An assessment of Fish Assemblages adjacent Port Stanvac

Interim Field Summary to Adelaide Aqua for the
Adelaide desalination plant project
Summer 2011 (February)

Coast and Marine Conservation Branch
Department of Environment and Natural Resources

Henry Rutherford, Dimitri Colella, David Miller and Ali Bloomfield

Contents

Page

Summary

A seawater desalination plant is now under construction at the former Mobil oil refinery site at Port Stanvac as part of the South Australian Government's plans to secure a future water supply for South Australia. 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 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. Stereo video footage is analysed to provide data on species type, abundance, species richness, and fish length.

Results from the summer sampling, carried out in February 2011 found that a total of 37 species representing 29 families were observed. Overall, 5163 fish were counted and 244 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 differed within Reef habitat sites but not in the Soft sites. 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 Summer sampling period in Year two of the monitoring program. It will be followed by an additional sampling period during May 2011 with an associated result summary.

1. Introduction

In late 2009 the Department of Environment and Natural Resources (DENR) 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 has now been extended a further year to include an assessment of inter-annual differences in fish assemblages at the site.

The DENR study will report on the species richness, abundance, and average fish lengths within and outside the proposed salinity impact zone. It will also examine spatial and temporal variability over four seasons during 2010 – 2011 and inter-annual variations between the two seasonal cycles.

The present summary is the third of four interim summaries for the second year of the project and will be followed by a final report delivered following completion of the 2010/11 field program.

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).

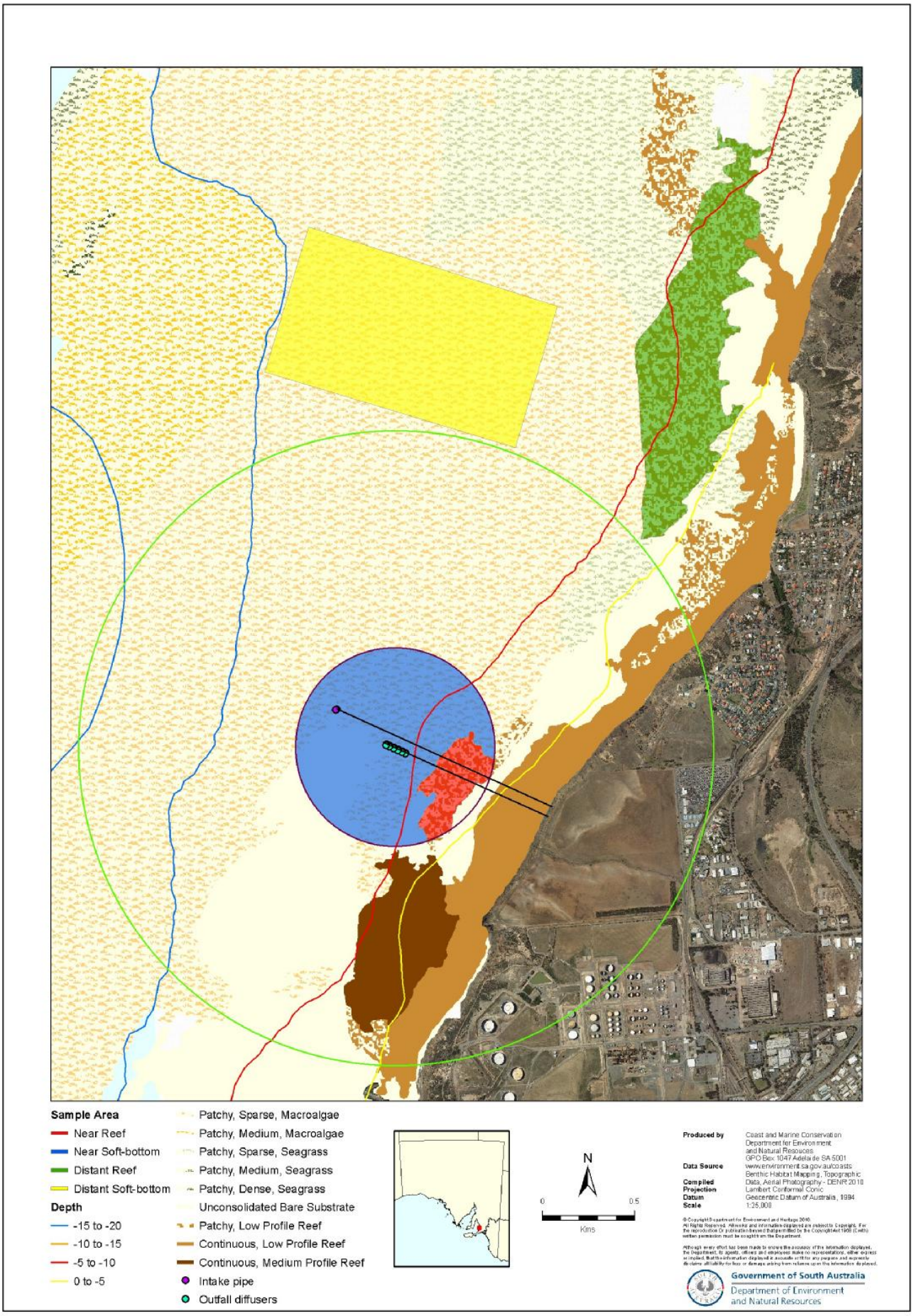


Figure 1: Port Stanvac area showing survey sites (red, blue, green & yellow) and predicted dilution contours, 50:1 (inner circle) and 100:1 (outer circle), in relation to the outfall and intake pipes. "Near" sites were located within the inner circle, while "Distant" sites were locate outside the outer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

2.2 Survey Dates

The four sites *Neat Reef, Near Soft-bottom, Distant Reef, and Distant Soft-bottom* were sampled each with three BRUVS units on each survey day. Two days of sampling were carried out on the 2nd and 3rd of February 2011.

2.3 BRUV systems

Each baited remote underwater video (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 sp.*) 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 *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 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 v6.1.1. One-way analysis of similarity (ANOSIM) was conducted on square-root transformed data using the factor Habitat and similarly for the factor Treatment. Two way pairwise comparisons of Treatments within Habitat were used to assess possible differences in fish assemblages between sites. A visual plot of these differences was produced using a non-metric multi-dimensional scaling (MDS) plot.

3. Results

During the summer sampling period a total of 37 species were identified, a further 6 described to genus level, and 3 to family level (see Appendix A). Overall, 29 Families were represented, 5163 fish counted and 244 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:

- *Platycephalus* spp.
- *Pseudocaranx* spp.
- *Pseudorhombus* spp.
- *Sillago* spp.
- *Sphyraena* spp.
- *Trachurus* spp.

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

- Clupeidae
- Engraulidae
- Monacanthidae

Fish communities were variable spatially (Figure 2) and differed between the two habitat types (reef and soft-bottom, R = 0.377, p = 0.001). Pairwise comparisons of the Near and Distant treatments within the Reef and Soft habitat types found there was a difference between the two reef sites (R = 0.373, p = 0.015, Table 1.2), but none between “Soft” sites (R = 0.191, p = 0.054). This is consistent with the results from the majority of previous seasonal surveys (the Spring 2010 survey being an exception)

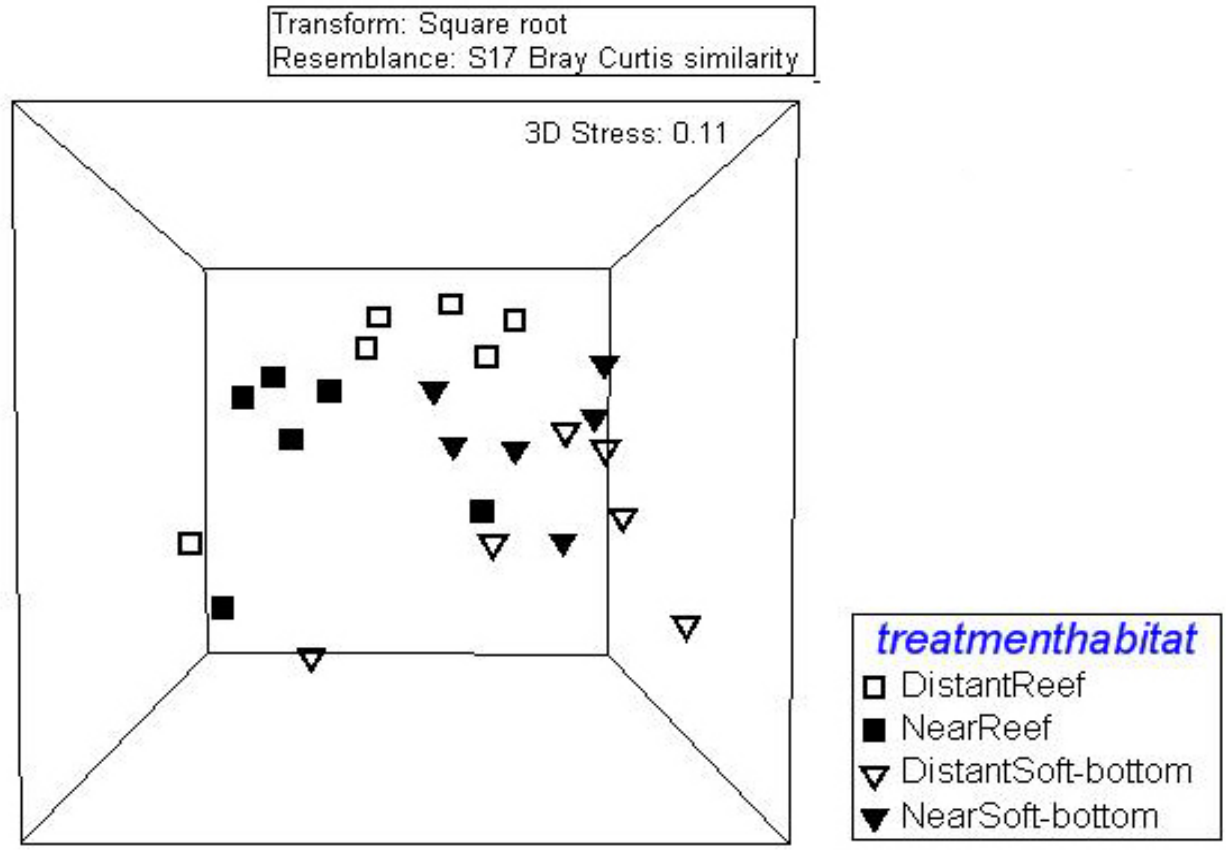


Figure 2. MDS ordination plot of the 24 sites by Treatment and Habitat

Table 1 Pairwise tests between near and distant sites within habitat classifications showing significant difference between Treatments within Reef habitats but none between treatments within soft bottom habitats.

