An assessment of Fish Assemblages adjacent Port Stanvac

Interim Field Summary to Adelaide Aqua for the
Adelaide desalination plant project
Autumn 2011 (May)

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. 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.

The DENR study involves the collection of data using baited remote underwater video systems (BRUVS) encompassing four seasons over a period of two years (8 seasons in total). Stereo video footage is analysed to provide data on species type, relative abundance and fish length.

Results from the Autumn sampling, carried out in May 2011 found that a total of 43 species representing 26 families were observed. Overall, 572 fish were counted and 245 individuals were measured for length.

Fish assemblages in the area were spatially variable and fish communities differed between the Reef and Soft-Bottom habitats overall. “Near” and “Distant” sites also differed. 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 Autumn sampling period in year two of the monitoring program. It is the last for the 2010/2011 survey and will be followed by a detailed final report examining fish community patterns in the study area over two full years.

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. This project was extended a further year to include an assessment of inter-annual differences in fish assemblages at the site.

The DENR study (over the two full years) will report on the species type, relative abundance, and average fish lengths within and outside the proposed salinity impact zone. It will also examine spatial and temporal variability over eight seasons during 2009 – 2011.

The present summary is the fourth and final interim summary of results from the Autumn field survey for the second year of the project and will be followed by a final report detailing the full two years of data.

2. Materials and methods

2.1 Study area

Two sites were selected within (*Near* sites) and two outside (*Distant* sites) the predicted zone of influence of the saline outfall. 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 and depth (Figure 1).

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).

Data collection points over two habitat types, patchy sparse algae on soft sediment (*soft-bottom*) and patchy low profile reef (*reef*), within the *near* and *distant* sites were located using existing habitat maps (Figure 1; DEH 2008a,b).

