Final Report 2023

Port Coogee Marina fish diversity monitoring programme

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March 2023

AQUA RESEARCH & MONITORING SERVICES

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EXECUTIVE SUMMARY

In 2018 and 2019 Aqua Research & Monitoring Services (ARMS) conducted a marine biodiversity study of Port Coogee Marina, focussing on the prevailing fish assemblage, but also recording other marine species, including crustaceans, molluscs, corals, seagrass, etc. In addition, abiotic parameters (temperature, water chemistry, sediment particle size, heavy metals, etc) were measured and recorded to create a baseline status report for future monitoring efforts. ARMS repeated the survey in 2022/23 to identify any spatial and temporal changes in species diversity since the initial survey. Observations yielded 81 fish species from 51 families, compared to 85 species from 47 families in 2018/19. Water temperatures in 2022 fluctuated seasonally with a daily average minimum of 15.4 ^{o}C in August to a maximum daily average of 26.2 ^{o}C in February. This report also includes an expanded record of coral growth and diversity; and other findings of interest, including records of the exotic gastropod *Mitrella bicincta*.

ARMS recommends:

- continued monitoring of fish diversity at 2-3 year intervals;
- extension of the water temperature monitoring programme using *in situ* data loggers (i.e. purchase of additional loggers to ensure redundancy);
- continued monitoring of coral growth and diversity within the Marina;
- monitoring of the emerging *Posidonia* seagrass stands on an annual basis as seagrass health/abundance has a positive correlation with ecosystem health;
- funding an affiliated project to identify non-fish fauna that were observed and photographed during the present study, thereby increasing the marine biodiversity measures and outputs associated with the Marina.

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7 March 2023

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OVERVIEW

A fish diversity monitoring program of Port Coogee Marina, Western Australia, was completed by Aqua Research and Monitoring Services for the City of Cockburn in 2022/23. The survey was designed to replicate a previous survey in 2018/19 to identify any spatial and temporal changes in the species diversity during that time. In addition, the 2022/23 survey included identification of other fauna within the Marina; a more detailed record of coral growth and diversity; observations of seagrass and algae spatial extent; and ongoing sea temperature measurements.

1.0 OBJECTIVES

1.1 The original objective of the Port Coogee Marina monitoring project (2018) was to design and implement an aquatic monitoring programme that:

1.1.1 focussed on the fish assemblage currently prevailing in the Marina;
1.1.2 documented current fish diversity using standard ecological biodiversity indicators;
1.1.3 included baseline sediment minerals analysis;
1.1.4 included baseline, elemental water analysis;
1.1.5 identified macrophyte stands and utilises a geographic information system to create a layered habitat map providing an indication of seasonal changes over time;
1.1.6 included the establishment of a long-term water temperature monitoring programme;
1.1.7 utilised a multi-tool approach to data gathering (*in situ* video, diver observation, habitat sampling, etc);
1.1.8 was repeatable.

1.2 Objectives of 2022-23 monitoring programme were to:

1.2.1 document current fish diversity using in situ video and diver observations, and utilise standard ecological biodiversity indicators to compare to previous diversity;
1.2.2 utilise Nearmap imagery in a Geographic Information System to indicate temporal changes in the spatial distribution of macrophyte stands;
1.2.3 photograph and measure the growth of coral heads GPS-tagged in the last study and comment on coral health and cover within the marina;
1.2.4 identify transient / developing marine habitats (e.g. seagrass patches, wrack) and comment on distribution compared to previous survey;
1.2.5 continue the long-term water temperature monitoring programme initiated in 2018 and provide annual plots of daily average water temperature for comparison.

2.0 Personnel

- Dr Glen Whisson, Aqua Research and Monitoring Services
- Alexandra Hoschke, Aqua Research and Monitoring Services

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Fig. 1 Survey and monitoring locations in Port Coogee Marina

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3.0 METHODS

3.1 Aquatic biodiversity assessment

Six 100m scuba transects (T1 to T6, Fig. 1) were traversed inside the Port Coogee Marina on 6 days between 14 and 27 March 2022, and repeated between 14 and 20 February 2023. In addition, a night dive was undertaken along T6 to photograph nocturnal species on 28 March 2022, and weed sampling carried out from D jetty in August 2022. During the surveys fish species (and other marine life of interest) were photographed and subsequently recorded in a spreadsheet with location, date, species name and count. In addition to the transects, other internal walls of the Marina were selected for additional surveys with all additional species photographed and recorded.