Pairwise Tests	R Statistic	Significance level (p)
Groups		
DistantReef, NearReef	0.373	0.015
DistantSoft, NearSoft	0.191	0.054

3.1 Species richness and relative overall abundance

Mean abundances were low at the “Near Soft-bottom” and “Distant Reef” sites relative to the “Near Reef” and “Distant Soft” sites (Figure 3). Although the “Near Reef” and “Distant Soft” sites had higher abundances the numbers were highly variable between samples at each site. However, these higher values resulted from very high numbers of individual fish in several samples (family Clupeidae, two samples at the “Near Reef” site and one at the “Distant Soft” site).

Mean number of species was similar at all sites with the highest values recorded at the near reef site (Figure 4) (see Appendix B for Raw Data).

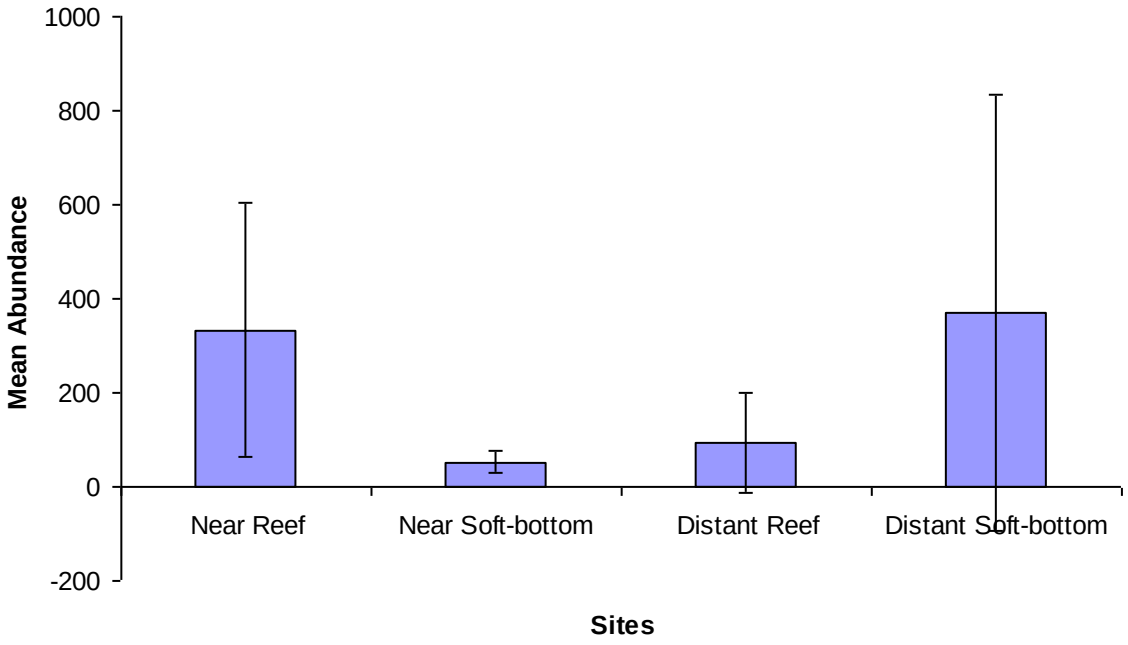


Figure 3. Mean total abundance across all sites (bars represent standard error).

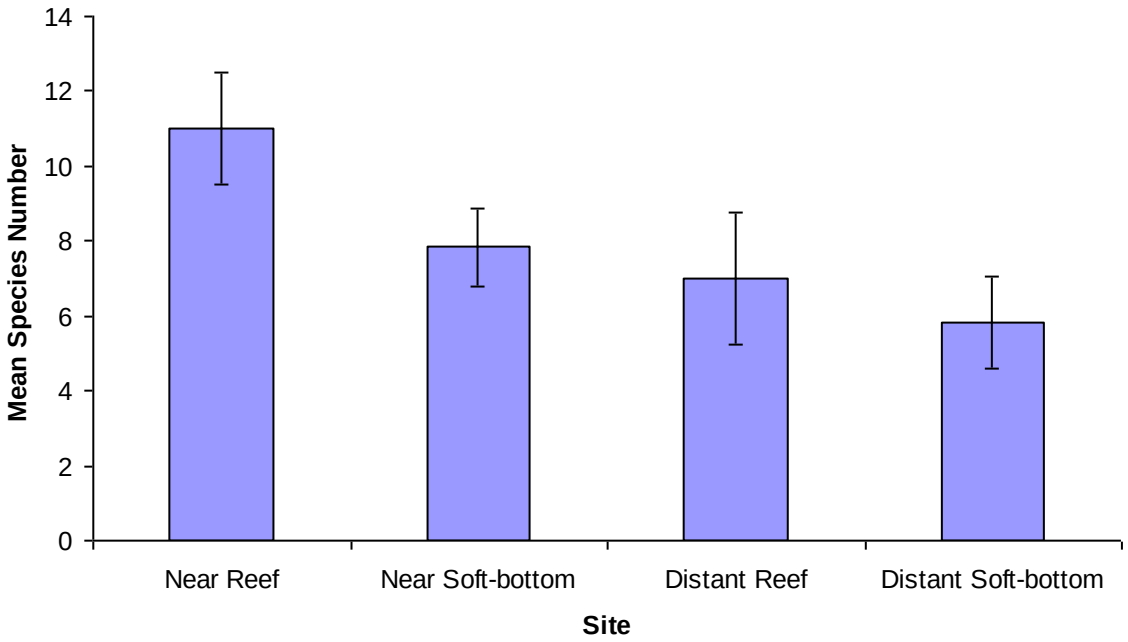


Figure 4. Mean number of species across all sites (bars represent standard error).

3.2 Fish lengths

A total of 244 fish comprising 33 identified individual species, and 4 identified genus groups were measured using stereo video imagery. There were no obvious patterns in fish length between sites (Figures 5.1 – 5.19).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 (see Appendix C for all fish lengths). This is consistent with observations from previous surveys.

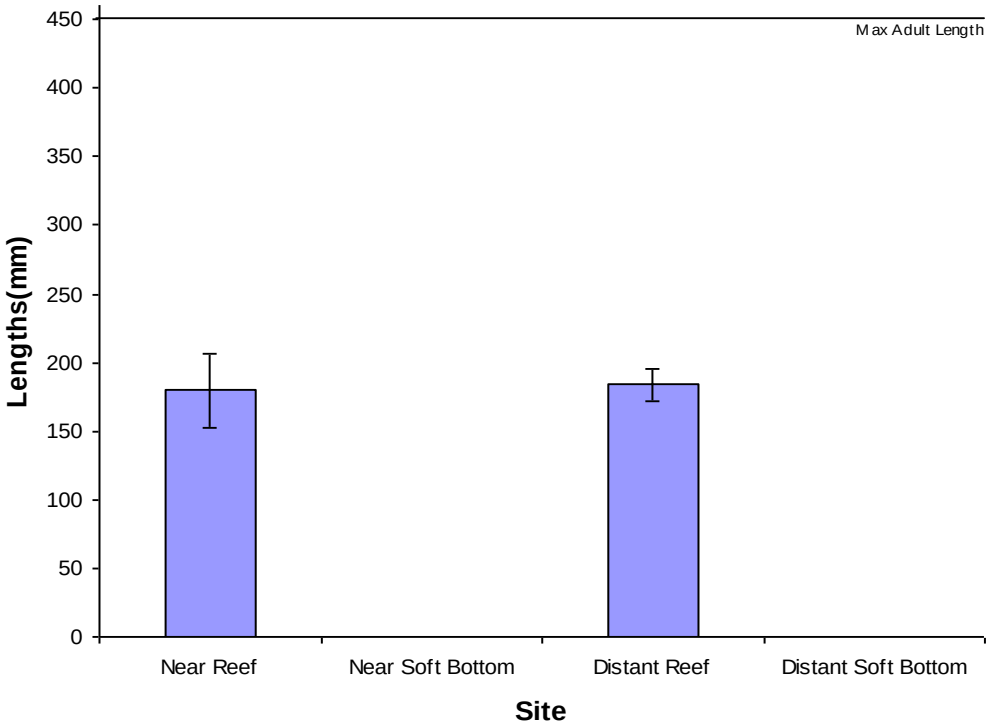


Figure 5.1 Mean length of *Acanthaluteres brownii* across sites including maximum adult length and standard error of mean