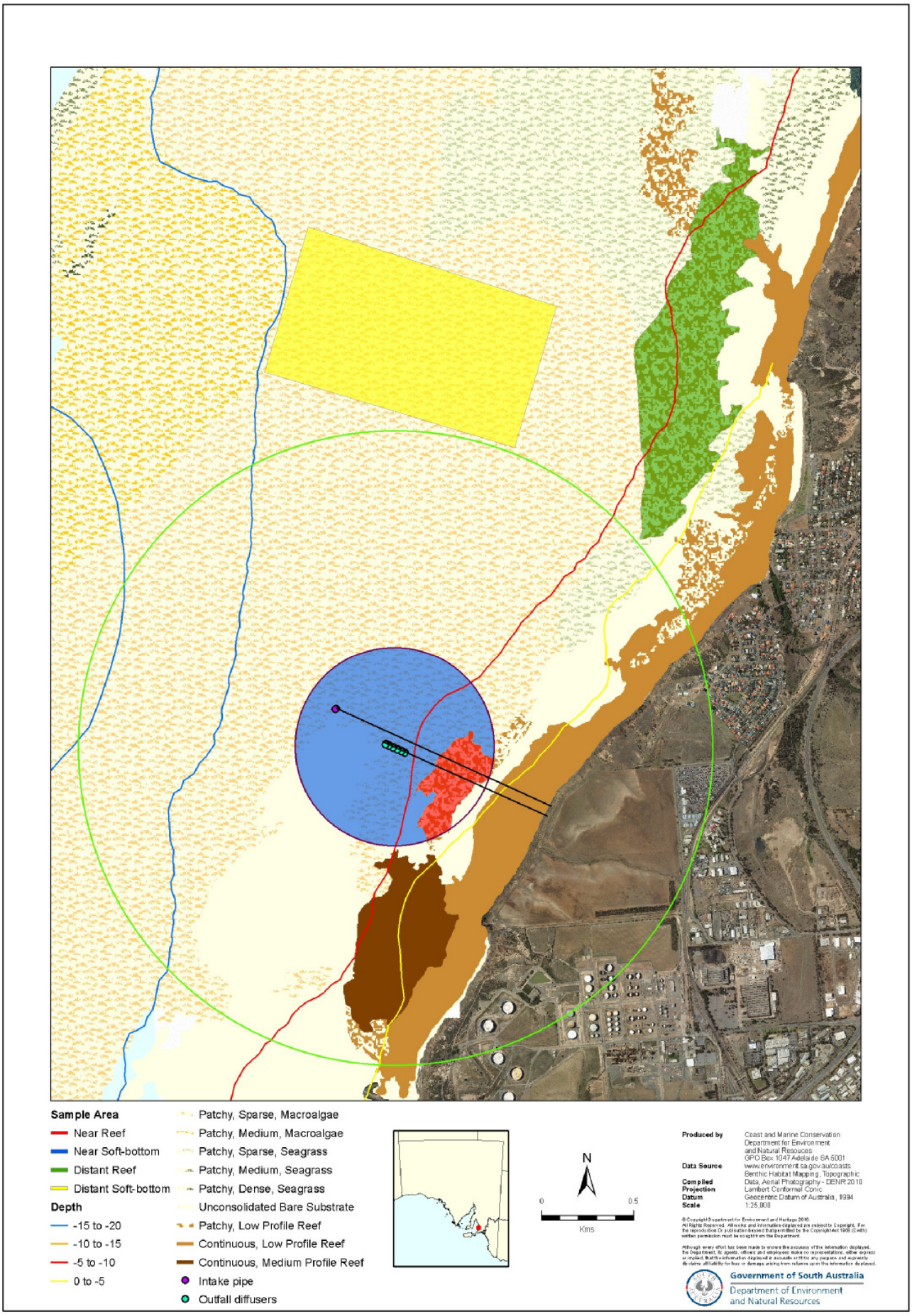

Figure 1: Port Stanvac area showing 'Near' and 'Distant' survey sites (red, blue, green & yellow) and predicted dilution contours, 50:1 (inner circle) and 100:1 (outer circle), in relation to the outfall and intake pipes.

2.2 Survey Dates

Two days of sampling were carried out on the 16th and 17th of May 2011. 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 are used. A bait bag containing ~ 800 grams of mashed pilchards (*Sardinops spp.*) is 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 is 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 made up to a range of 4 m from the cameras. Beyond this distance, precision of measurements decrease significantly.

2.4 Deployment methods

During each sampling season, six BRUVS are deployed within each of the four areas in daylight hours over two consecutive days. Three BRUV units are 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 are comparable.

BRUV units are deployed in groups of three with an average time separation of between 5 and 10 minutes. Where possible BRUV units are deployed a minimum of 200 m apart to avoid an unpredictable response of fish to the bait plume and achieve a level of independence between samples. Each BRUV is 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).

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*, *Heptranchias* and *Trygonorrhina* 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 the autumn sampling period a total of 43 species were identified, a further 3 described to genus level, and 3 to family level (see Appendix A). Overall, 26 Families were represented, 572 fish counted and 252 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 (Gomon *et al.* 2008; Edgar 2008; Kuiter 2001). These were:

- *Acanthaluteres* spp.
- *Aracana* spp.
- *Pseudocaranx* spp.

In addition, the following were only identified to family level (Gomon *et al.* 2008; Edgar 2008; Kuiter 2001):

- Gobiidae
- Labridae
- Ostraciidae
- Sillaginidae

A Significant difference in the fish assemblages was found between both habitats (F = 5.1556, P = 0.0019) and treatments (F = 3.3449, P = 0.0001). This difference is

apparent in the MDS plot (Figure 2) with reef samples ordinating largely to the left of the plot and soft bottom samples ordinating to the bottom right. Between treatments, distant samples ordinate centrally in the upper half of the plot, while distant sites ordinate to the bottom. The near site samples appear more variable (wider spread of points), particularly the reef samples. There was no significant interaction between Treatments and Habitats.

