide desalination plant project at Port Stanvac, South Australia. Subsequently this project was extended a further year to include an assessment of inter-annual differences in fish assemblages at the site.

In 2011 the results for 8 sampling seasons of the DENR study (2009 – 2011) were compiled in a report to Adelaide Aqua (Colella *et al.* 2011). This report provided information on the species present, relative abundance and average fish lengths within and outside the proposed salinity impact zone, and also examined spatial and temporal variability over eight seasons during 2009 – 2011.

The study has been extended into the summer of 2012 and the following document summarises data collected from the BRUVS monitoring at the desalinisation site on the 5th and 6th of March 2012.

2. Materials and methods

2.1 Study area

At the beginning of the survey in 2009 two sites were established within (*Near* sites) and two outside (*Distant* sites) the predicted zone of influence of the saline outfall (Figure 1). The location of these sites was based on salinity plume dispersal models detailed in the Adelaide desalination plant environmental impact statement (South Australian Water Corporation 2008). Site selection also considered seafloor habitat (soft bottom/sand with patchy sparse algae and low profile reef) and depth (Figure 1). All subsequent surveys have been carried out at these sites.

Modelling of the predicted saline concentrate plume suggests that the *near* sites should experience dilution rates of less than 50:1 while dilution rates at the *distant* sites should be greater than 100:1 (South Australian Water Corporation 2008).

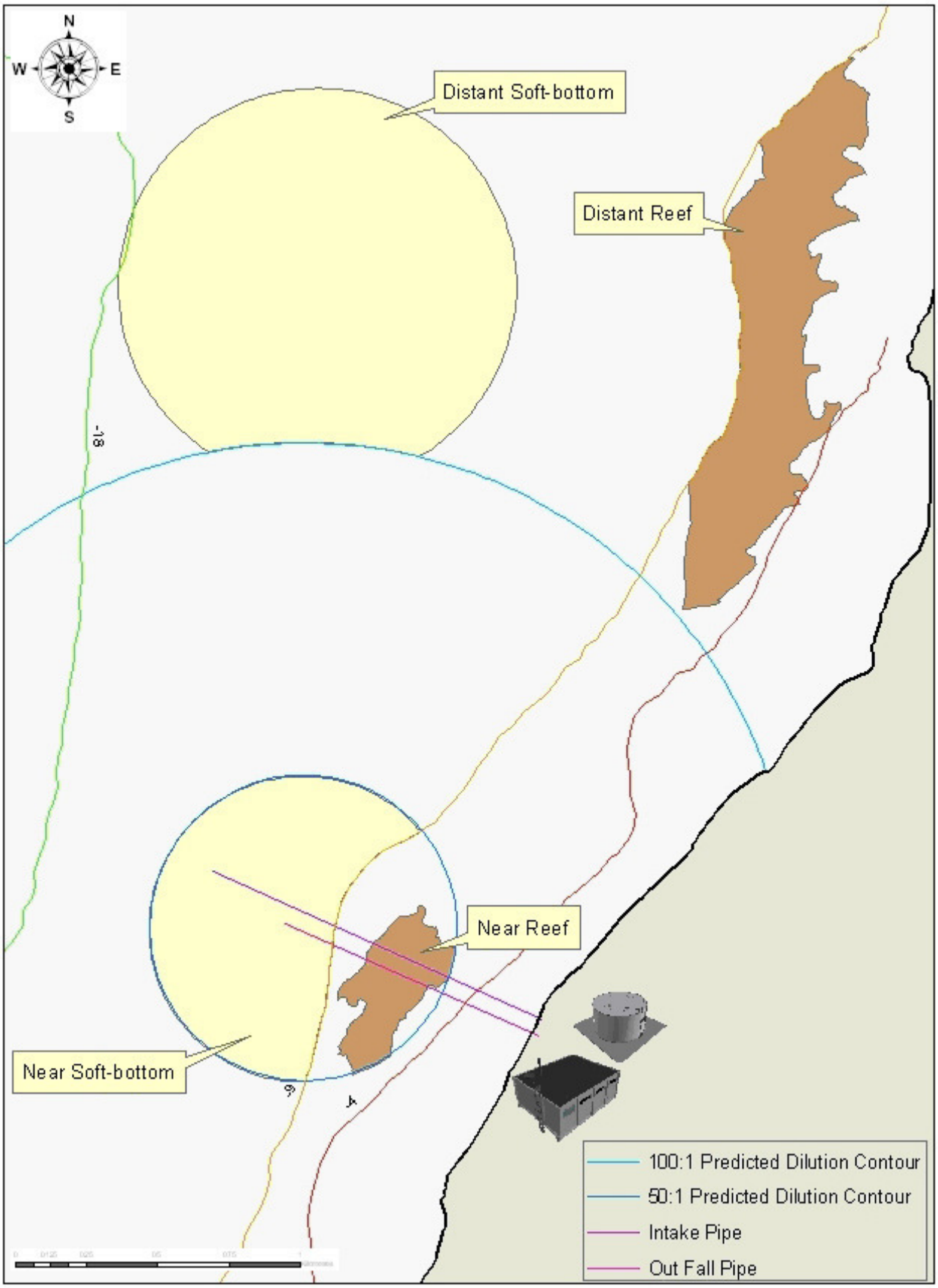

Figure 1: Port Stanvac survey area showing BRUVS sampling sites and predicted dilution contours, 50:1 (inner dark blue circle) and 100:1 (outer light blue circle), in relation to the outfall, and intake pipes.