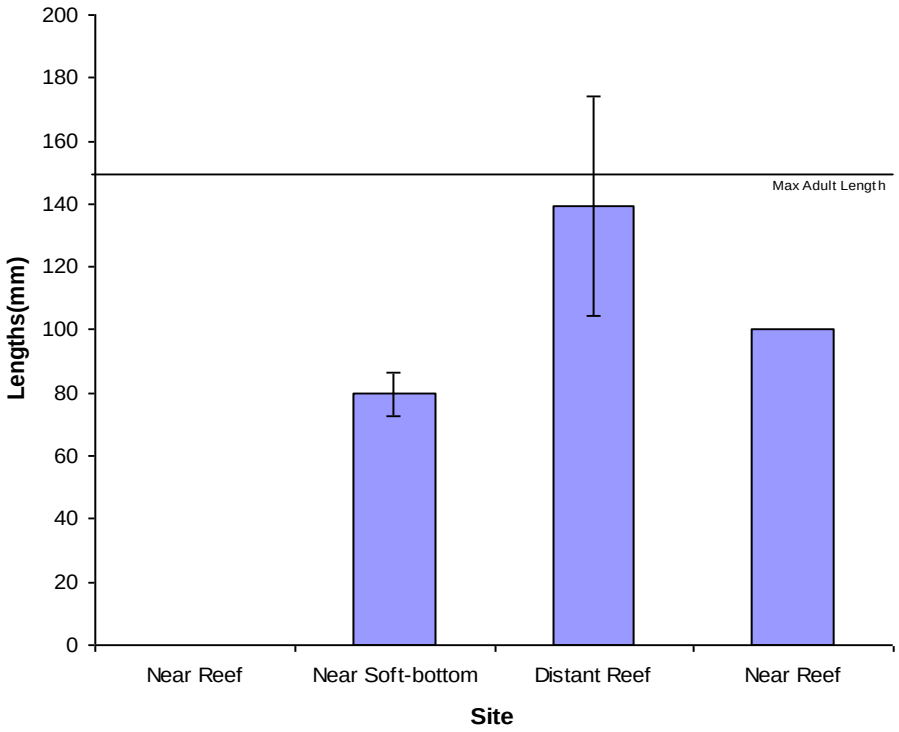


Figure 5.2 Mean length of *Aracana ornata*across sites including maximum adult length and standard error of mean (where appropriate)

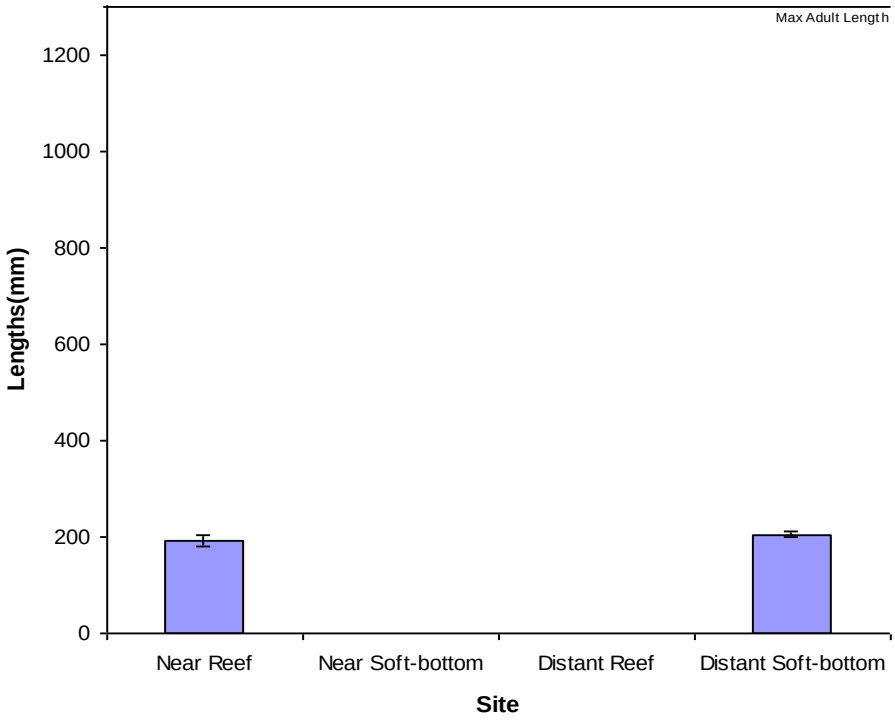


Figure 5.3 Mean length of *Chrysophrys auratus*across sites including maximum adult length and standard error of mean (where appropriate)

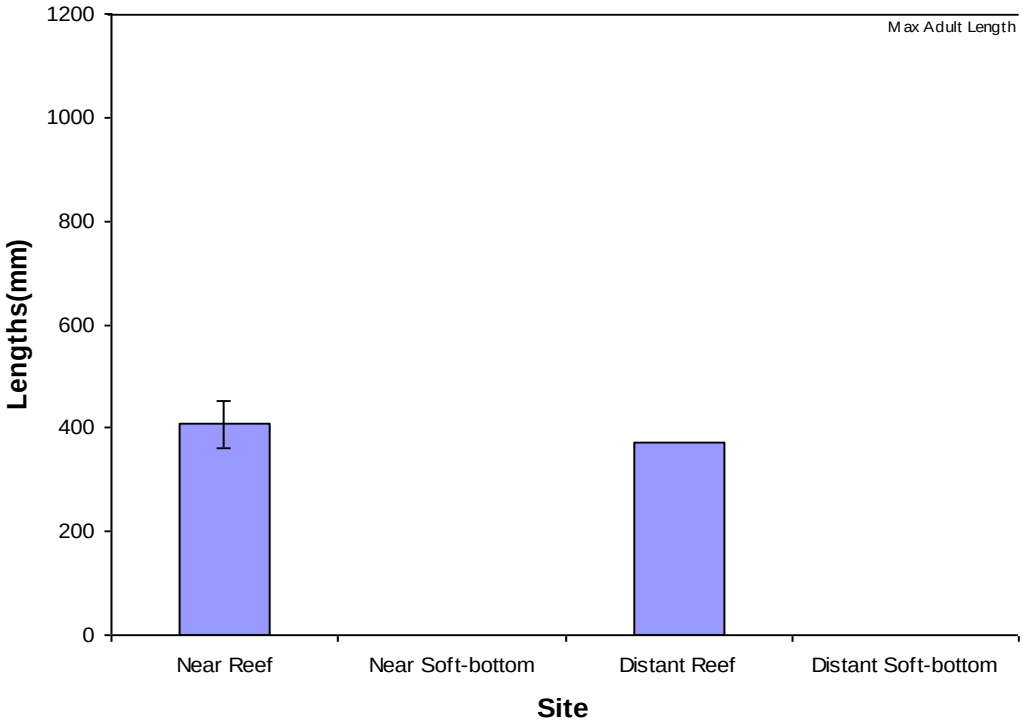


Figure 5.4 Mean length of *Dactylophora nigricans*across sites including maximum adult length and standard error of mean (where appropriate)

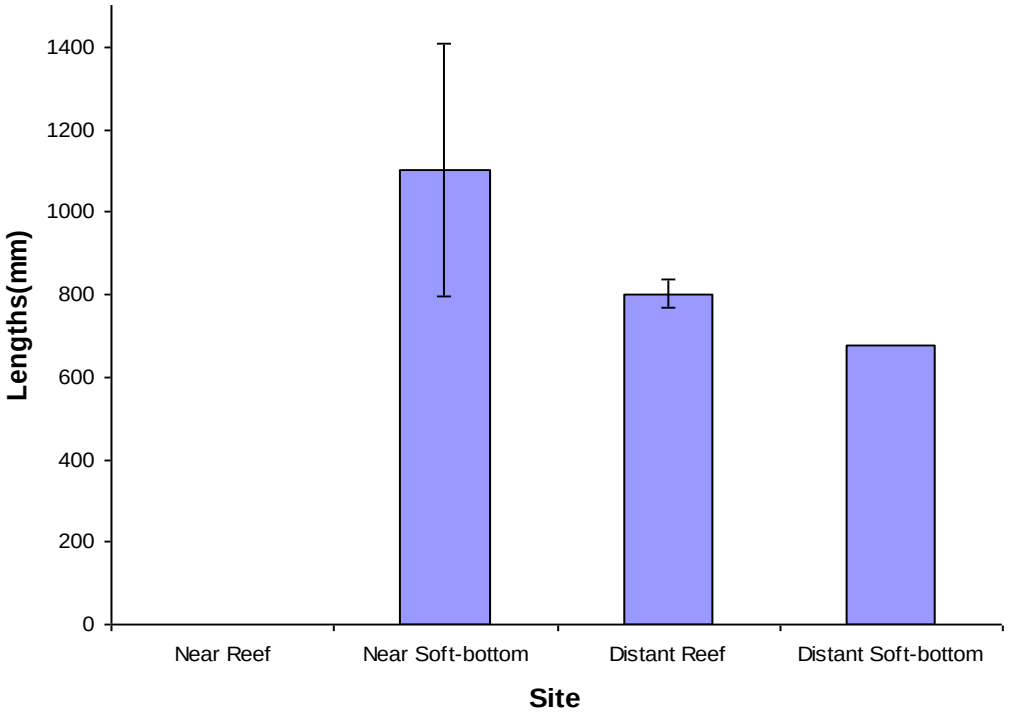


Figure 5.5 Mean length of *Dasyatis brevicaudata* across sites including standard error of mean (where appropriate)

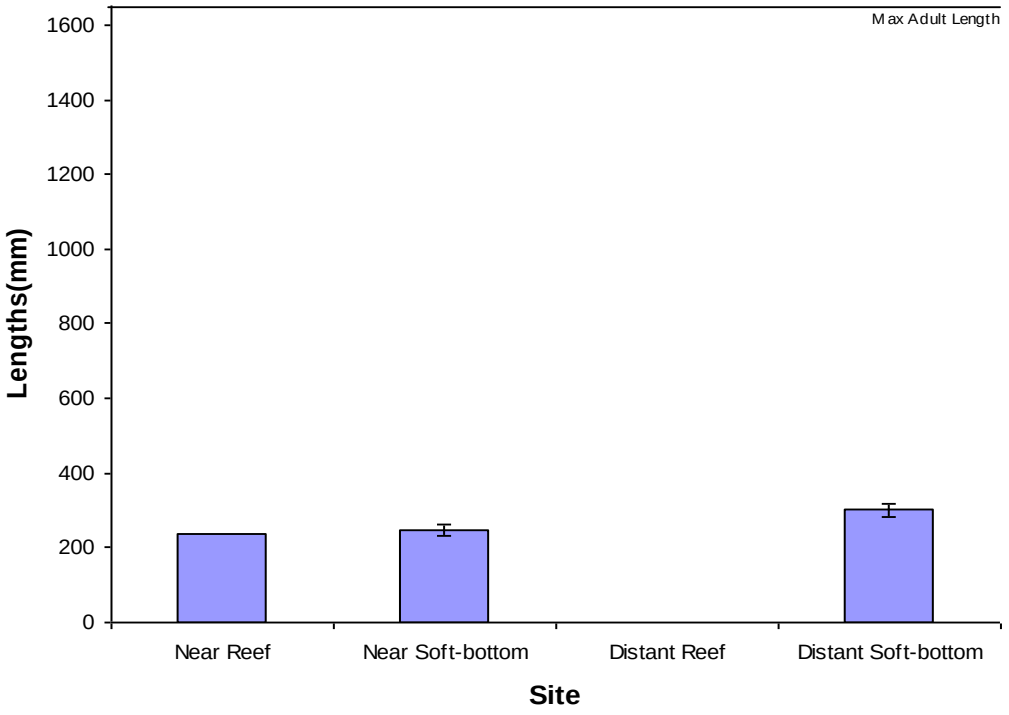


Figure 5.6 Mean length of *Heterodontus portusjacksoni* across sites including maximum adult length and standard error of mean (where appropriate)

