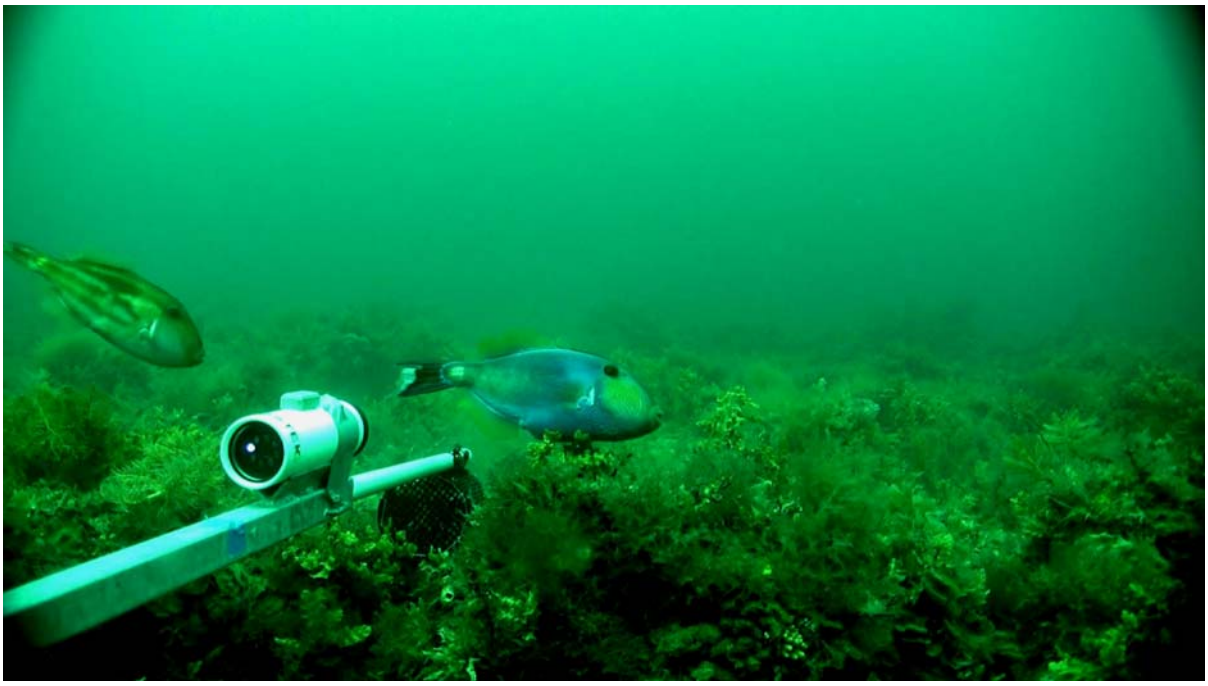
An assessment of Fish Assemblages adjacent Port Stanvac

Interim Field Summary to Adelaide Aqua for the
Adelaide desalination plant project
Winter / Spring 2012 (Sep-Oct)



Marine Parks Project
Department of Environment, Water and Natural Resources

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Government
of South Australia

Department of Environment,
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Summary

A seawater desalination plant at the former Mobil oil refinery site at Port Stanvac is now complete with sporadic discharges of saline concentrate occurring since the end of 2011. As part of an environmental monitoring program associated with this project, the Department of Environment Water, and Natural Resources (DEWNR) was commissioned to undertake a study of fish assemblages within two major habitat types (reef and soft sediment) present in the vicinity of the proposed saline outfall.

During the construction phase of the desalination plant (2009 to 2011), the DEWNR 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 winter sampling during the operational phase.

Results from this sampling, carried out in late September / early October 2012, found a total of 27 fish species representing 15 families. Overall, 393 fish were counted and 126 individuals were measured for length.

No obvious differentiation between fish assemblages at the four sites was observed for this sampling period. Ordination of assemblages showed a high degree of overlap between samples from the different habitats and treatments 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.

This Interim Field Summary details results from the 2012 winter/spring 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, Water and Natural Resources (DEWNR) Marine Parks Project (then known as the Coast and Marine Conservation Branch of the Department of Environment and Natural Resources) 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 winter of 2012 and the following document summarises data collected from the winter/spring BRUVS monitoring at the desalinisation site on the 27^{th} September and 3rd October 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).