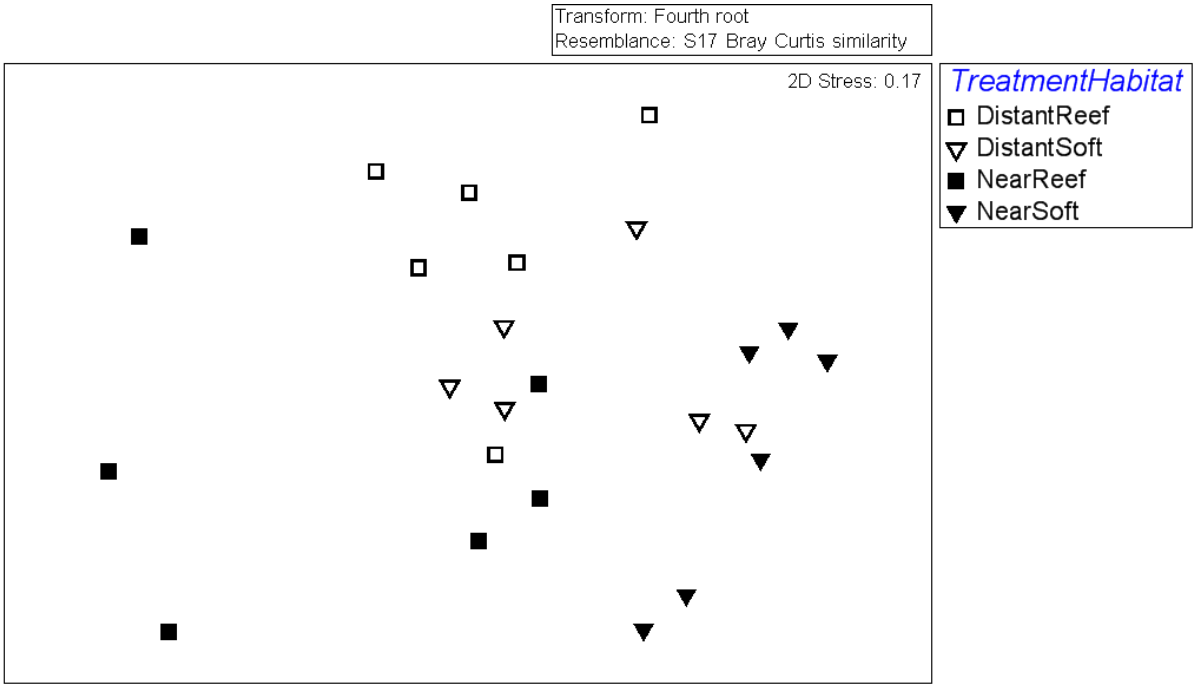

Figure 2. MDS ordination plot of the 24 sites by Treatment and Habitat

3.1 Species richness and relative overall abundance

Mean relative abundances were low at the distant sites relative to the near sites (Figure 3). As in previous seasons the higher relative abundances were also associated with higher variability (seen in the larger standard error bars, Figure 3), particularly in the soft bottom habitat. This suggests the higher values resulted from very high numbers of individual fish in several samples.

Overall, the mean number of species was similar to other seasons (Figure 4). The total number of species was highest at the near reef site (see Appendix B for Raw Data).

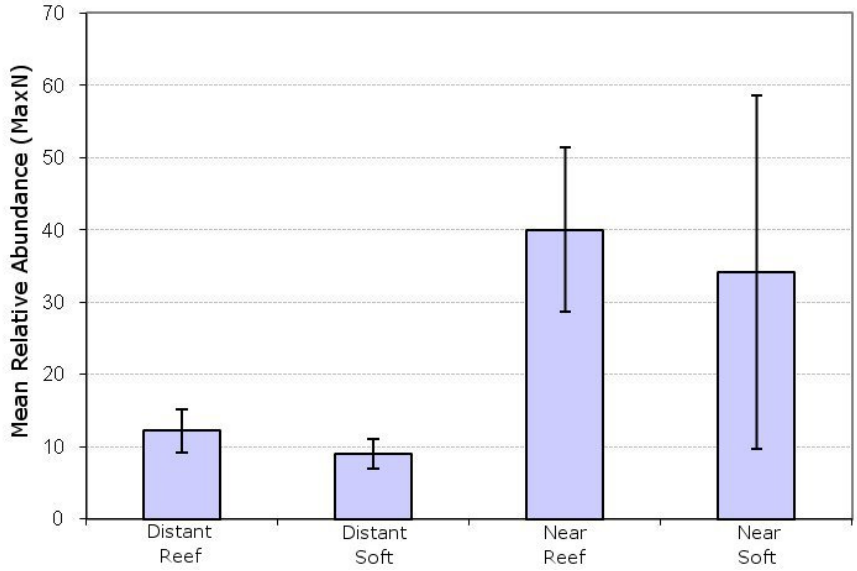

Figure 3 Mean relative abundance across all sites (bars represent standard error).