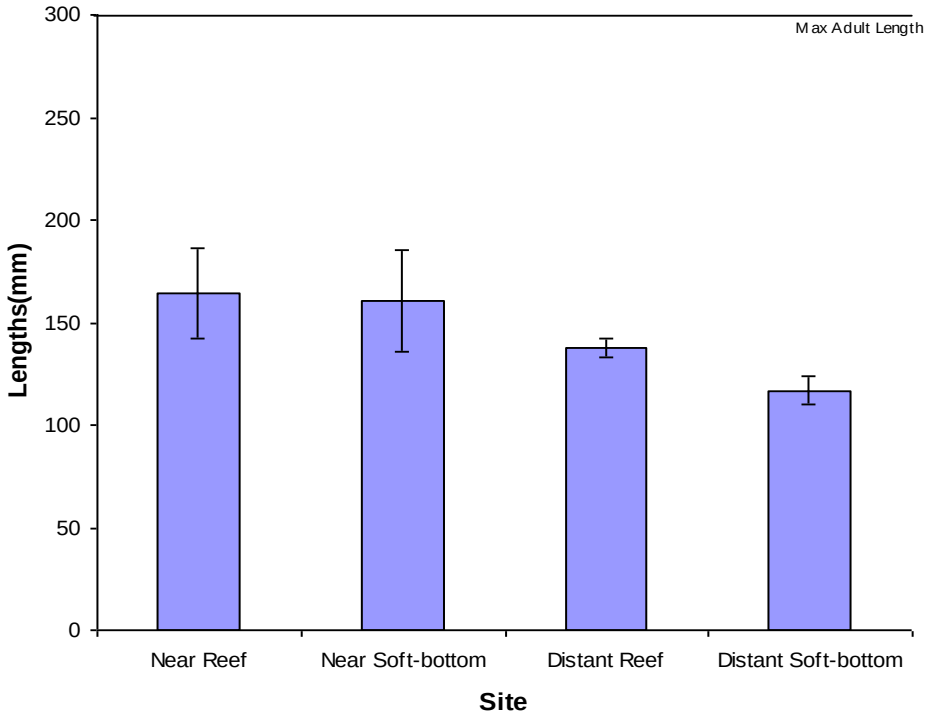


Figure 5.7 Mean length of *Meuschenia freycineti* across sites including maximum adult length and standard error of mean

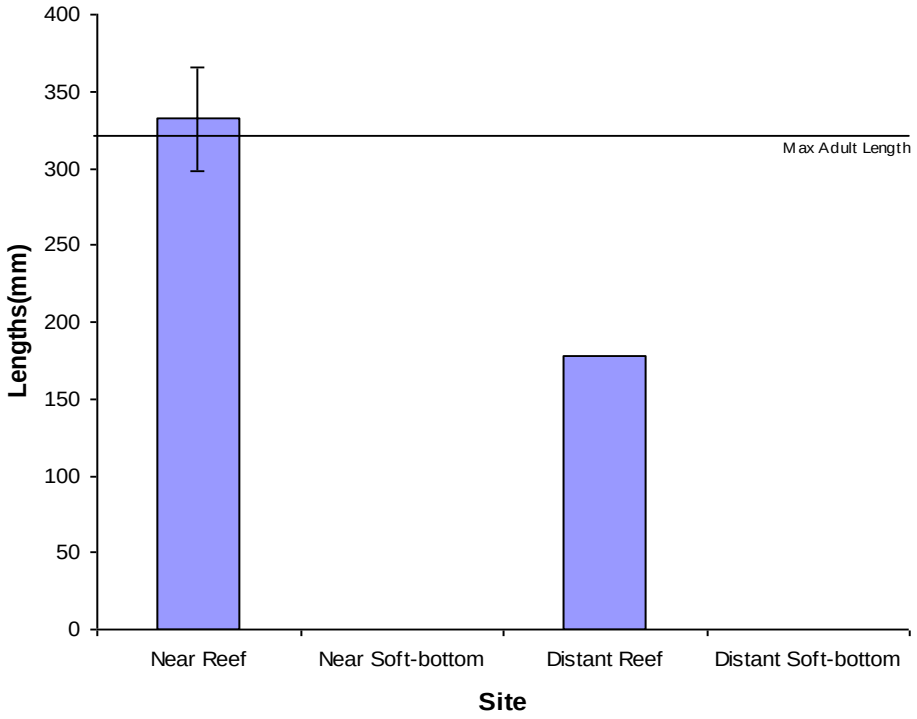


Figure 5.8 Mean length of *Notolabrus parilus*across sites including maximum adult length and standard error of mean (where appropriate)

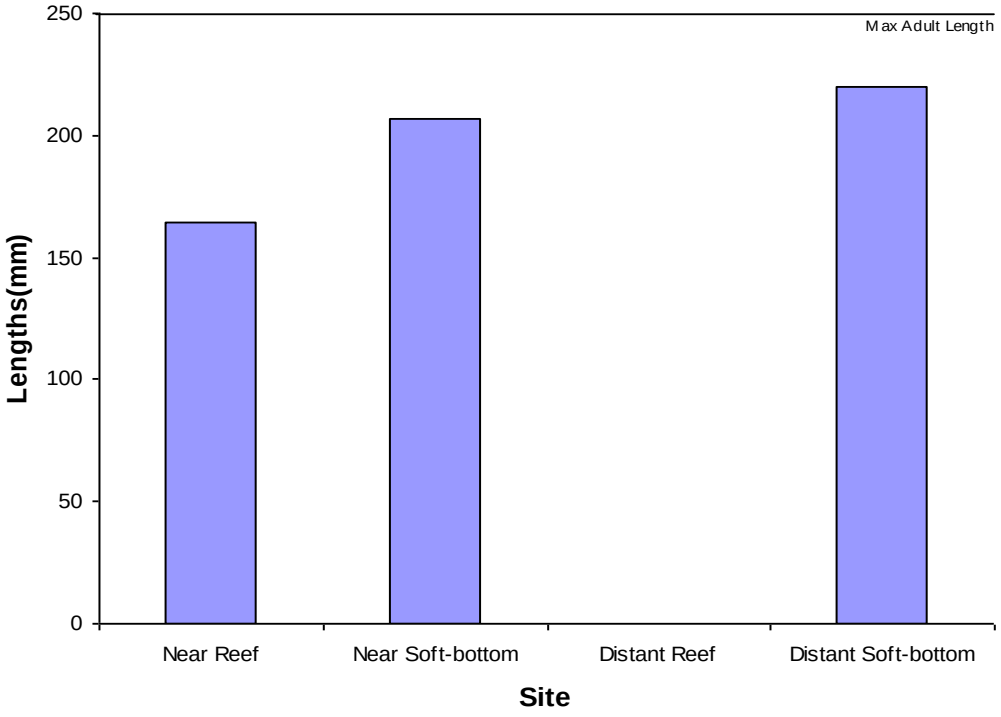


Figure 5.9 Mean length of *Omegophora armilla* across sites including maximum adult length

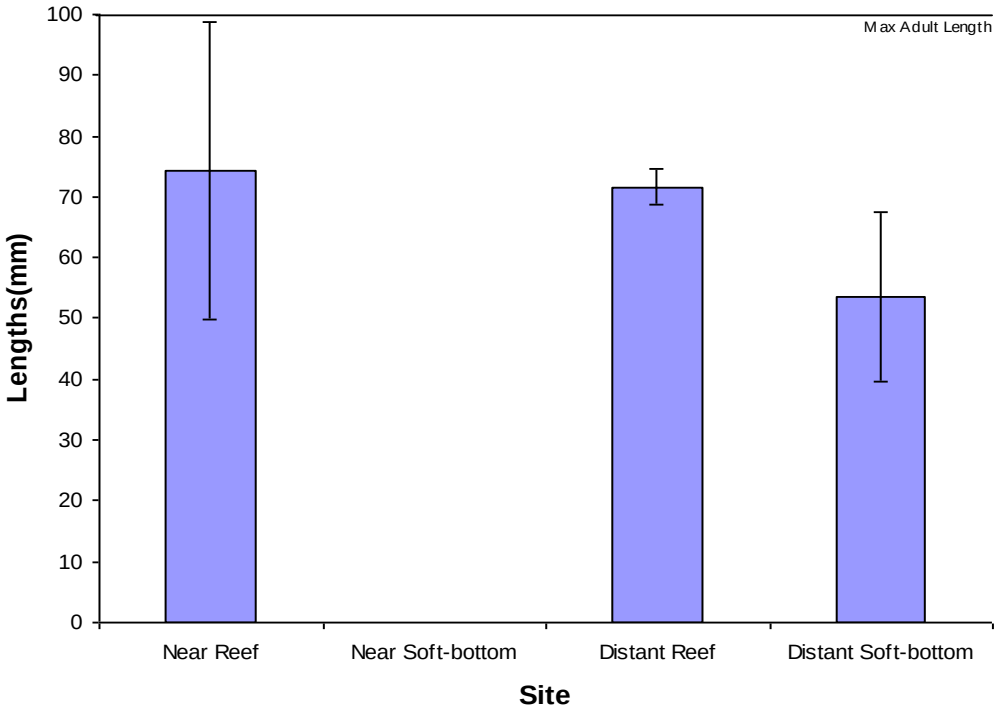


Figure 5.10 Mean length of *Parapercis haackei* across sites including maximum adult length and standard error of mean