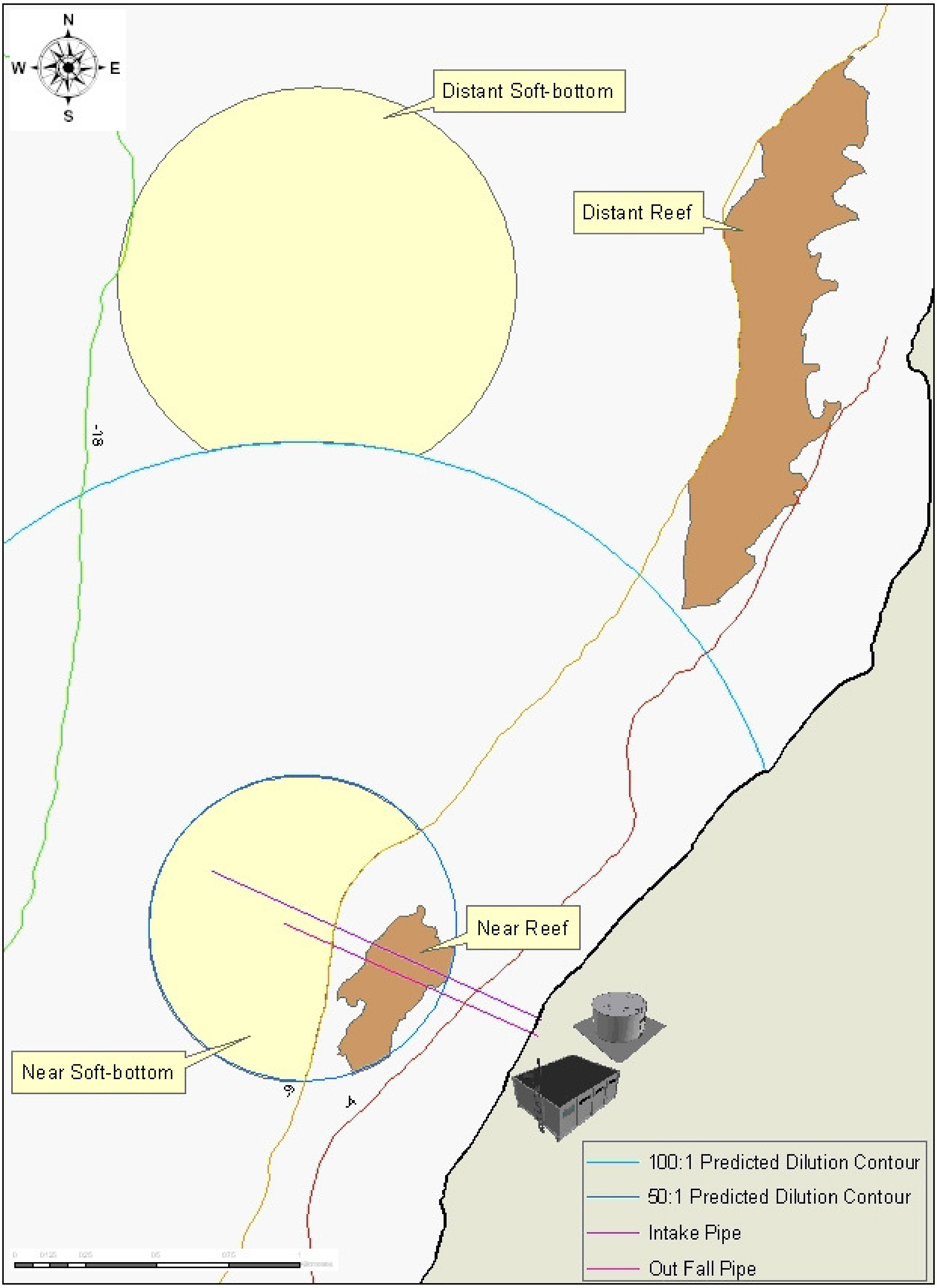

Figure 1: Port Stanvac survey area showing BRUVS sampling sites and predicted dilution contours, 50:1 (inner dark blue circle) and 100:1 (outer light blue circle), in relation to the outfall, and intake pipes.

2.2 Survey Dates

Despite several attempts to carry out a winter sampling more aligned to the previous winter sampling events (i.e. in August/September), poor weather and unsuitable visibility caused a significant delay to this round of field sampling. Two days of sampling were carried out on the 27th September and 3rd October 2012. Poor water clarity (<2 m) at the inshore reef sites also affected sampling design. Conditions necessitated sampling was carried out at the offshore 'soft-bottom' sites a week prior to the shallower 'reef' sites rather than the previous mixed sampling over two consecutive days.