2.2 Survey Dates

Two days of sampling were carried out on the 5th and 6th of March 2012 [1]. The four sites *Near Reef, Near Soft-bottom, Distant Reef, and Distant Soft-bottom* were each sampled with three BRUVS units on each survey day.

2.3 BRUV systems

Each BRUV system consists of two video cameras fitted with wide angle lenses and waterproof housings attached to a steel frame. Canon HV 30 high definition and Sony DCR-HC52 standard definition camcorders were used. A bait bag containing ~ 800 grams of mashed pilchards (*Sardinops* spp.) was mounted on a pole 1.5 m in front of the cameras. The pilchards create an odour plume which serves as an attractant.

Prior to deployment in the field, each stereo BRUV unit was calibrated using SeaGIS *CaI* software (http://www.seagis.com.au/bundle.html). Calibration ensures accurate length measurements can be made during video analysis (Harvey *et al.* 2003,Shortis *et al.* 2007). Fish measurements were made up to a range of 4 m from the cameras. This distance standardises the field of view for each unit depending on water quality and visibility. In addition, beyond this distance, precision of measurements decrease significantly.

2.4 Deployment methods

Six BRUVS were deployed within each of the four areas in daylight hours over two consecutive days. Three BRUV units were deployed in each area each day, with the deployment order being reversed on the second day so that sampling times overall for each site/habitat type were comparable.

BRUV units were deployed with an average time separation of between 5 and 10 minutes. Where possible BRUV units were deployed with a minimum separation distance of 200 m to maintain independence between samples. Each BRUV was lowered to the seafloor at the appropriate location (predetermined GPS points) and left to record 60 minutes of footage before retrieval.

2.5 Video analysis

Video footage was analysed to produce species abundance and length distribution data. Footage from the right side camera was analysed using SeaGIS *EventMeasure* software (http://www.seagis.com.au/event.html) to identify fish and estimate abundance.

Fish identification was performed with the aid of Gomon *et al.* (2008), Edgar (2008) and Kuiter (2001).

[1] An earlier sampling in late January was cancelled due to a hire vessel mechanical failure. Data was collected and retained (but not processed) for one day (i.e. half of the normal sampling locations spread across four sites).

The total number of fish within a particular species that is counted throughout the duration of a single sample recording is given as a *MaxN* value. *MaxN* should be considered a conservative estimate of abundance, particularly where large numbers of fish are present. This issue has been reviewed in detail by Cappo *et al*. (2003, 2004).

Fish length measurements were obtained from paired stereo images using SeaGIS *PhotoMeasure* software (http://www.seagis.com.au/photo.html). Associated files from EventMeasure are loaded into *Photomeasure*. The time coordinates from the event file are used to locate the point in the video where the *MaxN* event occurs for each species. All length measurements for each species are performed at this point in time for each sample.

Where possible fish were measured using fork length rather than total length. Fork length is a more accurate measure which reduces potential errors resulting from fin damage. For fish which do not have fork tails, standard lengths are used. Rays from the families *Dasyatis*, *Rajidae* and *Rhinobatidae* were measured by disk length.

2.6 Statistical analysis

Analyses were carried out using *PRIMER-E* and *PERMANOVA+* (Plymouth Marine Laboratories). Permutational multivariate analysis of variance (PERMANOVA) was used to test for significant differences in fish assemblages across treatments and habitats using *MaxN* abundances. The data were 4th Root transformed and a matrix was constructed based on Bray Curtis similarities. A visual plot of these differences was produced using a non-metric multi-dimensional scaling (MDS) plot.

3. Results

During this summer sampling period, a total of 25 species of fish were identified, and a further 3 described to genus level, (see Appendix A). Overall, 23 Families were represented, 2806 fish counted and 96 measured. In addition 3 cephalopods and 1 dolphin were recorded and measured.

Poor image quality and the similarity of some species within their genus or family resulted in a number of individuals being identified to genus level only. These were:

- *Pseudocaranx* spp.
- *Sillago* spp.
- *Trachurus* spp.