3.2 Identification of fauna

The authors utilised photographic records from previous surveys combined with online resources to identify all fish fauna. Any uncertain records were referred to Dr Glenn Moore, Fish Curator, WA Museum. For non-fish fauna, the authors utilised extensive reference material to identify most observations. Dr Andrew Hosie (Curator of Crustaceans, WA Museum) was consulted for some interesting decapod crustacean specimens; however, identifications were not pursued to the lowest taxa possible, owing to the focus of the study on finfish and the large amount of time required to certify many non-fish fauna observed.

RECOMMENDATION: The authors recommend that the City considers funding an affiliated project to identify the non-fish fauna that were observed and photographed during the present study. This will increase the marine biodiversity measures associated with Port Coogee Marina.

3.3 Coral measurements

As part of the original monitoring effort in 2018/19, a number of representative corals were photographed and measured, with their locations marked on the adjacent concrete retaining wall. These corals were re-visited in March 2022 and March 2023 and, where possible, identified and measured. Comparisons were made with initial measurements and growth rates estimated where applicable.

3.4 Sea Temperature

Sea temperature was recorded at hourly intervals using a HOBO UA-001-64 data logger installed 50cm above the seabed at the western end of D Jetty (water depth 3m). The logger was retrieved and downloaded at approximately 6 month intervals. Data from the initial survey was combined on a continuous plot and aggregated on a yearly chart to provide comparative data of average daily water temperature in the Marina.

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4.0 RESULTS & RECOMMENDATIONS

4.1 Fish diversity assessment

A total of 81 finfish species were photographed during the period (Appendix 1), with representative photos included at Appendix 2.

The number of species recorded (richness) and total estimated abundance were highest along the southern wall of the Marina entrance channel (T6) and the north-west corner of the western sea wall (T1) (Fig. 2). This abundance/richness data is similar to the results from the 2019 survey with the highest diversity in the T1 and T6 transects.

Fifteen of the species identified were not previously recorded in the Marina (Table 1), and 20 species originally recorded were not seen during the current survey. Some of these were the more obscure species that had been recorded from weed sampling after storms in the previous survey (e.g. seahorses and pipefish). Combining the two surveys, 102 finfish species have been recorded in the Marina between 2019 and the end of February 2023 (Appendix 1).

RECOMMENDATION: It is the authors' recommendation that the City of Cockburn continues to monitor fish diversity within Port Coogee Marina at 2-3 year intervals.