2.3 BRUV systems

Each BRUV system consists of two video cameras with wide angle lenses in waterproof housings attached to a steel frame. This season, new Panasonic HC-V700 high definition video cameras recording to memory cards replaced the previous digital video tape cameras. A bait bag containing ~800 grams of ground pilchards (*Sardinops* spp.) was mounted on a pole 1.5 m in front of the cameras. The pilchards create an odorous plume which serves as an attractant.

Prior to deployment in the field, each stereo BRUV unit was calibrated using SeaGIS *Cal* 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 are done 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

Normally, six BRUVS are deployed within each of the four areas in daylight hours over two consecutive days (3 per site per day). However, due to poor weather and water clarity (< 2m) at the reef sites, the sampling regime was modified. All 'soft-bottom' sites were surveyed in a single day and all 'reef' sites surveyed on another day approximately 1 week later.

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 a random distance from a predetermined GPS point (actual drop position also recorded) and left to record at least 60 minutes of footage before retrieval.

2.5 Video analysis

Video footage was analysed to produce species abundance and fish 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).

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. The ray from the family *Dasyatis* was measured using disk length (see Appendix A).

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. Data were 4th root transformed and a similarity matrix was constructed based on the Bray Curtis method.

Five samples this season failed to detect any fish. Samples with all zero values can be problematic when using Bray Curtis coefficients. Where samples with all zero values can be considered biologically the same, the use of a 'zero adjusted Bray Curtis coefficient' (Clarke & Gorley 2006) can adjust for the influence of these samples. This was done by adding a dummy variable with a score of 1 to all samples before the similarity matrix was produced.

A visual plot of these differences was produced using a non-metric multi-dimensional scaling (MDS) plot.

3. Results

During this winter sampling period, a total of 26 species of fish were identified, and a further 22 described only to genus level, (see Appendix B). Overall, 15 families were represented, 393 fish counted and 126 measured.

Poor underwater visibility 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.
- *Neosebastes* spp.
- *Trachurus* spp.
- *Platycephalus* spp.
- *Aracana* spp.

Overall, sites from all habitats and treatments appeared similar for the winter sampling, with considerable overlap between samples from both habitats and treatments evident in the MDS plot (Figure 2a, b). Results showed that the 'near soft-bottom' sites ordinated together while the 'near reef' sites exhibited two groupings of samples. 'Distant reef' sites tended to ordinate centrally within the plot. Some separation was evident between 'soft-bottom' sites (Figure 2a). However, apart from the 'near soft-bottom' site, differences within sites appeared similar to the differences between sites. This observation was supported by the non significant *PERMANOVA* result observed between habitats ($F = 1.895$, $P = 0.0773$) and treatments ($F = 1.895$, $P = 0.0686$).