Overall, sites from all habitats and treatments appear similar for the summer sampling, with considerable overlap between samples from both habitats and treatments in the MDS plot (Figure 1). More reef sites ordinated to the upper half of the plot and more soft bottom sites to the lower half suggesting some habitat differentiation however no statistical difference was found (F = 1.3415, P = 0.2206). No significant difference was found in the fish assemblages between treatments (F = 1.1666, P = 0.3232).

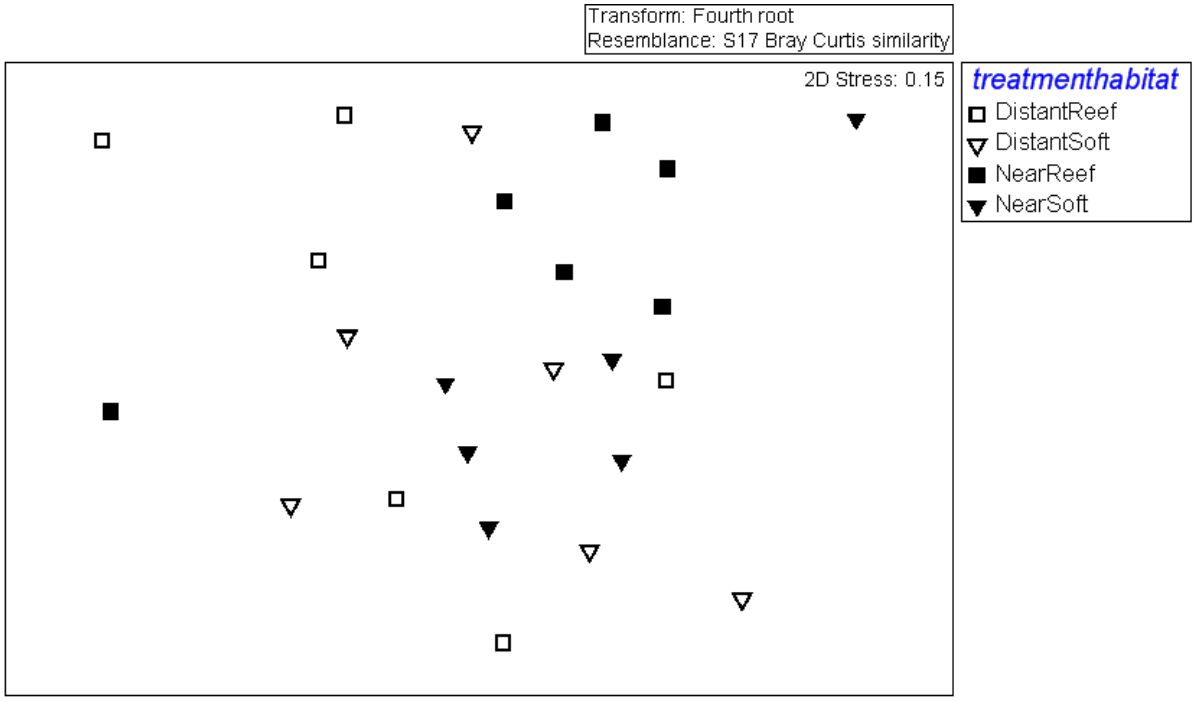

Figure 1. MDS ordination plot of the 24 sites by Treatment and Habitat

3.1 Species richness and relative overall abundance

Mean overall abundance was highest at the distant sites and lowest at the 'near reef' site (Figure 2). As in previous seasons the higher relative abundances were associated with higher variability (seen in the larger standard error bars, Figure 2). This suggests the higher values resulted from very high numbers of individual fish species in several individual samples (i.e. schooling species).

Overall the mean number of species was similar to the majority of sites sampled in previous seasons (Figure 3). The total number of species was highest at the near reef site and lowest at the 'distant reef' site however little difference is apparent between the four sites overall (see Appendix B for Raw Data).