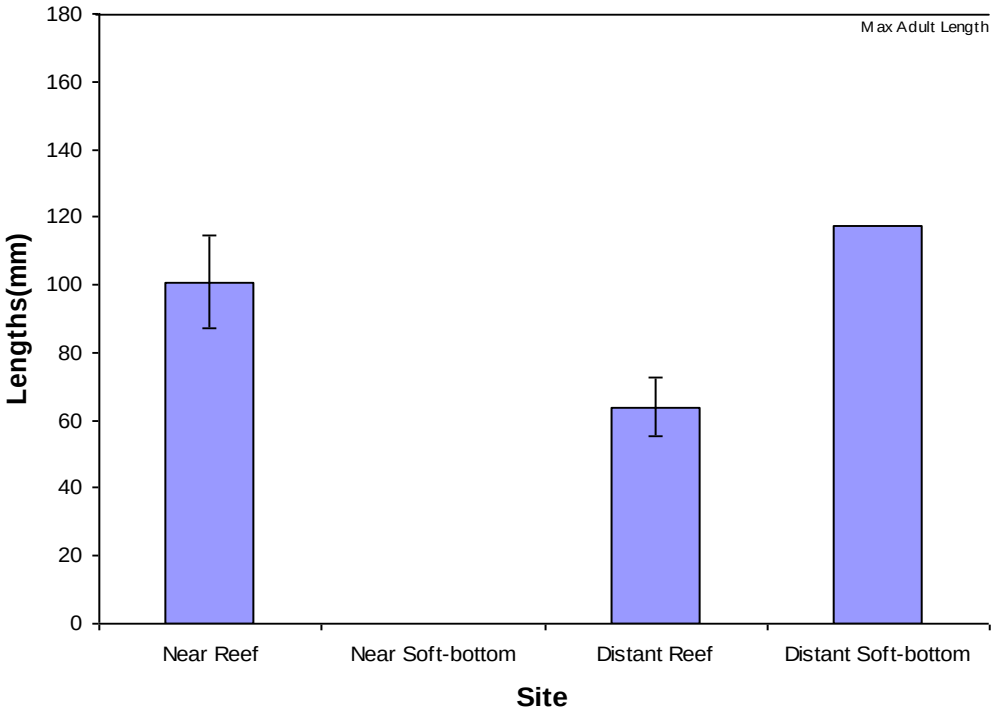


Figure 5.11 Mean length of *Parequula melbournensis*across sites including maximum adult length and standard error of mean (where appropriate)

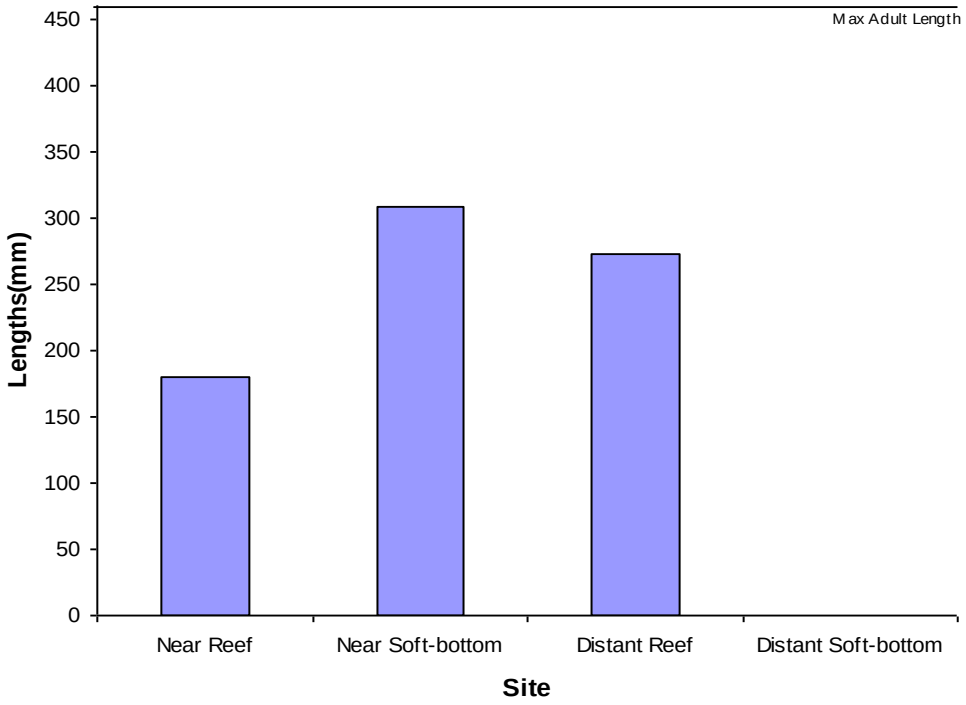


Figure 5.12 Mean length of *Platycephalus bassensis*across sites including maximum adult length

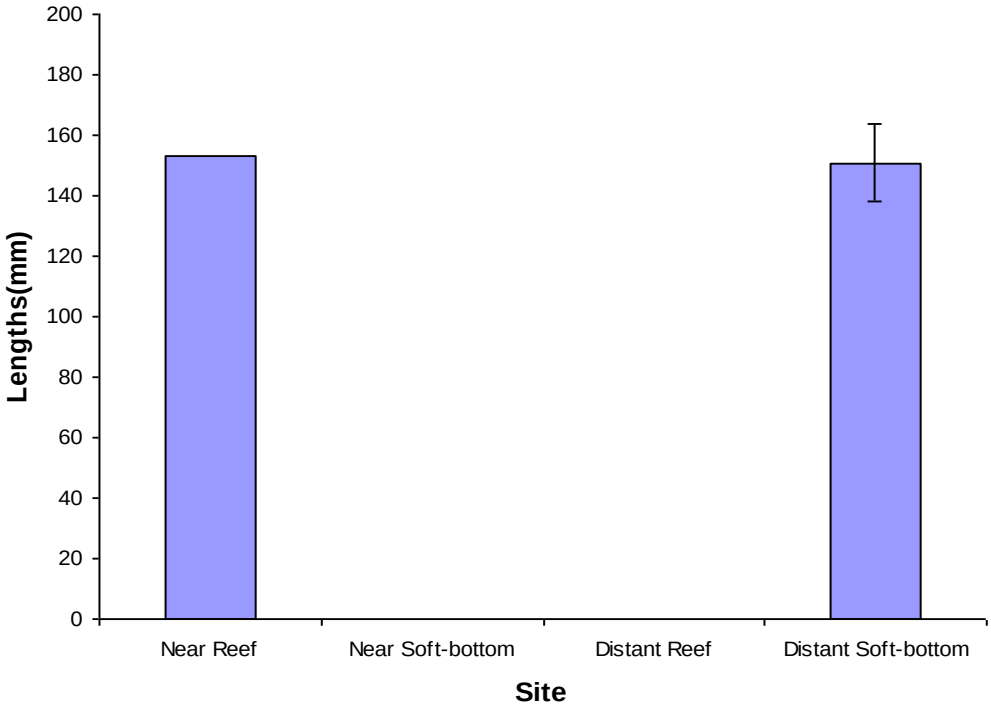


Figure 5.13 Mean length of *Pseudocaranx sp* across sites including standard error of mean (where appropriate)

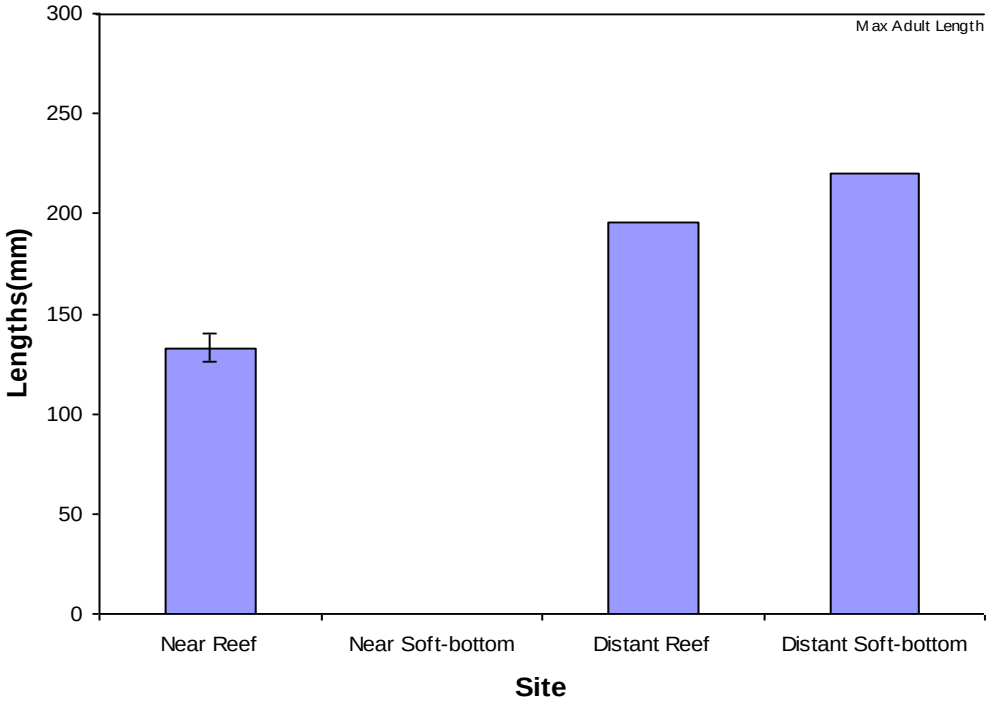


Figure 5.14 Mean length of *Scobinichthys granulatus* across sites including maximum adult length and standard error of mean (where appropriate)