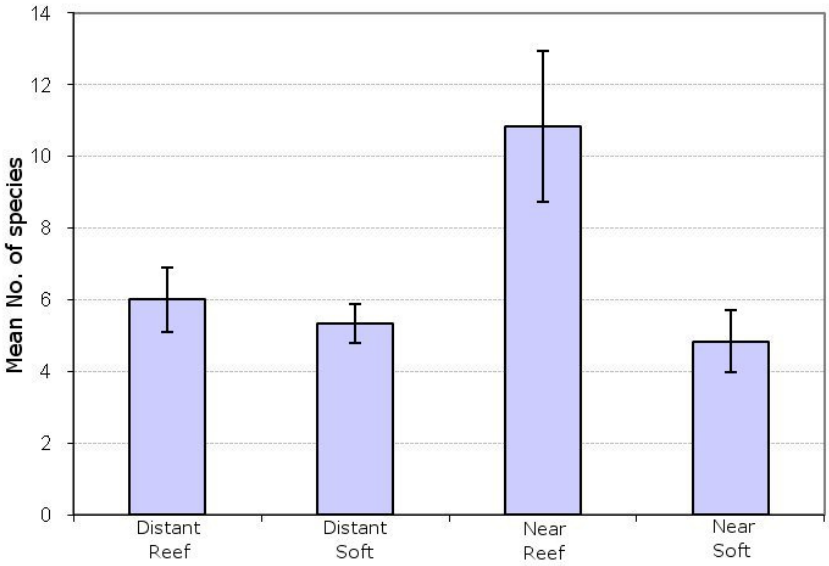

Figure 4 Mean number of species across all sites (bars represent standard error).

3.2 Fish lengths

A total of 247 fish comprising 33 identified individual species, were measured using stereo video imagery. There were no obvious patterns in fish length between sites (Figure 5 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.