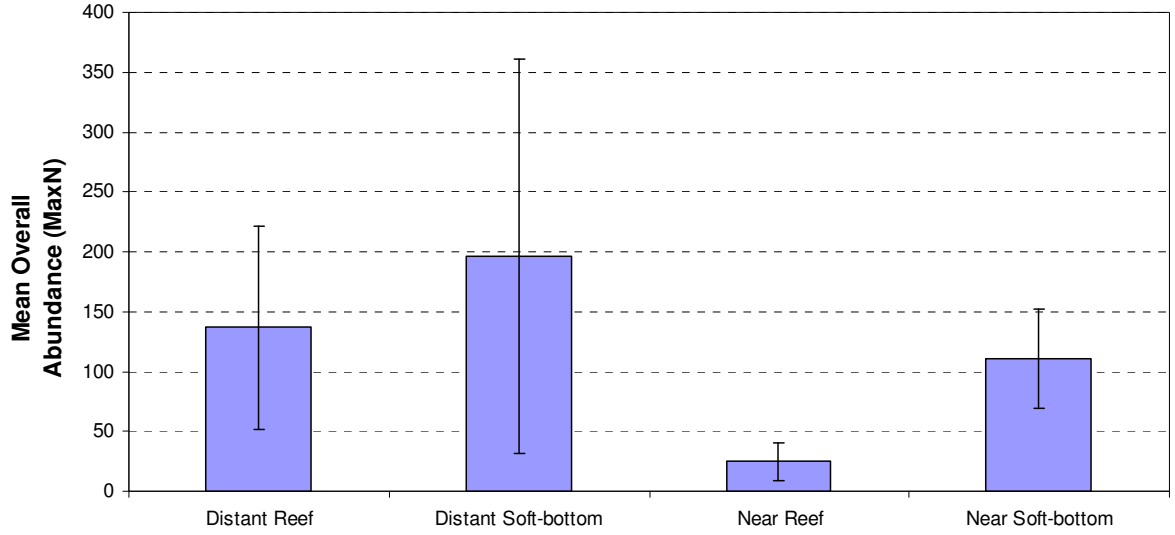

Figure 2 Mean overall abundance across all sites (bars represent standard error).

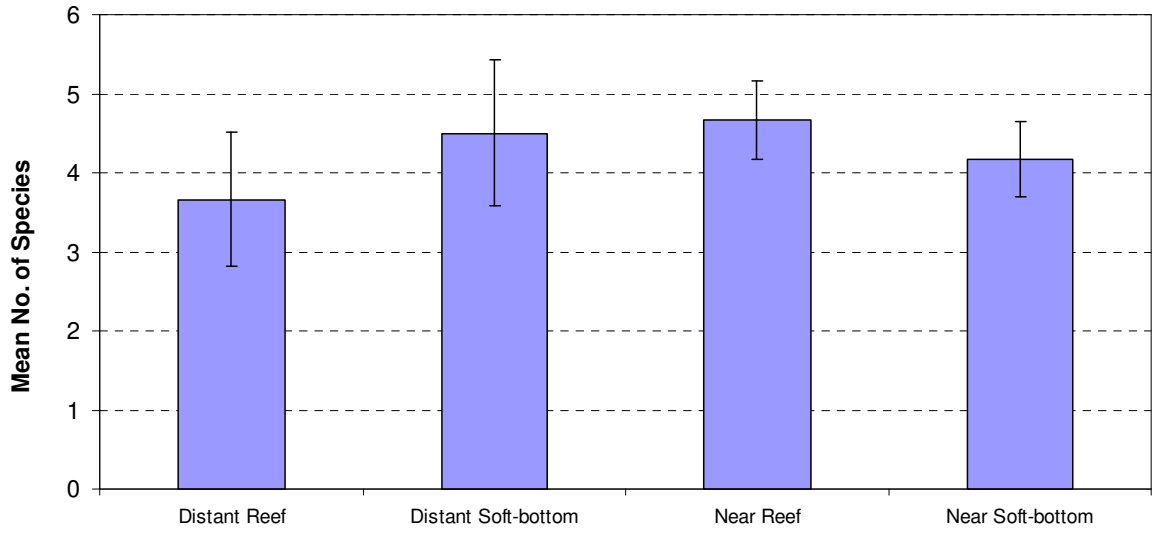

Figure 3 Mean number of species across all sites (bars represent standard error).

3.2 Fish lengths

A total of 96 fish comprising 19 identified individual species, were measured using stereo video imagery. In addition 3 cephalopods and 1 dolphin were measured. There were no obvious patterns in fish length between sites (Figure 4 a-d).The lengths of individuals of many species fell well short of their maximum adult length suggesting a high proportion of juvenile or sub adult fish. This is consistent with observations from previous surveys.