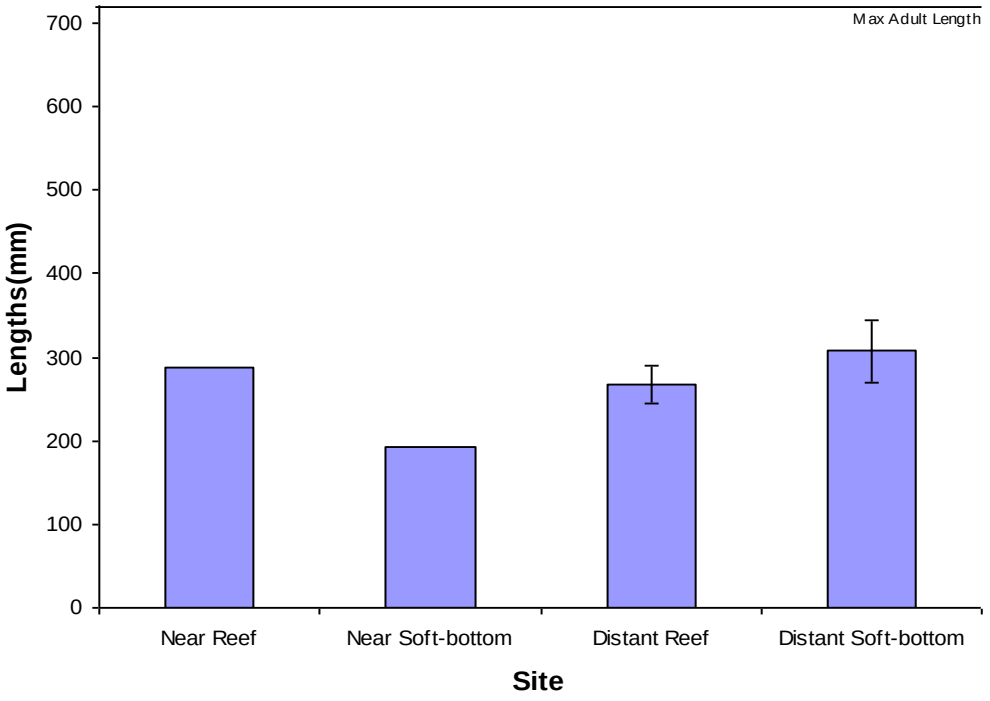


Figure 5.15 Mean length of *Sillaginodes punctata* across sites including maximum adult length and standard error of mean (where appropriate)

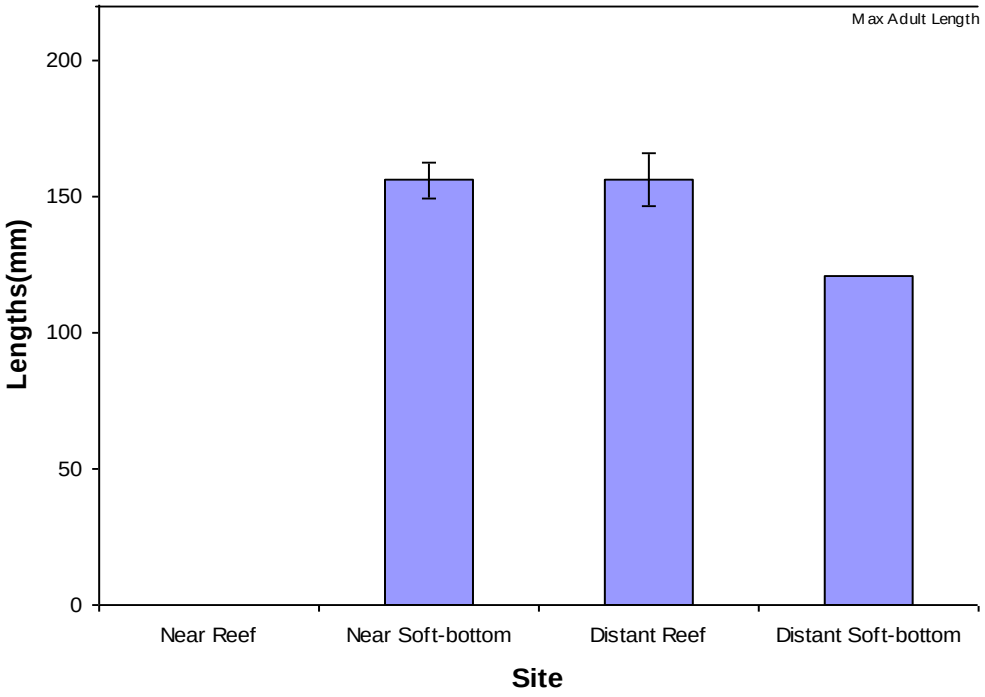


Figure 5.16 Mean length of *Torquigener pleurogramma* across sites including maximum adult length and standard error of mean (where appropriate)

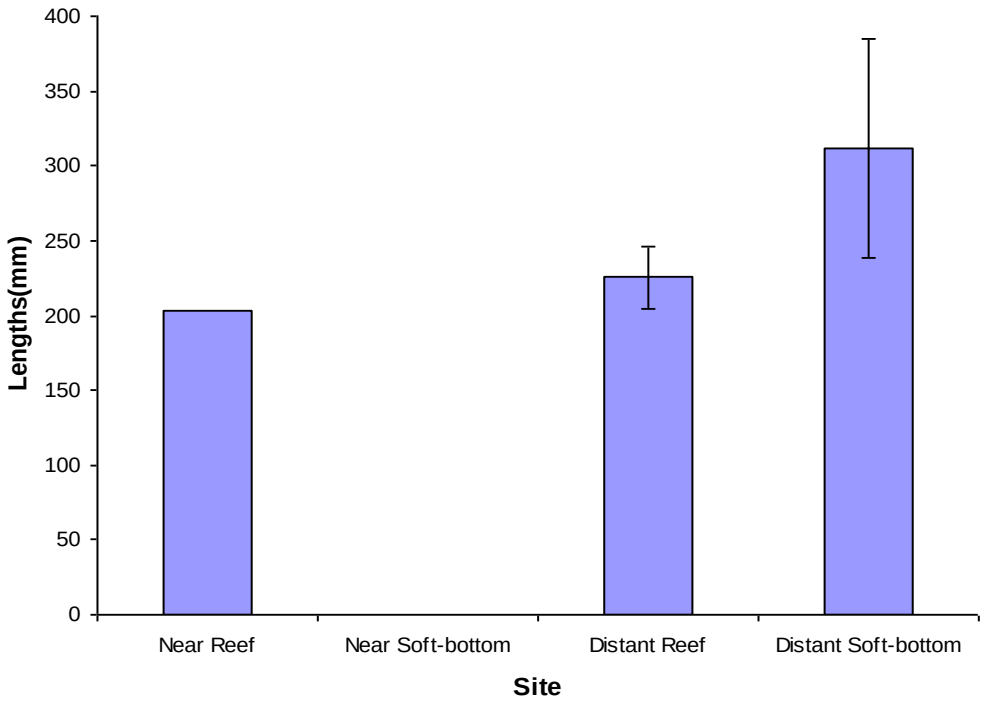


Figure 5.17 Mean length of *Trachurus sp* across sites including standard error of mean (where appropriate)

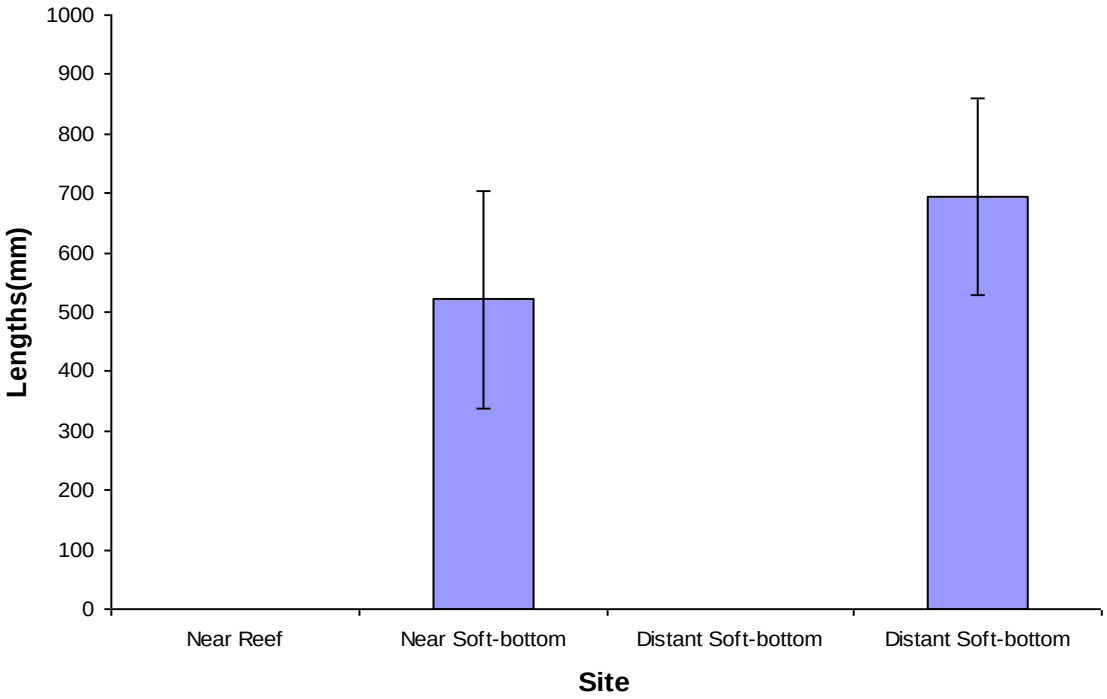


Figure 5.18 Mean length of *Trygonorrhina fasciata* across sites including standard error of mean