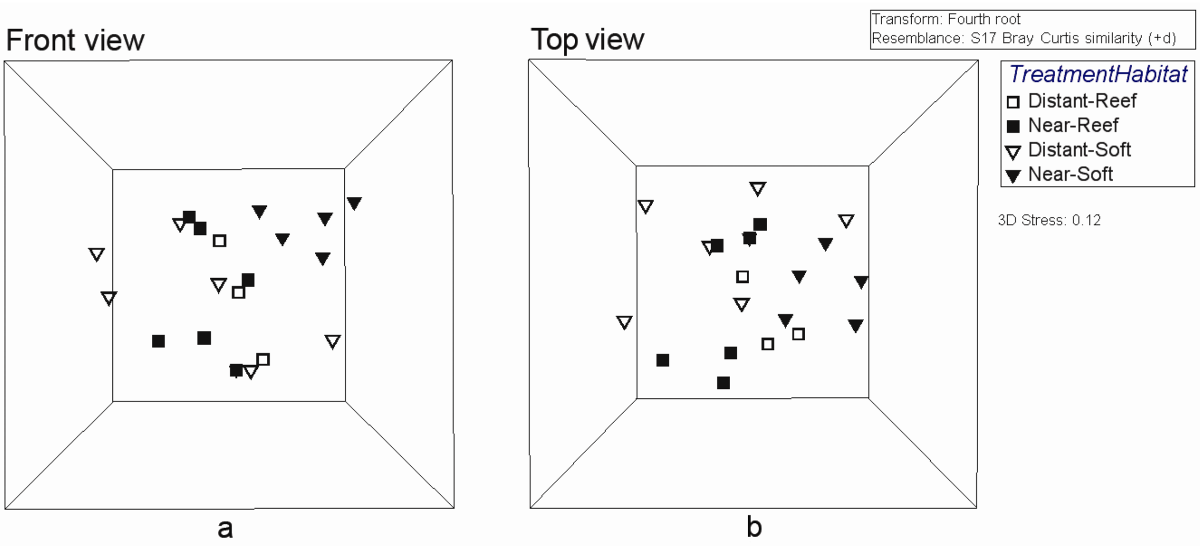

Figure 2a,b: 3D MDS ordination plot of the 24 sites by Treatment and Habitat (stress 0.12)

3.1 Overall abundance and species richness.

Mean overall abundance was highest at the 'distant soft-bottom' site and lowest at the 'near reef' site (Figure 3). As in previous seasons the higher relative abundances were associated with higher variability (seen in the larger standard error bars). This suggests the higher values may result from very high numbers of individual fish species in several individual samples (i.e. schooling species). Standard error bars suggest no difference exists between sites with the exception of the 'distant reef' site (Figure 3).

The 'distant reef' site also had the lowest mean number of species (Figure 4) and standard error bars suggest a significant difference between the reef sites. The total number of species was highest at the 'near soft-bottom' site, however, the error bars do not suggest a significant difference between the 'soft-bottom' sites (see Appendix C for raw data).