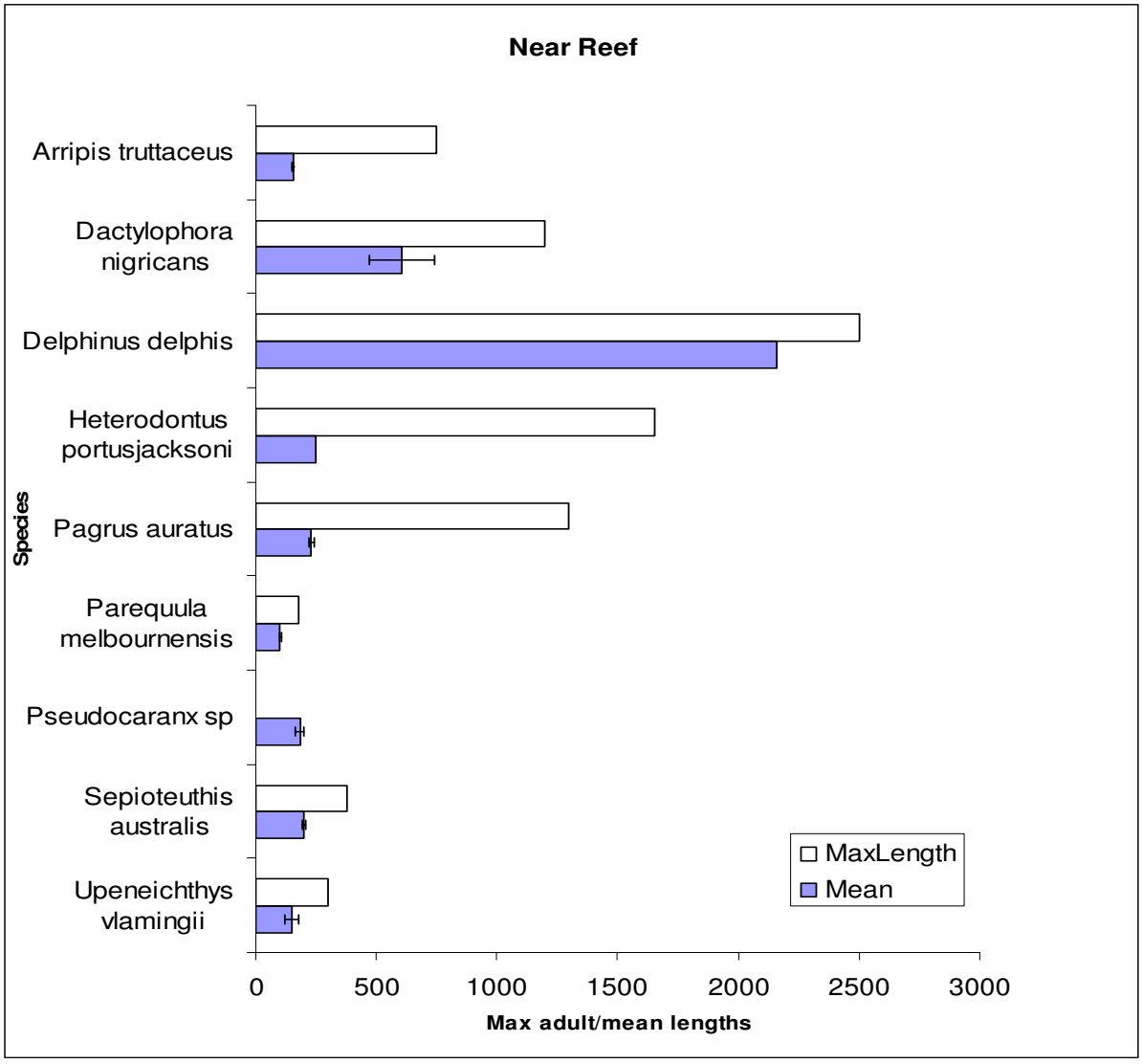

Figure 4a Near Reef mean fish length and maximum lengths as per Gommon *et al* (2008) with standard error (where appropriate)