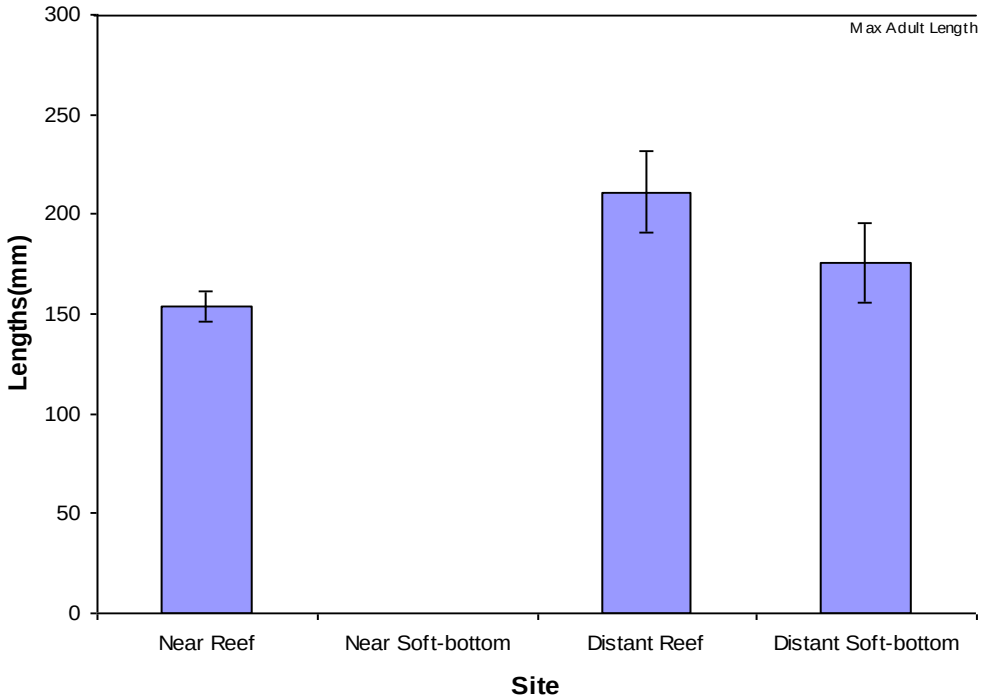


Figure 5.19 Mean length of *Upeneichthys vlamingii* across sites including maximum adult length and standard error of mean

References

Anderson MJ, Gorley RN, Clarke KR (2008). *Permanova+ for PRIMER: Guide to Software and Statistical Methods*. PRIMER-E: Plymouth, UK

Cappo M, Harvey E, Malcolm H, Speare P (2003). Potential of video techniques to monitor diversity abundance and size of fish in studies of marine protected areas. In: Beumer JP, Grant A, Smith DC (eds) *Aquatic protected areas—What works best and how do we know?* Proc World Congr on Aquat Protected Areas. Australian Society for Fish Biology, North Beach, Western Australia,
p 455–464

Cappo M, Speare P, D'eath G (2004). Comparison of baited remote underwater video stations (BRUVS) and prawn (shrimp) trawls for assessments of fish biodiversity in inter-reefal areas of the Great Barrier Reef Marine Park. J Exp Mar Biol Ecol. 302(2):123–152

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

DEH (2008a). Spatial distribution of benthic habitats adjacent to Port Stanvac. Coast and Marine Conservation Branch, Department for Environment and Heritage, South Australia.

DEH (2008b). *Nearshore Marine Benthic Habitat Mapping. Adelaide and Mount Lofty Ranges Region – South Australia*. Coast and Marine Conservation Branch, Department for Environment and Heritage and Adelaide and Mount Lofty natural Resources Management Board, South Australia.

Edgar GJ (2008). *Australian marine life: the plants and animals of temperate waters*, 2nd edition. New Holland Publishers, Sydney

Gommon MF, Bray D and Kuiter R (2008). *Fishes of Australia's Southern Coast*. New Holland Publishers, Sydney.

Grochowski A and Harvey E (2009). Analysis of DEH SA stereo BRUVS. University of Western Australia

Harvey E, Cappo M, Shortis M, Robson S, Buchanan J and Speare P (2003) The accuracy and precision of underwater measurements of length and maximum body depth of southern bluefin tuna (Thunnus maccoyii) with a stereo–video camera system. Fisheries Research 63 (3): 315-326.

Kuiter RH (2001). *Guide to Sea Fishes of Australia – A comprehensive reference for divers & fishermen*. New Holland Publishers, Australia.

Shortis M, Harvey E and Seager J (2007) A review of the status and trends in Underwater videometric measurement. Invited paper, SPIE Conference 6491, Videometrics IX.

South Australian Water Corporation (2008). SA Water Environmental Impact Statement for the Adelaide Desalination Plant Project.
http://www.sawater.com.au/SAWater/WhatsNew/MajorProjects/EIS.htm

Appendix A. Species identified adjacent the Port Stanvac desalination plant

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

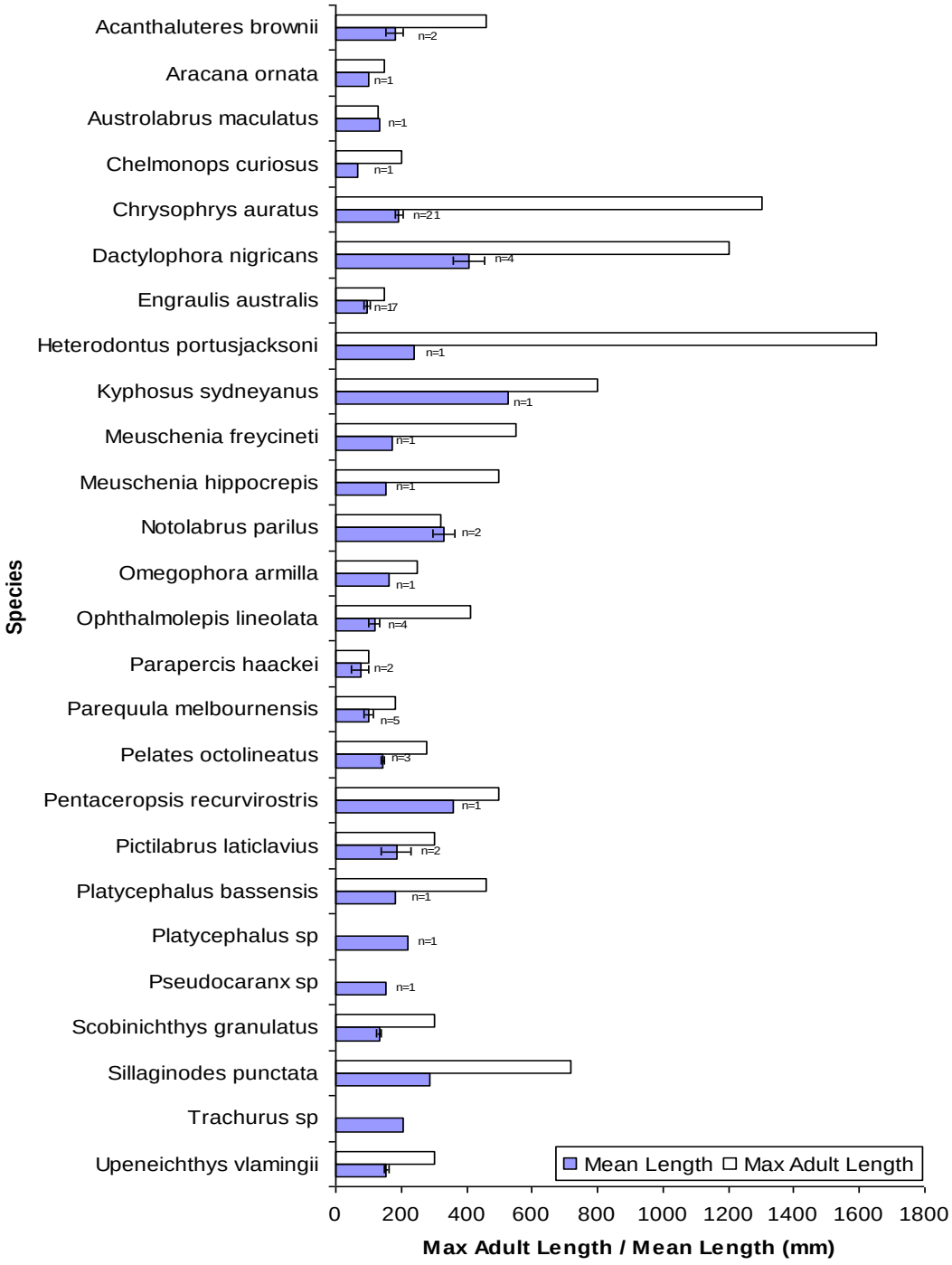
Class	Family	*Genus*	*Species*	Common name	Fish ID/Code
Chondrichthyes	Dasyatidae	*Dasyatis*	*brevicaudata*	Smooth Stingray	37 035001
	Heterodontidae	*Heterodontus*	*portusjacksoni*	Port Jackson Shark	37 007001
	Hexanchidae	*Heptranchias*	*perlo*	Sharpnose Sevengill Shark	37 005001
	Rhinobatidae	*Trygonorrhina*	*fasciata*	Guitarfish	37 027006
Osteichthyes	Carangidae	*Pseudocaranx*	*sp*	Travally	
	Carangidae	*Pseudocaranx*	*wrighti*	Skipjack Trevally	37 337063
	Carangidae	*Trachurus*	*sp*		
	Cheilodactylidae	*Dactylophora*	*nigricans*	Dusky Morwong	37 377005
	Clupeidae				
	Dasyatidae	*Dasyatis*	*brevicaudata*	Smooth Stingray	37 035001
	Dinolestidae	*Dinolestes*	*lewini*	Longfin Pike	37 327002
	Engraulidae				
	Gerreidae	*Parequula*	*melbournensis*	Melbourne Silverbelly	37 349001
	Kyphosidae	*Kyphosus*	*sydneyanus*	Silver Drummer	37 361001
	Labridae	*Austrolabrus*	*maculatus*	Blackspotted Wrasse	37 384025
	Labridae	*Notolabrus*	*parilus*	Brownspotted Wrasse	37 384022
	Labridae	*Ophthalmolepis*	*lineolata*	Southern Maori Wrasse	37 384040
	Labridae	*Pictilabrus*	*laticlavius*	Senator Wrasse	37 384020
	Monacanthidae	*Acanthaluteres*	*brownii*	Spinytail Leatherjacket	37 465001
	Monacanthidae	*Meuschenia*	*freycineti*	Sixspine Leatherjacket	37 465036
	Monacanthidae	*Meuschenia*	*galii*	Bluelined Leatherjacket	37 465040
	Monacanthidae	*Meuschenia*	*hippocrepis*	Horseshoe Leatherjacket	37 465004
	Monacanthidae	*Meuschenia*	*venusta*	Stars-and-stripes Leatherjacket	37 465060
	Monacanthidae	*Scobinichthys*	*granulatus*	Rough Leatherjacket	37 465007
	Monacanthidae				
	Mugilidae	*Aldrichetta*	*forsteri*	Yelloweye Mullet	37 381001
	Mullidae	*Upeneichthys*	*vlamingii*	Bluespotted Goatfish	37 355029
	Odacidae	*Siphonognathus*	*attenuatus*	Slender Weed Whiting	37 385004
	Odacidae	*Siphonognathus*	*beddomei*	Pencil Weed Whiting	37 385006
	Ostraciidae	*Aracana*	*aurita*	Shaw's Cowfish	37 466003
	Ostraciidae	*Aracana*	*ornata*	Ornate Cowfish	37 466001
	Paralichthyidae	*Pseudorhombus*	*sp*	Flounder	
	Pempheridídae	*Parapriacanthus*	*elongatus*	Elongate Bullseye	37 357002
	Pentacerotidae	*Pentaceropsis*	*recurvirostris*	Longsnout Boarfish	37 367003
	Pinguipedidae	*Parapercis*	*haackei*	Wavy Grubfish	37 390004
	Platycephalidae	*Platycephalus*	*bassensis*	Southern Sand Flathead	37 296003
	Platycephalidae	*Platycephalus*	*sp*	Flathead	
	Platycephalidae	*Platycephalus*	*speculator*	Southern Bluespotted Flathead	37 296037
	Plesiopidae	*Trachinops*	*noarlungae*	Yellowhead Hulafish	37 316017
	Sillaginidae	*Sillaginodes*	*punctata*	King George whiting	37 330001
	Sillaginidae	*Sillago*	*sp*	Whiting	
	Sparidae	*Chrysophrys*	*auratus*	Snapper	37 353001
	Sphyraenidae	*Sphyraena*	*sp*		
	Terapontidae	*Pelates*	*octolineatus*	Western Striped Grunter	37 321020