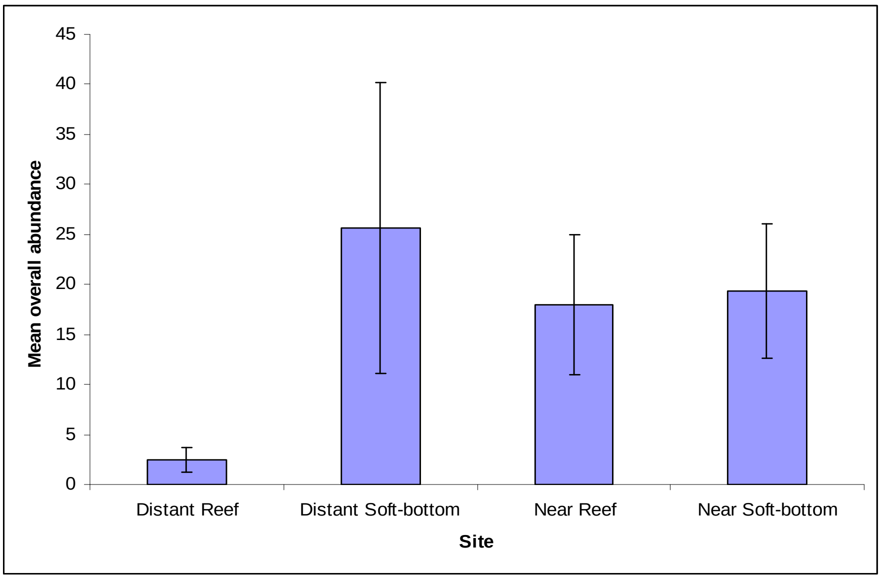

Figure 3: Mean overall abundances across sites

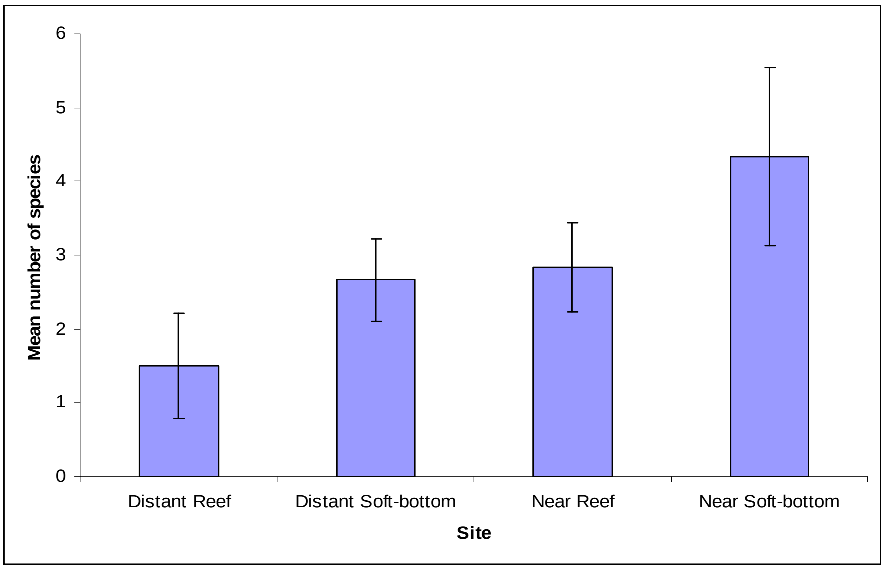

Figure 4: Mean number of species across sites

3.2 Fish lengths

A total of 126 fish comprising 18 identified individual species (and 3 additional genera), were measured using stereo video imagery. There were no obvious patterns in fish length between sites (Figure 5 a-d). Similar to previous surveys, 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.

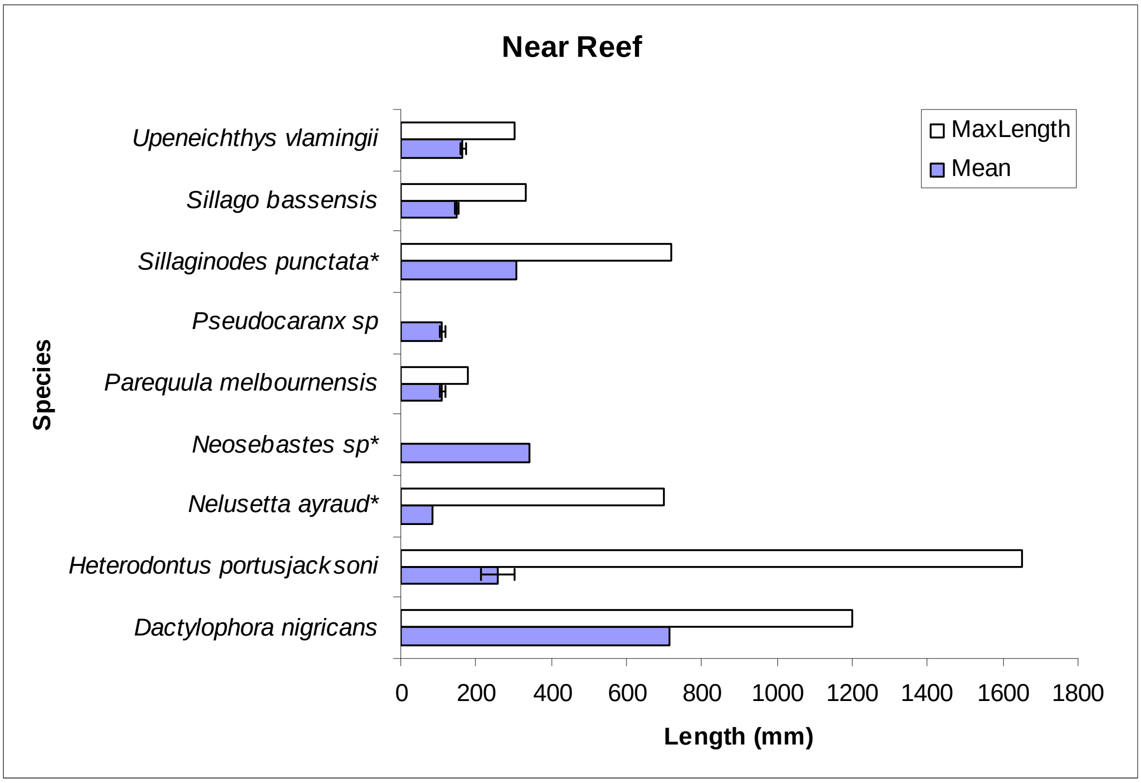

Figure 5a: 'Near reef' mean fish length and maximum adult length as per Gomon *et al* (2008) with standard error. * = single fish length (no mean). Note – because of the high variability of maximum adult fish length between species within the Genera *Pseudocaranx and Neosebastes*, this measurement was not included.