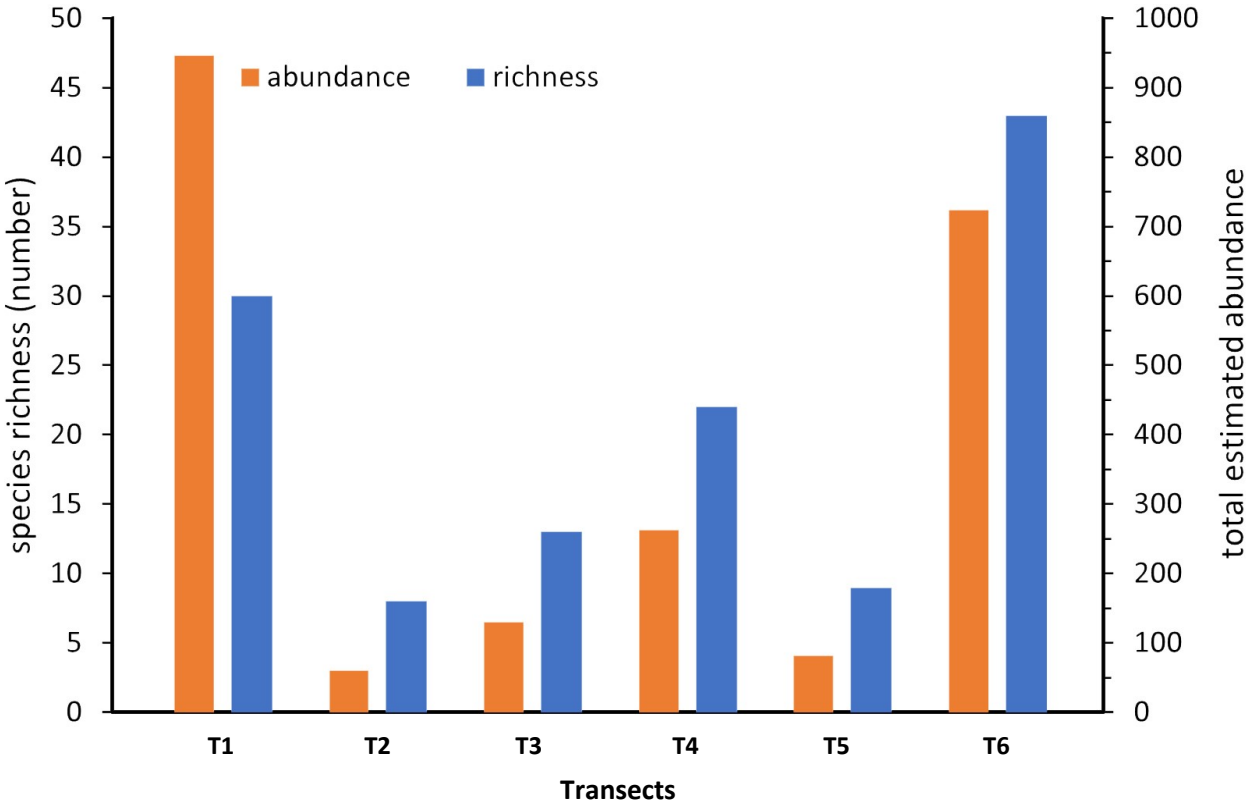

Fig. 2 Fish species richness and abundance recorded at Port Coogee Marina, 2022-23

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Table 1 Finfish species additional to those logged in the 2019 survey

	FAMILY	Common Name	Species Name
1	PLOTOSIDAE	Estuary Cobbler	*Cnidoglanis macrocephalus*
2	HEMIRAMPHIDAE	Southern Garfish	*Hyporhamphus melanochir*
3	NEOSEBASTIDAE	Little Gurnard Perch	*Maxillicosta scabriceps*
4	PLATYCEPHALIDAE	Southern Bluespotted Flathead	*Platycephalus speculator*
5	LATIDAE	Black Sand Bass	*Psammoperca datnoides*
6	POMATOMIDAE	Tailor	*Pomatomus saltatrix*
7	SILLAGINIDAE	Western Trumpeter Whiting	*Sillago burrus*
8	MICROCANTHIDAE	Moonlighter	*Tilodon sexfasciatus*
9	POMACENTRIDAE	Western Scalyfin	*Parma occidentalis*
10	LABRIDAE	Bluethroat Rainbow Wrasse	*Suezichthys cyanolaemus*
11	BLENNIDAE	Crested Sabretooth Blenny	*Petroscirtes mitratus*
12	MONACANTHIDAE	Bridled Leatherjacket	*Acanthaluteres spilomelanurus*
13	MONACANTHIDAE	Sixspine Leatherjacket	*Meuschenia freycineti*
14	TETRAODONTIDAE	Stars and Stripes Puffer	*Arothron hispidus*
15	DIODONTIDAE	Globefish	*Diodon nicthemerus*

4.2 Coral growth in the Marina

During the 2022/23 survey, corals that were photographed and measured in the previous survey were re-visited to assess their condition/growth. Photos comparing their size and health are given in Appendix 4. Individual colonies of *Pocillopora damicornis* (C4 & C5) appeared to have grown significantly, although so many new colonies of the same species had grown in the same areas it was hard to isolate the original colonies. There was also algal overgrowth partially obscuring some of these corals.

Turbinaria sp. (C2) had grown from 11.5cm maximum diameter to 14cm, including an extra plate. *Plesiastraea sp*. (C1, C3, C7) also grew but were impacted by partial bleaching and algal overgrowth, which may threaten their long-term survival in this location.

Favites sp. (C4 and C6) appeared to be propsering, with steady growth and no signs of bleaching. This area was highly turbid and had high sedimentation and growth of turf algae on the rocks, which seems to be impacting some coral species more than others.