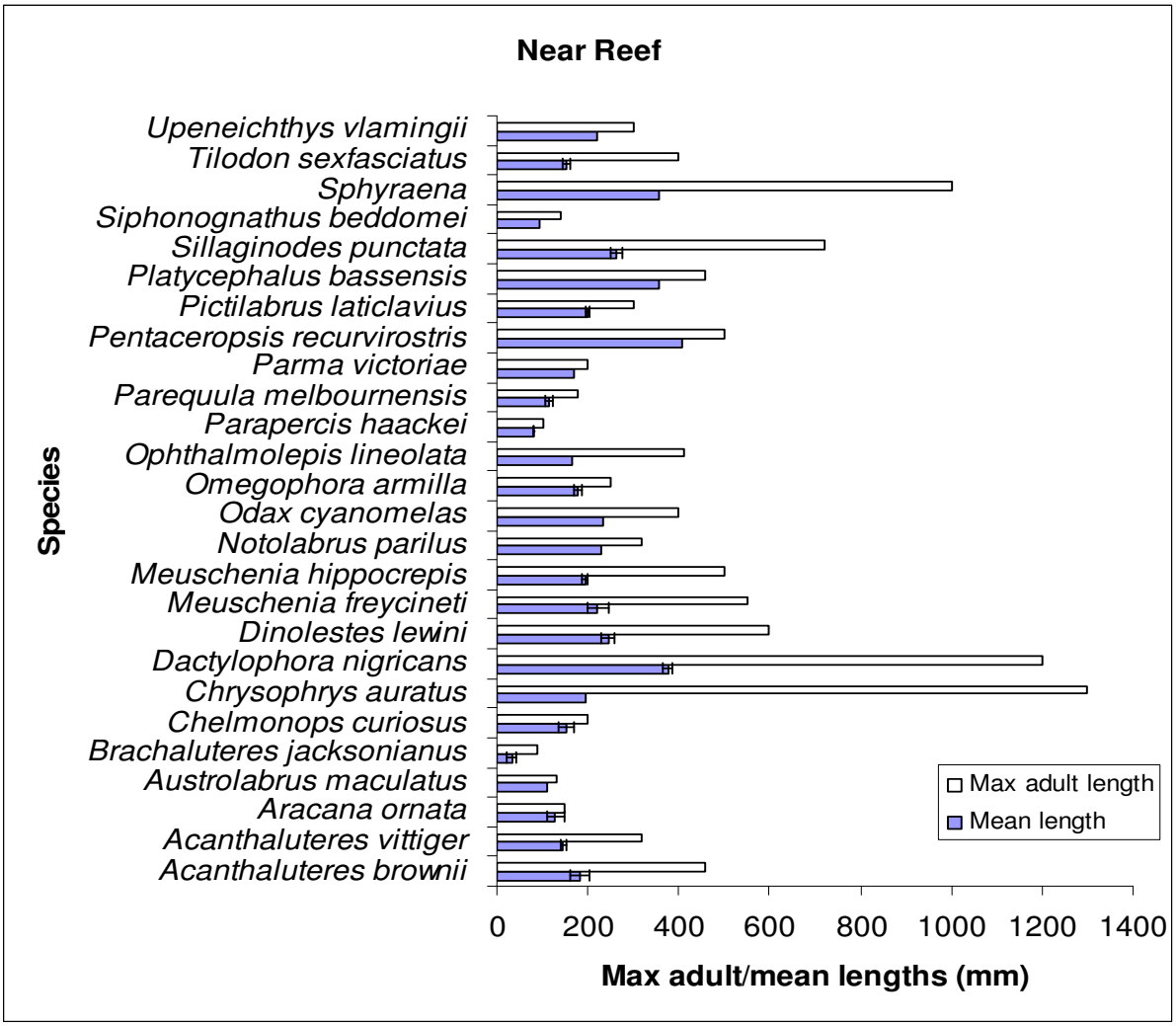

Figure 5a Near Reef mean fish length with standard error (where appropriate)