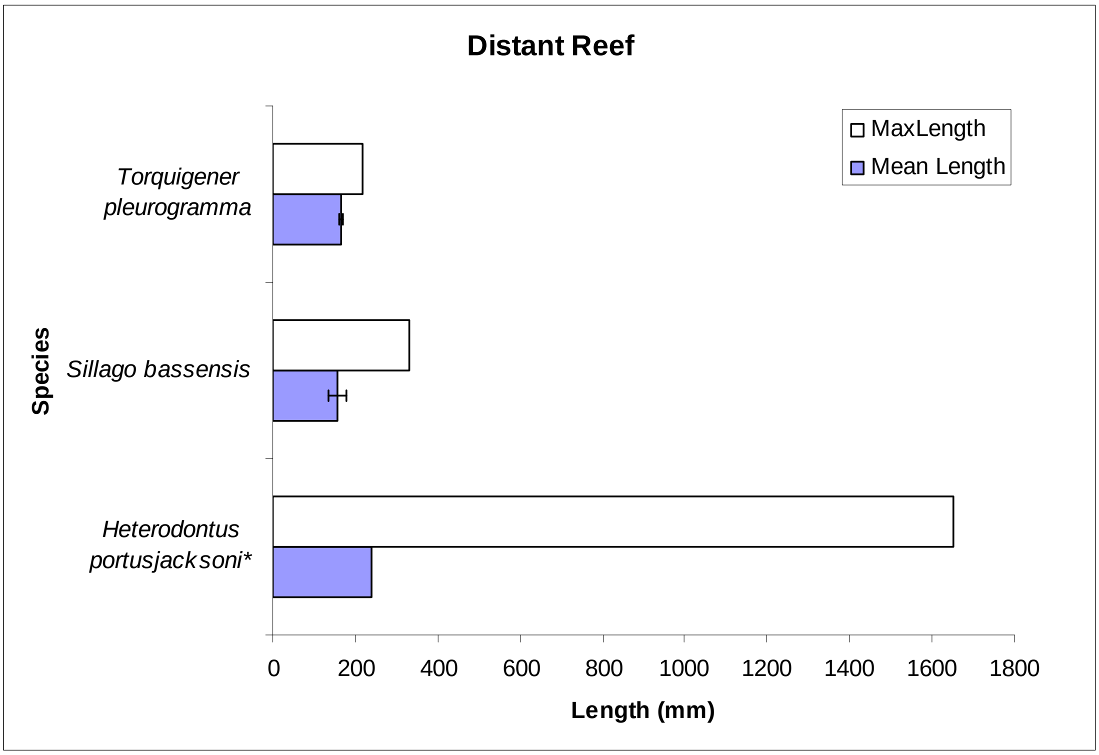

Figure 5b: 'Distant reef' mean fish length and maximum adult length as per Gomon *et al* (2008) with standard error. * = single fish length (no mean).