Elsewhere in the Marina, corals continue to grow on all the internal walls, with a total of 12 different species of hard coral identified

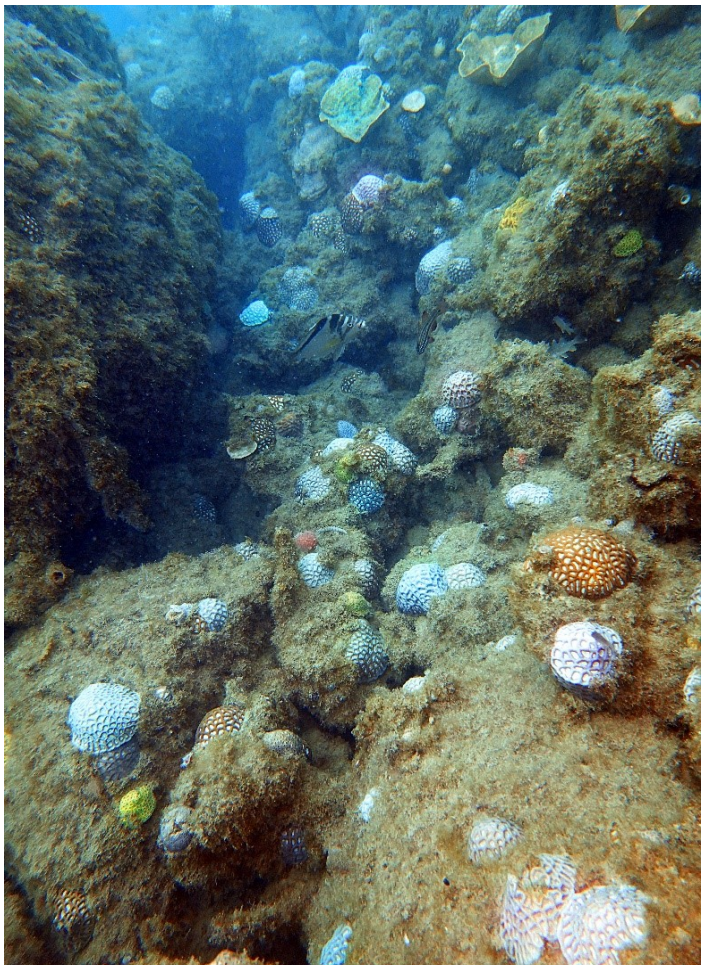

Fig. 3 Hard corals on transect T6, March 2022

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during the survey (Appendix 4), which will act as a useful baseline for coral health and diversity going forward. In general, corals were more common, with a greater variety of species, on the breakwater walls towards the Marina entrance where water flow is higher (Fig. 3). Corals further into the Marina appear more restricted by sedimentation, turbid water and competition with algae. In particular the corals C1 to C7 are likely to have been impacted by the ongoing development directly adjacent to the southern Marina wall, with dust from the earthworks blown into the Marina on the prevailing sea breeze (Fig. 4).

RECOMMENDATION: The authors recommend ongoing monitoring of corals in an effort to assess long-term growth and impacts.