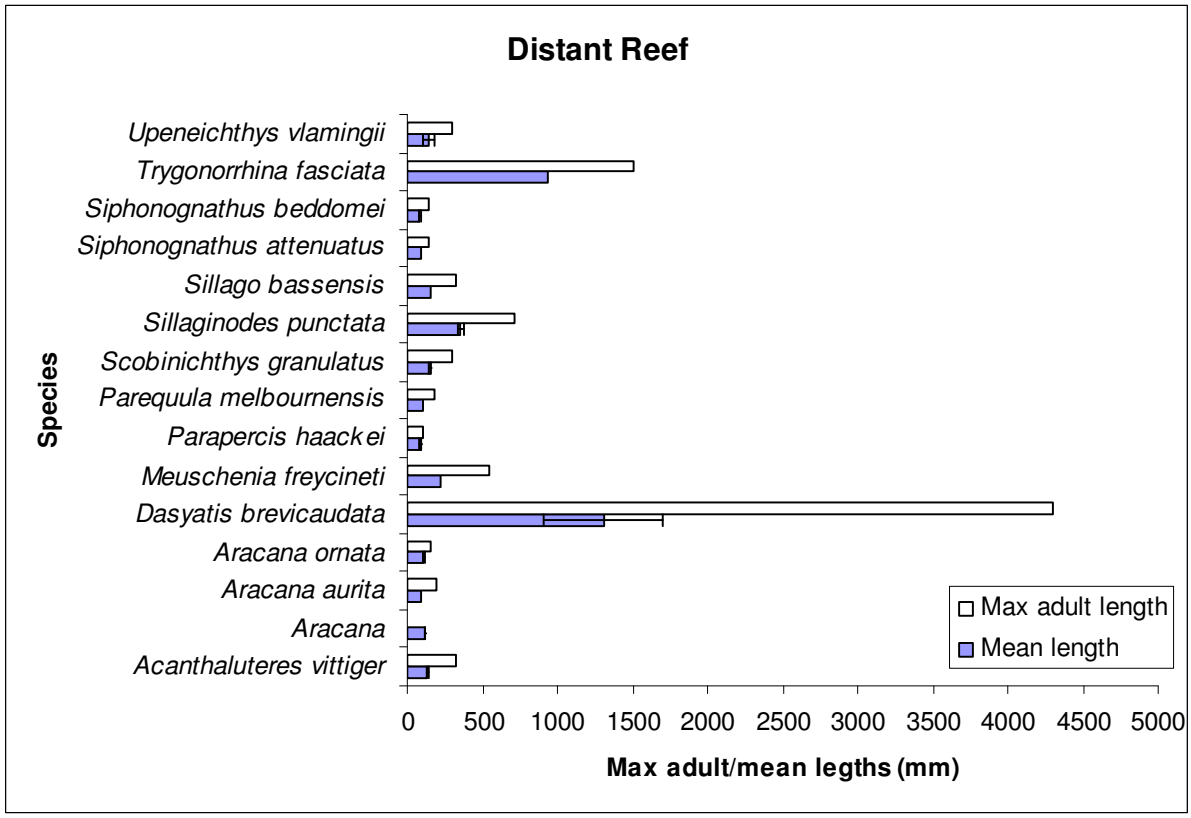

Figure 5b Distant Reef mean fish length with standard error (where appropriate)

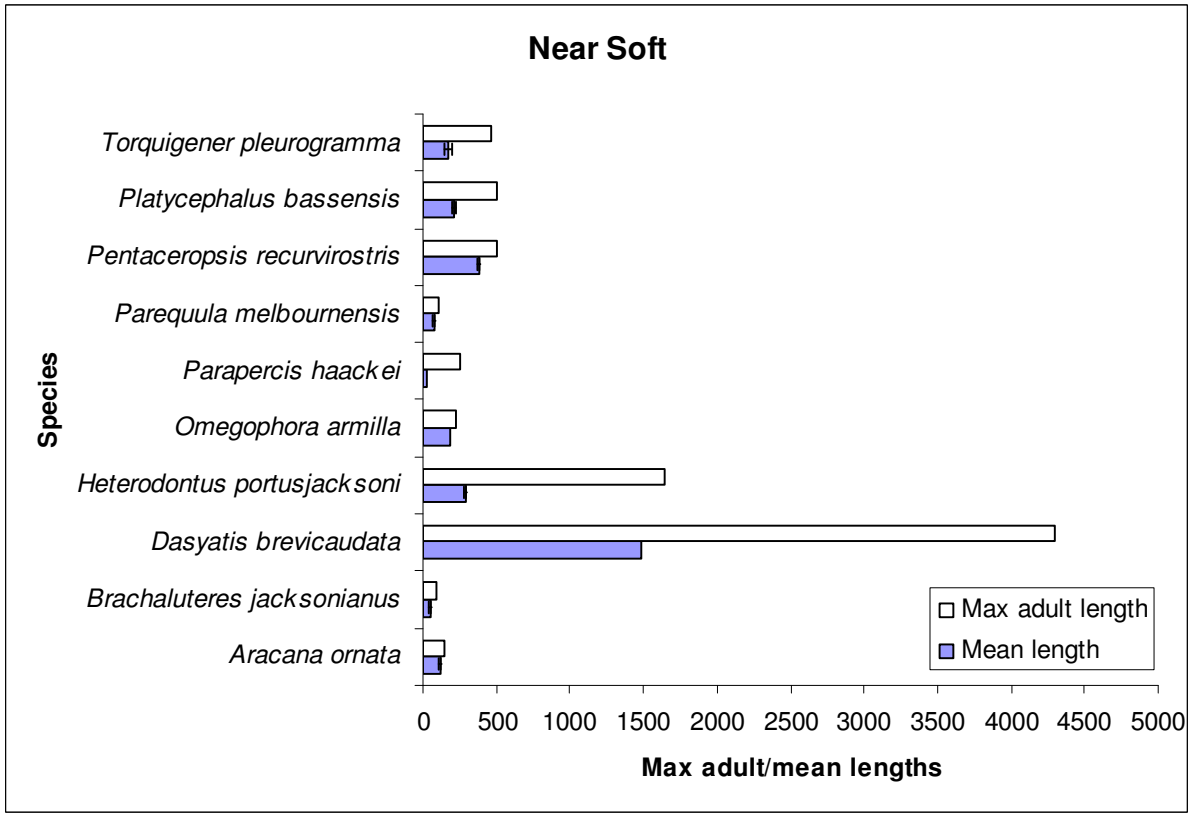

Figure 5c Near Soft-bottom mean fish length with standard error (where appropriate)