Tetraodontidae	*Omegophora*	*armilla*	Ringed Toadfish	37 467002
Tetraodontidae	*Tetractenos*	*glaber*	Smooth Toadfish	37 467003

Appendix B. Abundance and number of species

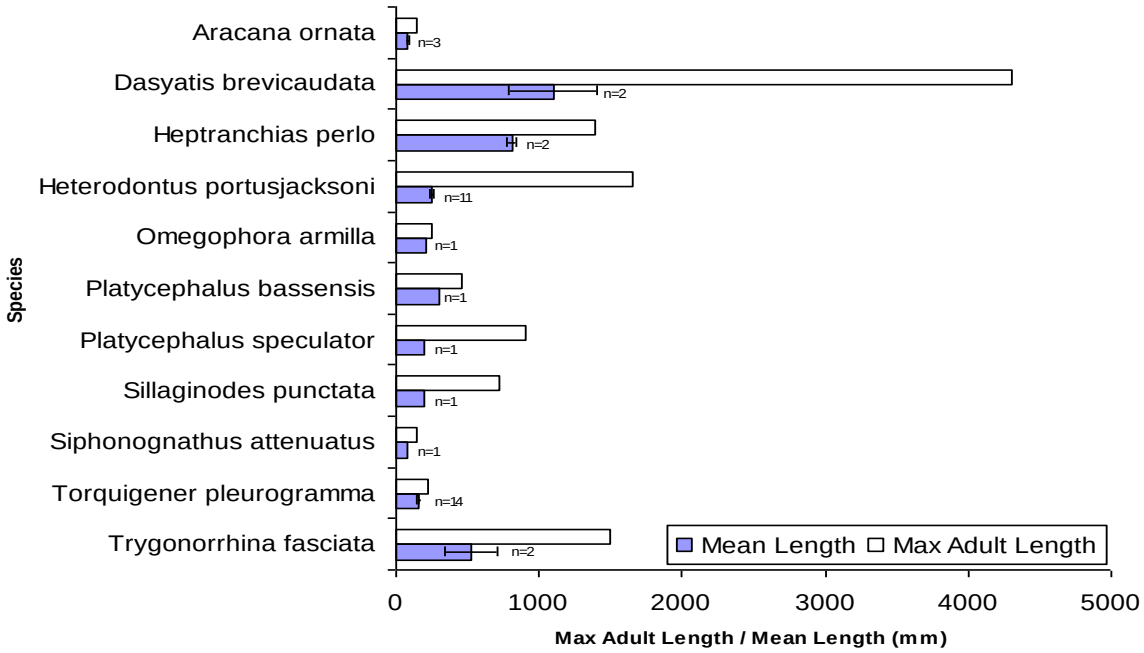
Site	Sample	Abundance	No of Sp
Near Reef	PS104	766	9
Near Reef	PS105	24	8
Near Reef	PS106	42	10
Near Reef	PS122	45	13
Near Reef	PS123	96	16
Near Reef	PS124	1079	10
Near Soft-bottom	PS110	82	7
Near Soft-bottom	PS111	92	11
Near Soft-bottom	PS112	85	7
Near Soft-bottom	PS113	8	5
Near Soft-bottom	PS114	10	8
Near Soft-bottom	PS115	38	9
Distant Reef	PS101	24	9
Distant Reef	PS102	12	5
Distant Reef	PS103	45	6
Distant Reef	PS119	471	13
Distant Reef	PS120	17	6
Distant Reef	PS121	5	3
Distant Soft-bottom	PS107	3	2
Distant Soft-bottom	PS108	115	7
Distant Soft-bottom	PS109	2006	6
Distant Soft-bottom	PS116	26	9
Distant Soft-bottom	PS117	66	7
Distant Soft-bottom	PS118	6	4

Appendix C. Mean fish lengths

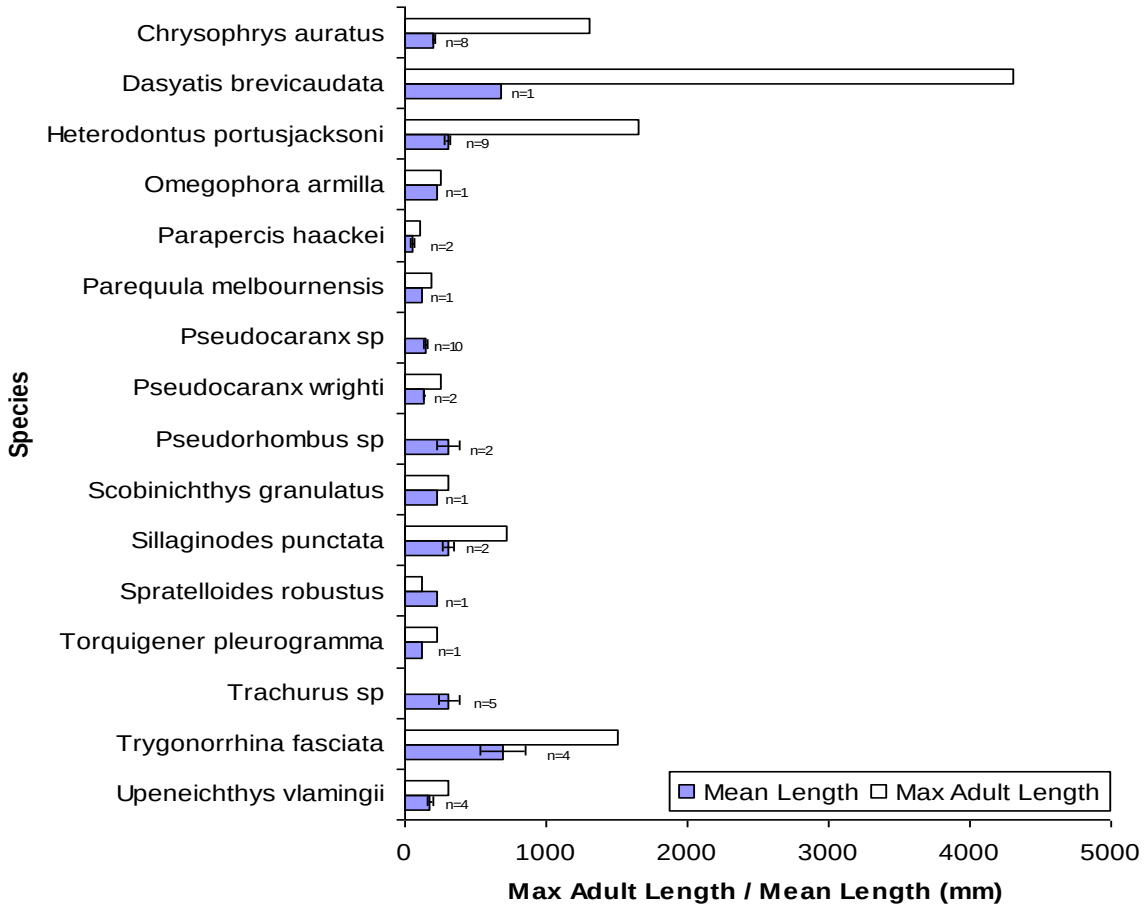


1. Near Reef mean fish length with standard error (where appropriate) and number measured ('n' in associated text box)

2. Distant Reef mean fish length with standard error (where appropriate) and number measured ('n' in associated text box).



3. Near Soft-bottom mean fish length with standard error (where appropriate) and number measured ('n' in associated text box).



4. Distant Soft-bottom mean fish length with standard error (where appropriate) and number measured ('n' in associated text box).