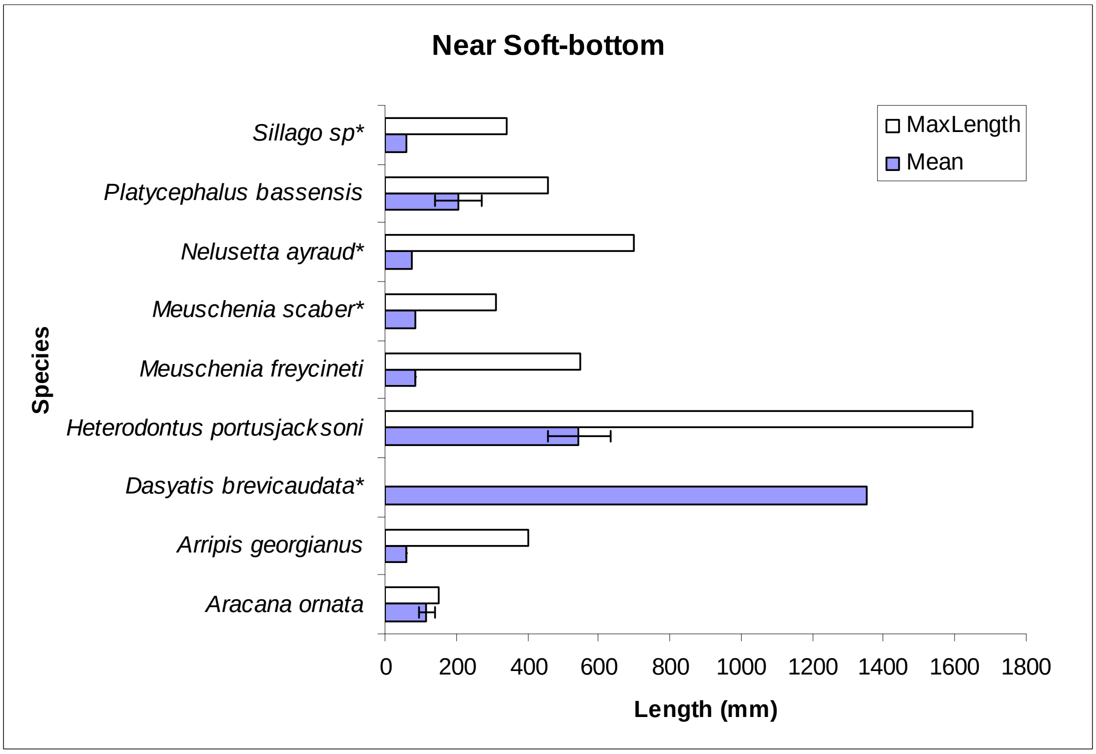

Figure 5c: 'Near soft-bottom' mean fish length and maximum adult length as per Gomon *et al* (2008) with standard error. * = single fish length (no mean). Note: the ray *D. brevicaudata* was measured using disc length, and therefore no maximum adult length comparison given.

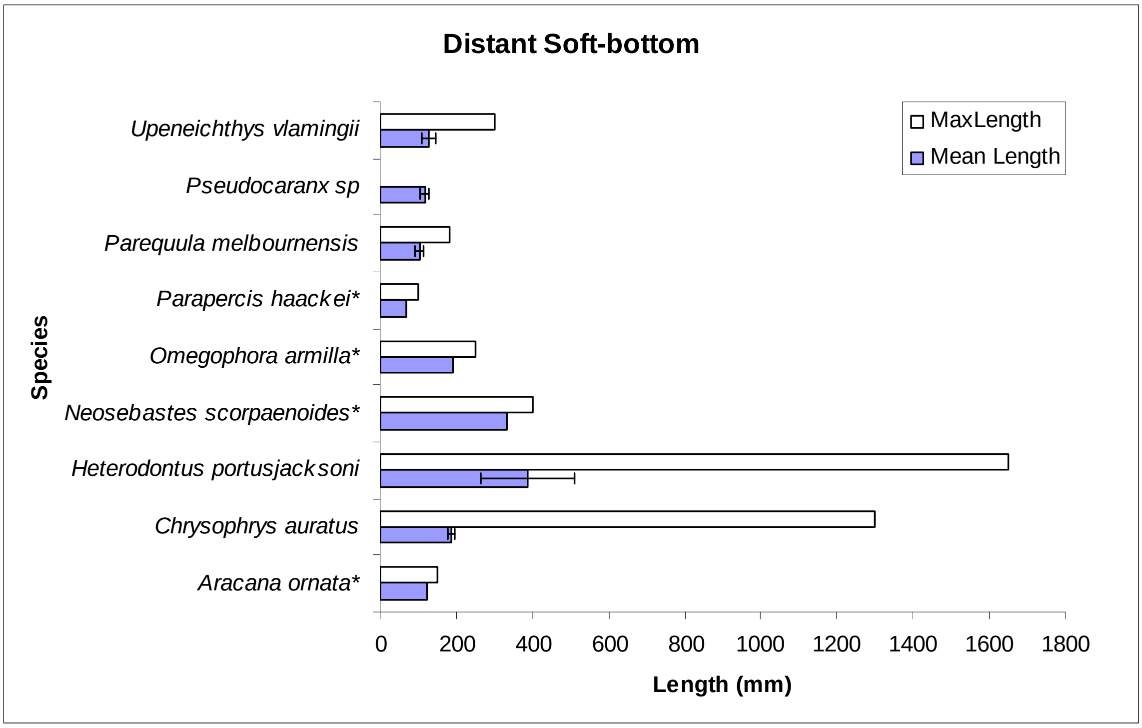

Figure 5d: 'Distant soft-bottom' mean fish length and maximum adult length as per Gomon *et al* (2008) with standard error. * = single fish length (no mean). Note – because of the high variability of maximum adult fish length between species within the Genus *Pseudocaranx*, this measurement was not included.