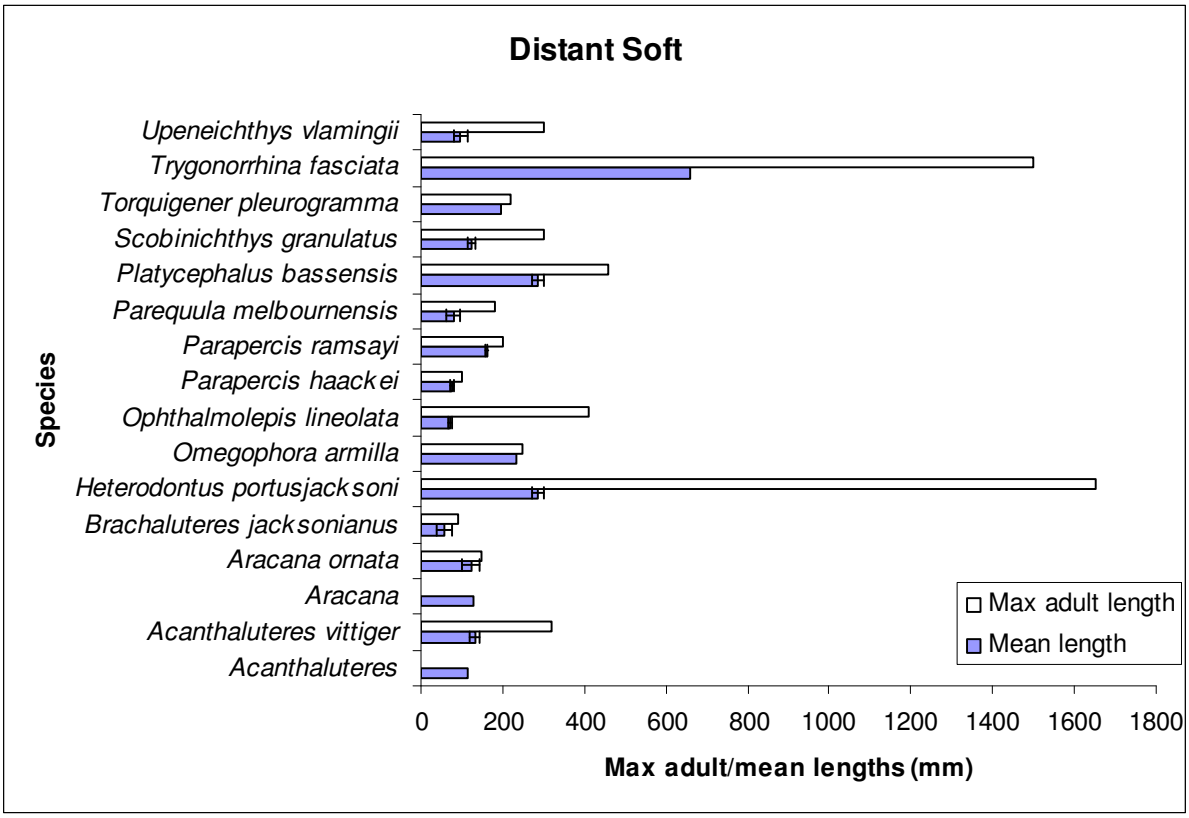

Figure 5d Distant Soft-bottom mean fish length with standard error (where appropriate)