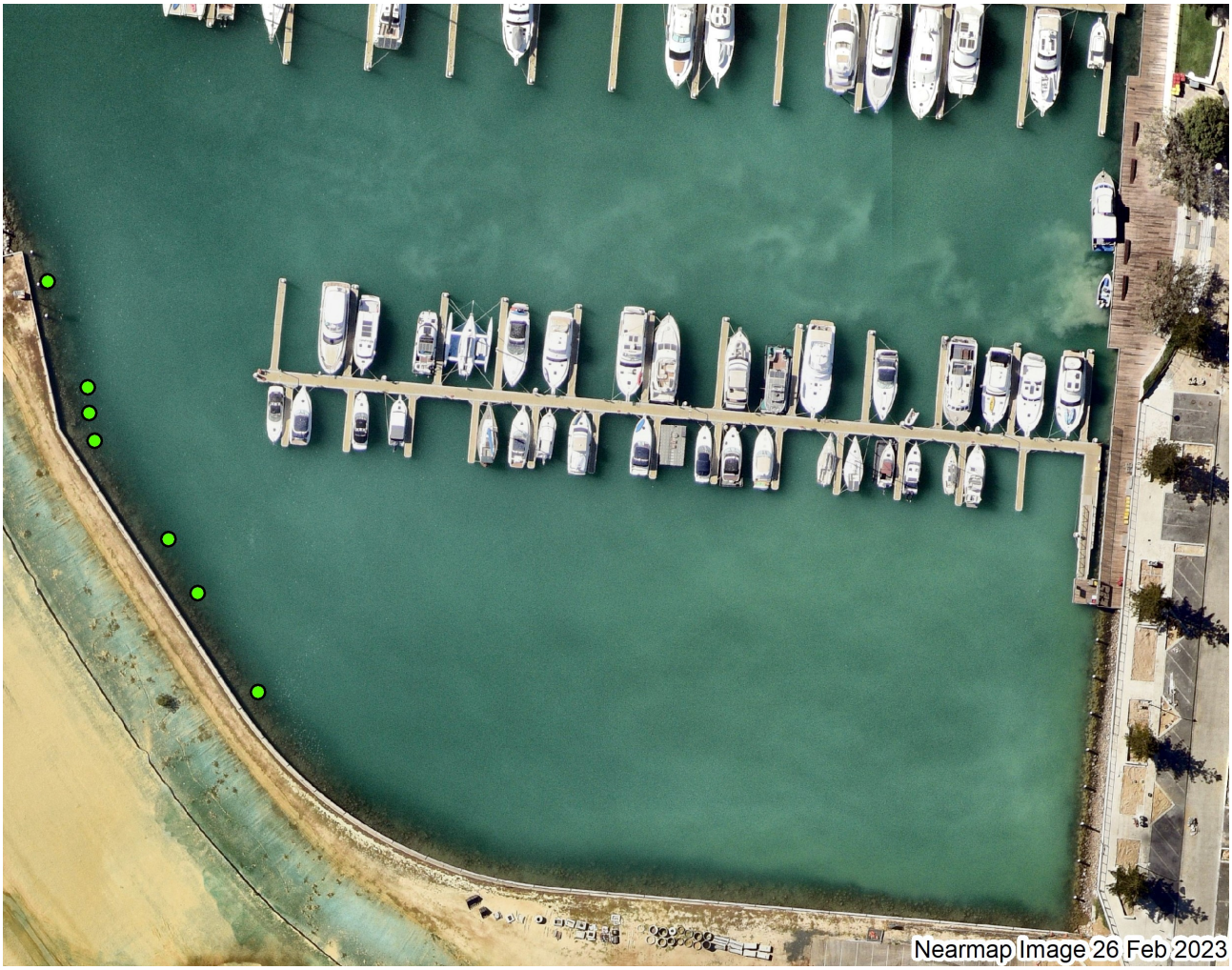

Fig. 4 Nearmap image from 26 February 2023 showing high turbidity in the southern part of Port Coogee Marina including the project's coral measurement locations (green dots). Note the sediment plume stirred up by the boat at the loading jetty, indicating unconsolidated sediments on the Marina floor.

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4.3 Other fauna

In addition to the fish and corals, other observed fauna included marine mammals and reptiles, ascidians, echinoderms, molluscs, crustaceans, worms, jellyfish and anemones. A representation of non-fish observations is presented in Appendix 3 along with unconfirmed, preliminary observations. Many other observations were made but completing identifications is beyond the scope of this report.

RECOMMENDATION: The authors recommend that the City considers funding an affiliated project to identify the non-fish fauna that were observed and photographed during the present study. This will increase the marine biodiversity measures associated with Port Coogee Marina.

4.3.1 Observations of interest include:

- An introduced species of Dove Snail (*Mitrella bicincta*) photographed in the Marina on 15 February 2023 (Fig. 5). This species was introduced from east Asia in the 1960s, and although it is now common on the coast of NSW, there are only four museum records from WA (Garden Island, Fremantle Port, Cottesloe Beach) between 1983 and 2006. The record from the Marina was logged and identification confirmed on the iNaturalist.org platform, where it is the only record of this species from WA to date.