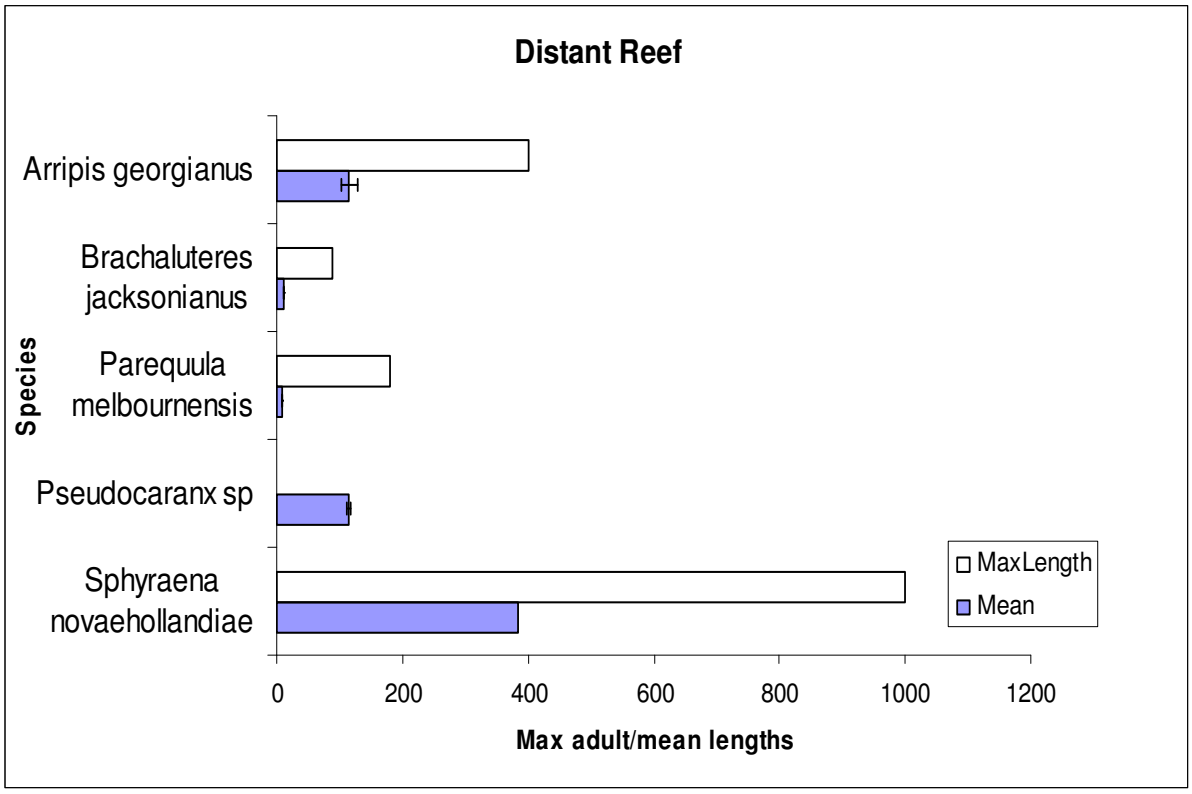

Figure 5b Distant Reef mean fish length and maximum lengths as per Gommon *et al* (2008) with standard error (where appropriate)

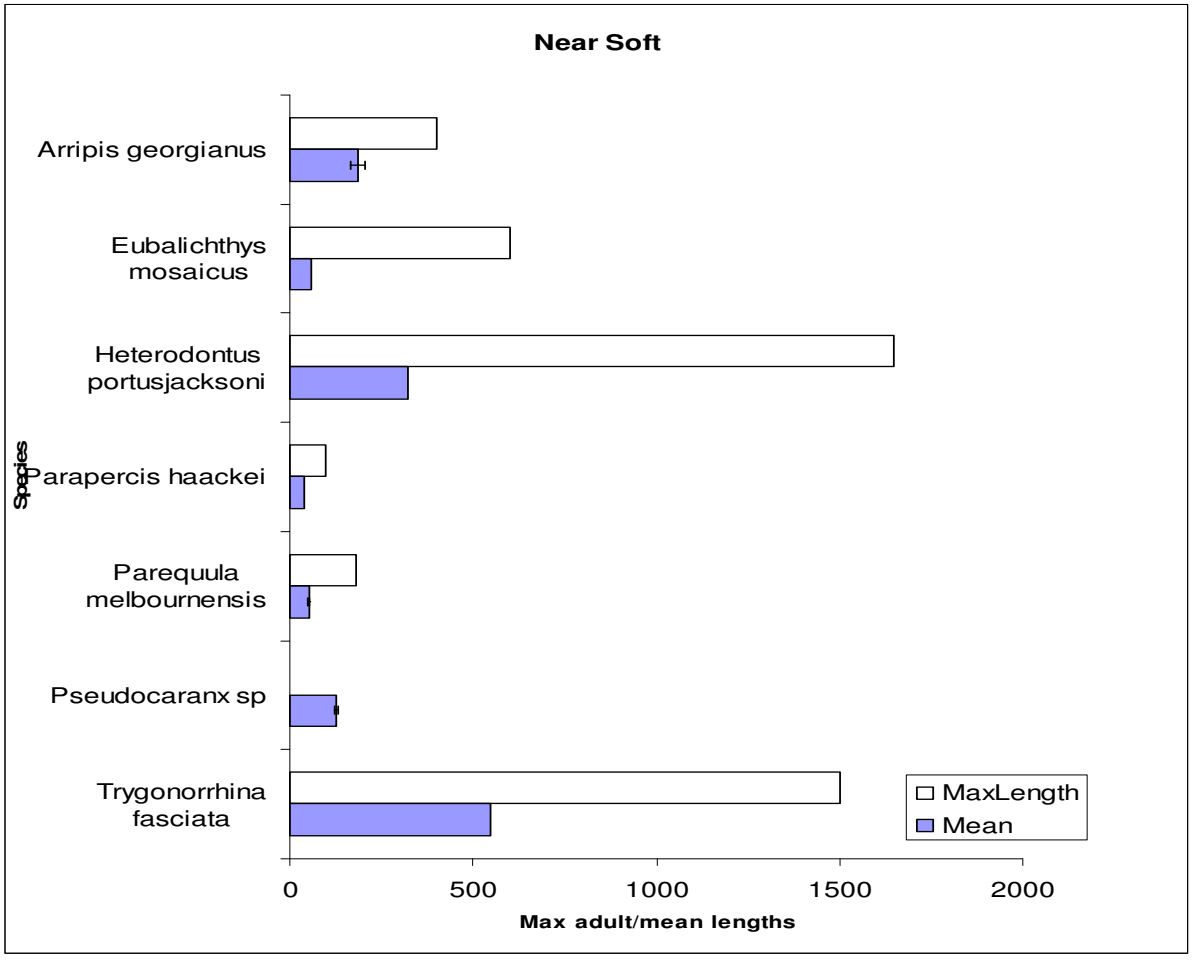

Figure 5c Near Soft-bottom mean fish length and maximum lengths as per Gommon *et al* (2008) with standard error (where appropriate)