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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	37 035001
	Heterodontidae	*Heterodontus*	*portusjacksoni*	Port Jackson Shark	37 007001
	Rhinobatidae	*Trygonorrhina*	*fasciata*	a Guitarfish	37 027006
Osteichthyes	Arripidae	*Arripis*	*georgianus*	Australian herring	37 344001
		Arripis	*truttaceus*	West Australian salmon	37 344004
	Carangidae	*Pseudocaranx*	spp	Travally	37 337000
	Chaetodontidae	*Chelmonops*	*curiosus*	Western talma	37 365066
		Cheilodactylus	*nigripes*	Magpie perch	37 377001
		Dactylophora	*nigricans*	Dusky Morwong	37 377005
	Dinolestidae	*Dinolestes*	*lewini*	Longfin Pike	37 327002
	Enoplosidae	*Enoplosus*	*armatus*	Old wife	37 366001
	Gerreidae	*Parequula*	*melbournensis*	Melbourne Silverbelly	37 349001
	Gobiidae	Gobiidae Unk	spp	Goby	37 428000
	Labridae	*Austrolabrus*	*maculatus*	Blackspotted Wrasse	37 384025
		Dotalabrus	*aurantiacus*	Castelnau's wrasse	37 384018
		Notolabrus	*parilus*	Brownspotted Wrasse	37 384022
		Ophthalmolepis	*lineolata*	Southern Maori Wrasse	37 384040
		Pictilabrus	*laticlavius*	Senator Wrasse	37 384020
		Labridae Unk	spp	Wrasse	37 384000
	Monacanthidae	*Acanthaluteres*	*brownii*	Spinytail Leatherjacket	37 465001
		Acanthaluteres	*spilomelanurus*	Bridled leatherjacket	37 465043
		Acanthaluteres	spp	Leatherjacket	37 465901
		Acanthaluteres	*vittiger*	Toothbrush leatherjacket	37 465002
		Brachaluteres	*jacksonianus*	Southern pygmy leatherjacket	37 465025
		Meuschenia	*flavolineata*	Yellowstriped leatherjacket	37 465035
		Meuschenia	*freycineti*	Sixspine Leatherjacket	37 465036
		Meuschenia	*hippocrepis*	Horseshoe Leatherjacket	37 465004
		Scobinichthys	*granulatus*	Rough Leatherjacket	37 465007
	Mullidae	*Upeneichthys*	*vlamingii*	Bluespotted Goatfish	37 355029
	Odacidae	*Olisthops*	*cyanomelas*	Herring cale	37 385001
		Siphonognathus	*attenuatus*	Slender Weed Whiting	37 385004
		Siphonognathus	*beddomei*	Pencil Weed Whiting	37 385006
	Ostraciidae	*Aracana*	*aurita*	Shaw's Cowfish	37 466003
		Aracana	*ornata*	Ornate Cowfish	37 466001
		Aracana	spp	Cowfish	37 466000
		Ostraciidae Unk	spp	Boxfish	37 466000
	Paralichthyidae	*Pseudorhombus*	*jenynsii*	Smalltooth flounder	37 460002
	Pentacerotidae	*Pentaceropsis*	*recurvirostris*	Longsnout Boarfish	37 367003
	Pinguipedidae	*Parapercis*	*haackei*	Wavy Grubfish	37 390004
	Platycephalidae	*Platycephalus*	*bassensis*	Southern Sand Flathead	37 296003
	Pinguipedidae	*Parapercis*	*ramsayi*	Spotted grubfish	37 390002
	Scorpididae	*Tilodon*	*sexfasciatus*	Moonlighter	37 361003
	Sillaginidae	*Sillaginodes*	*punctata*	King George whiting	37 330001
		Sillago	*bassensis*		37 330901

	Sillago	spp	Whiting	37 330000
Sparidae	*Chrysophrys*	*auratus*	Snapper	37 353001
Sphyraenidae	*Sphyraena*	*novaehollandiae*	Snook	37 382002
Tetraodontidae	*Omegophora*	*armilla*	Ringed Toadfish	37 467002
	Torquigener	*pleurogramma*	Weeping Toadfish	37 467030
Tetrarogidae	*Gymnapistes*	*marmoratus*	Cobbler	37 287018

Appendix B. Abundance and number of species

Site	Sample	Abundance	No of Sp
Near Reef	PS010	23	10
Near Reef	PS011	50	9
Near Reef	PS012	10	5
Near Reef	PS016	19	7
Near Reef	PS017	54	17
Near Reef	PS018	84	12
Near Soft-bottom	PS004	156	5
Near Soft-bottom	PS005	6	4
Near Soft-bottom	PS006	12	8
Near Soft-bottom	PS019	18	3
Near Soft-bottom	PS020	7	4
Near Soft-bottom	PS021	6	4
Distant Reef	PS001	7	6
Distant Reef	PS002	8	4
Distant Reef	PS003	18	4
Distant Reef	PS022	15	7
Distant Reef	PS023	22	7
Distant Reef	PS024	3	3
Distant Soft-bottom	PS007	12	5
Distant Soft-bottom	PS008	7	4
Distant Soft-bottom	PS009	7	5
Distant Soft-bottom	PS013	5	4
Distant Soft-bottom	PS014	5	4
Distant Soft-bottom	PS015	18	7