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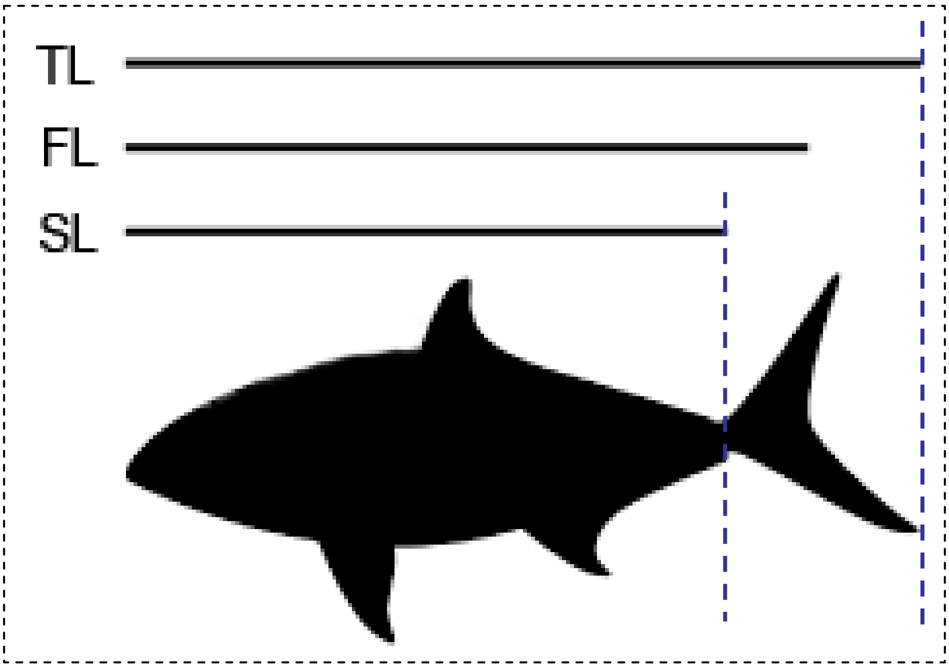
http://www.sawater.com.au/SAWater/WhatsNew/MajorProjects/EIS.htm

Appendix A. Fish length measurements

TL = Total length
FL = Fork length
SL = Standard length (also referred to as disc length in some rays)



Appendix B. Species identified adjacent the Port Stanvac desalination plant winter/spring 2012

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

(CSIRO (2010). CAAB - Codes for Australian Aquatic Biota. CSIRO Marine Research http://www.marine.csiro.au/caab/)

Class	Family	Genus	Species	Common name	Fish ID/Code
Chondrichthyes	Dasyatidae	*Dasyatis*	*brevicaudata*	Smooth stingray	37035001
	Heterodontidae	*Heterodontus*	*portusjacksoni*	Port Jackson shark	37007001
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
	Gerreidae	*Parequula*	*melbournensis*	Melbourne silverbelly	37349001
	Monacanthidae	*Acanthaluteres*	*spilomelanurus*	Bridled leatherjacket	37465043
		Meuschenia	*freycineti*	Brownstriped leatherjacket	37465036
		Meuschenia	*scaber*	Velvet leatherjacket	37465005
		Nelusetta	*ayraud*	Ocean jacket	37465006
	Mullidae	*Upeneichthys*	*vlamingii*	Bluespotted goatfish	37355029
	Neosebastidae	*Neosebastes*	*scorpaenoides*	Common gurnard perch	37287003
	Neosebastidae	*Neosebastes*	spp	Gurnard perch	37287927
	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	*Chrysophrys*	*auratus*	Snapper	37353001
	Tetraodontidae	*Torquigener*	*pleurogramma*	Weeping toadfish	37467030
	Tetraodontidae	*Omegophora*	*armilla*	Ringed toadfish	37467002

Appendix C. Abundance and Number of species

Site	Sample	Abundance	Number of species
Near Reef	PS04	37	3
Near Reef	PS05	24	3
Near Reef	PS06	4	3
Near Reef	PS22	5	4
Near Reef	PS23	38	4
Near Reef	PS24	0	0
Near Soft-bottom	PS10	40	8
Near Soft-bottom	PS11	9	4
Near Soft-bottom	PS12	30	6
Near Soft-bottom	PS13	6	6
Near Soft-bottom	PS14	31	2
Near Soft-bottom	PS15	0	0
Distant Reef	PS01	4	3
Distant Reef	PS02	0	0
Distant Reef	PS03	4	4
Distant Reef	PS19	0	0
Distant Reef	PS20	7	2
Distant Reef	PS21	0	0
Distant Soft-bottom	PS07	91	3
Distant Soft-bottom	PS08	1	1
Distant Soft-bottom	PS09	2	2
Distant Soft-bottom	PS16	15	5
Distant Soft-bottom	PS17	42	3
Distant Soft-bottom	PS18	3	2