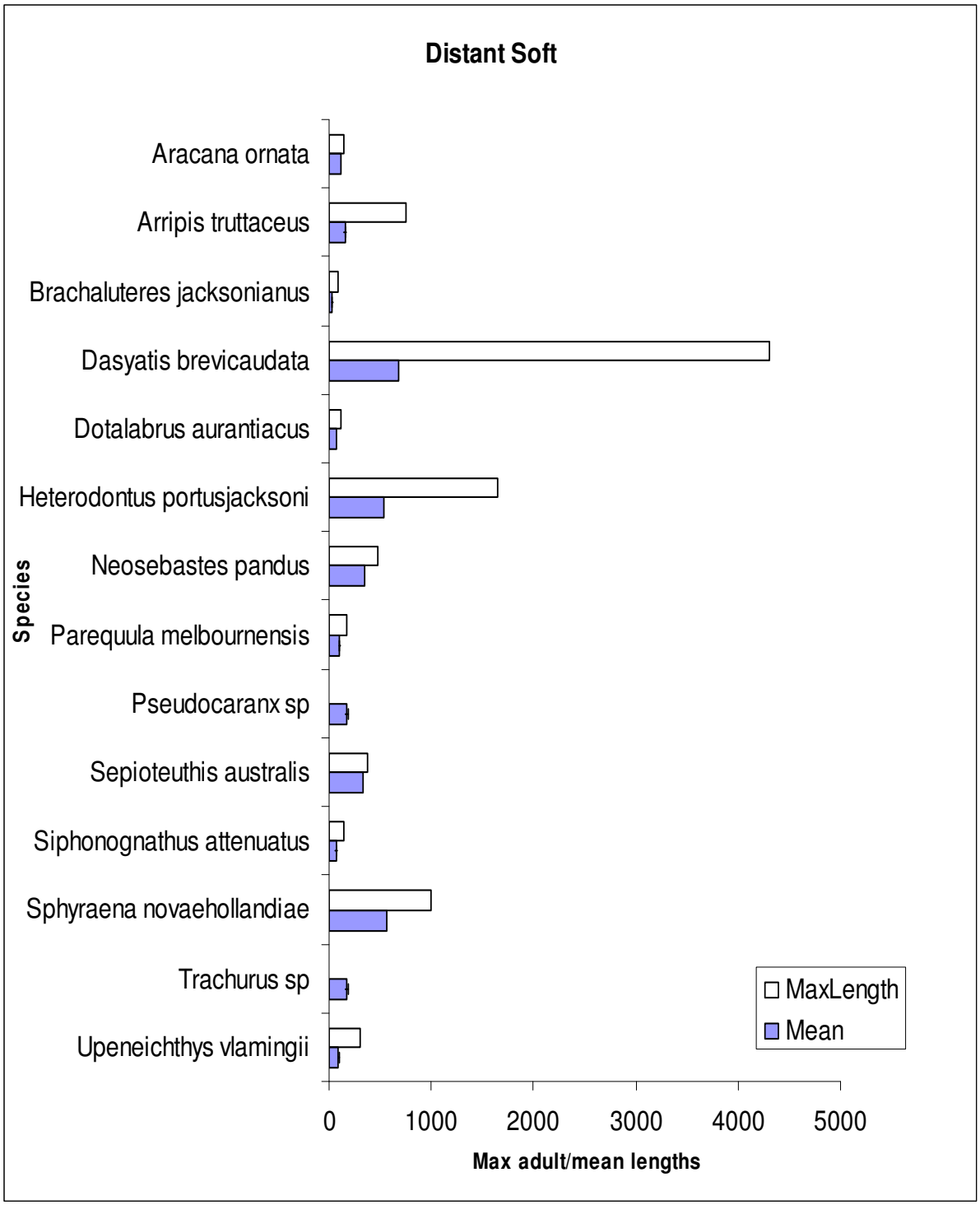

Figure 5d Distant Soft-bottom mean fish length and maximum lengths as per Gommon *et al* (2008) with standard error (where appropriate)

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Appendix A. Species identified adjacent the Port Stanvac desalination plant

Fish ID/Code: Codes for Australian Aquatic Biota (CAAB) (CSIRO 2010)

Class	Family	Genus	Species	Common name	Fish ID/Code
Chondrichthyes	Dasyatidae	Dasyatis	brevicaudata	Smooth stingray	37035001
	Heterodontidae	Heterodontus	portusjacksoni	Port Jackson shark	37007001
	Rajidae	Dentiraja	lemprieri	Thornback skate	37031007
	Rhinobatidae	Trygonorrhina	fasciata	Southern fiddler ray	37027006
Actinopterygii	Arripidae	Arripis	georgianus	Australian herring	37344001
	Astraciidae	Aracana	ornata	Ornate cowfish	37466001
	Carangidae	Pseudocaranx	spp	Travally	37337000
		Trachurus	spp	Mackerel or Scad	37337907
	Cheilodactylidae	Dactylophora	nigricans	Dusky morwong	37377005
	Delphinidae	Delphinus	delphis	Common dolphin	41116001
	Engraulidae	Engraulis	australis	Australian anchovy	37086001
	Gerreidae	Parequula	melbournensis	Melbourne silverbelly	37349001
	Labridae	Dotalabrus	aurantiacus	Castelnau's wrasse	37384018
		Ophthalmolepis	lineolata	Southern Maori wrasse	37384040
	Loliginidae	Sepioteuthis	australis	Southern calamari	23617005
	Monacanthidae	Acanthaluteres	spilomelanurus	Bridled leatherjacket	37465043
		Brachaluteres	jacksonianus	Southen pygmy Leatherjacket	37465025
		Eubalichthys	mosaicus	Mosaic leatherjacket	37465003
		Scobinichthys	granulatus	Rough leatherjacket	37465007
	Mullidae	Upeneichthys	vlamingii	Bluespotted goatfish	37355029
	Neosebastidae	Neosebastes	pandus	Common gurnard perch	37287003
	Odacidae	Siphonognathus	attenuatus	Slender weed whiting	37385004
	Pinguipedidae	Parapercis	haackei	Wavy grubfish	37390004
	Platycephalidae	Platycephalus	bassensis	Southern sand flathead	37296003
	Siliquariidae	Sillago	spp	Whiting	37330000
	Sillaginidae	Sillaginodes	punctata	King George whiting	37330001
	Sparidae	Pagrus	auratus	Snapper	37353001
	Sphyraenidae	Sphyraena	novaehollandiae	Snook	37382002
	Terapontidae	Pelates	octolineatus	Western striped grunter	37321020
	Tetraodontidae	Omegophora	armilla	Ringed toadfish	37467002
Chondrichthyes	Dasyatidae	Dasyatis	brevicaudata	Smooth stingray	37035001
	Heterodontidae	Heterodontus	portusjacksoni	Port Jackson shark	37007001
	Rajidae	Dentiraja	lemprieri	Thornback skate	37031007
	Rhinobatidae	Trygonorrhina	fasciata	Southern fiddler ray	37027006
Actinopterygii	Arripidae	Arripis	georgianus	Australian herring	37344001
	Astraciidae	Aracana	ornata	Ornate cowfish	37466001
	Carangidae	Pseudocaranx	spp	Travally	37337000
		Trachurus	spp	Mackerel or Scad	37337907
	Cheilodactylidae	Dactylophora	nigricans	Dusky morwong	37377005
	Delphinidae	Delphinus	delphis	Common dolphin	41116001
	Engraulidae	Engraulis	australis	Australian anchovy	37086001
	Gerreidae	Parequula	melbournensis	Melbourne silverbelly	37349001
	Labridae	Dotalabrus	aurantiacus	Castelnau's wrasse	37384018
		Ophthalmolepis	lineolata	Southern Maori wrasse	37384040

Loliginidae	Sepioteuthis	australis	Southern calamari	23617005
Monacanthidae	Acanthaluteres	spilomelanurus	Bridled leatherjacket	37465043
	Brachaluteres	jacksonianus	Southen pygmy Leatherjacket	37465025
	Eubalichthys	mosaicus	Mosaic leatherjacket	37465003
	Scobinichthys	granulatus	Rough leatherjacket	37465007

Appendix B. Abundance and number of species

Site	Sample	Abundance	No of Sp
Near Reef	PS04	104	3
Near Reef	PS05	6	4
Near Reef	PS06	4	4
Near Reef	PS22	9	5
Near Reef	PS23	16	6
Near Reef	PS24	9	6
Near Soft-bottom	PS10	3	3
Near Soft-bottom	PS11	202	4
Near Soft-bottom	PS12	11	3
Near Soft-bottom	PS13	134	5
Near Soft-bottom	PS14	63	6
Near Soft-bottom	PS15	252	4
Distant Reef	PS01	266	3
Distant Reef	PS02	4	4
Distant Reef	PS03	2	2
Distant Reef	PS19	505	6
Distant Reef	PS20	4	1
Distant Reef	PS21	38	6
Distant Soft-bottom	PS07	70	4
Distant Soft-bottom	PS08	51	2
Distant Soft-bottom	PS09	1021	7
Distant Soft-bottom	PS16	14	7
Distant Soft-bottom	PS17	9	2
Distant Soft-bottom	PS18	13	5