Fig. 5 The exotic Dove Snail (*Mitrella bicincta*) in Port Coogee Marina

- A juvenile loggerhead turtle was observed by Robbie Wilson in the Marina in June 2022 (Fig. 6). Post hatching loggerheads are occasionally washed inshore along the SW coast of WA in winter storms, but are rarely observed along the Perth Coast.

Fig. 6 Juvenile Loggerhead Turtle (*Caretta caretta*) in Port Coogee Marina. Credit: Robbie Wilson

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- Australian Blue Swimmer Crabs (*Portunus armatus*) appear to be increasing in abundance in the Marina (Fig. 7), with 8 specimens observed during the current survey, mostly around the inner southern breakwater (T6).

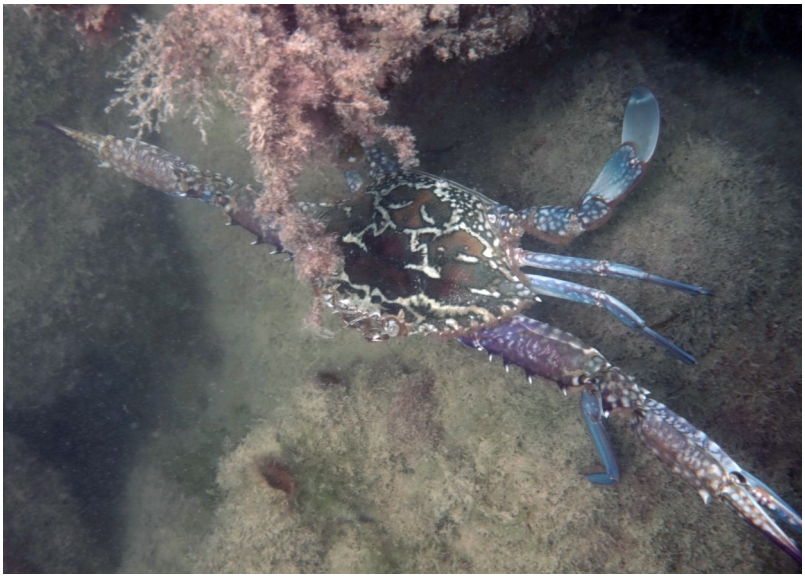

Fig. 7 Australian Blue Swimmer Crab (*Portunus armatus*) in Port Coogee Marina, February 2023

4.4 Flora

Two small patches of the seagrass *Posidonia australis*, mapped during the initial survey in 2019 off the end of D jetty, were still *in situ* despite heavy epiphytic growth and high turbidity (Fig. 8). The patches appeared denser and expanded in area slightly. No new patches were discovered, although visibility was generally very poor at the bottom of the Marina during the periods when the surveys were carried out.

RECOMMENDATION: The authors recommend a continuation of *Posidonia australis* monitoring in the Marina.

Fig. 8 *Posidonia australis* seagrass in 2019 (left) and the same stand in 2023 (right)

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The large stands of the brown algae *Sargassum* sp. that are conspicuous growing up to the surface of the Marina from rock substrate during the winter months continued their cycle of dying back during the summer months. The location and size of the stands was similar in June 2022 and July 2019 (Fig. 9), which is not unexpected given its requirement for a hard substrate to anchor its holdfast, therefore limiting potential locations to the rock walls and other solid surfaces within the Marina.

Fig. 9 Nearmap images of *Sargassum* sp. in Port Coogee Marina: 2019 vs 2022

Turf algae is thick on rocks in deeper parts of the Marina, particularly in areas of lower water flow and lower light where it out-competes the corals.

4.5 Sea Temperature

Water temperature was recorded at hourly intervals using HOBO UA-001-64 data loggers installed at 50cm above the seabed at the western end of D Jetty. The program has been ongoing since 28 Nov 2018 (with a gap in the data from 25 September 2019 to 8 February 2020 due to a flooded logger), with duplicate loggers now utilised to ensure continuous coverage. Daily average temperatures were calculated to the end of 2022, with a maximum daily average value in 2022 of 26.2^{o}C on February 20, and a minimum of 15.4^{o}C on August 4 (Fig. 10).

Of interest, the value of 26.2^{o}C in February was the highest daily average recorded since monitoring began in 2018, and the monthly average for February 2022 was also the highest recorded, at 25.1^{o}C (Table 2).

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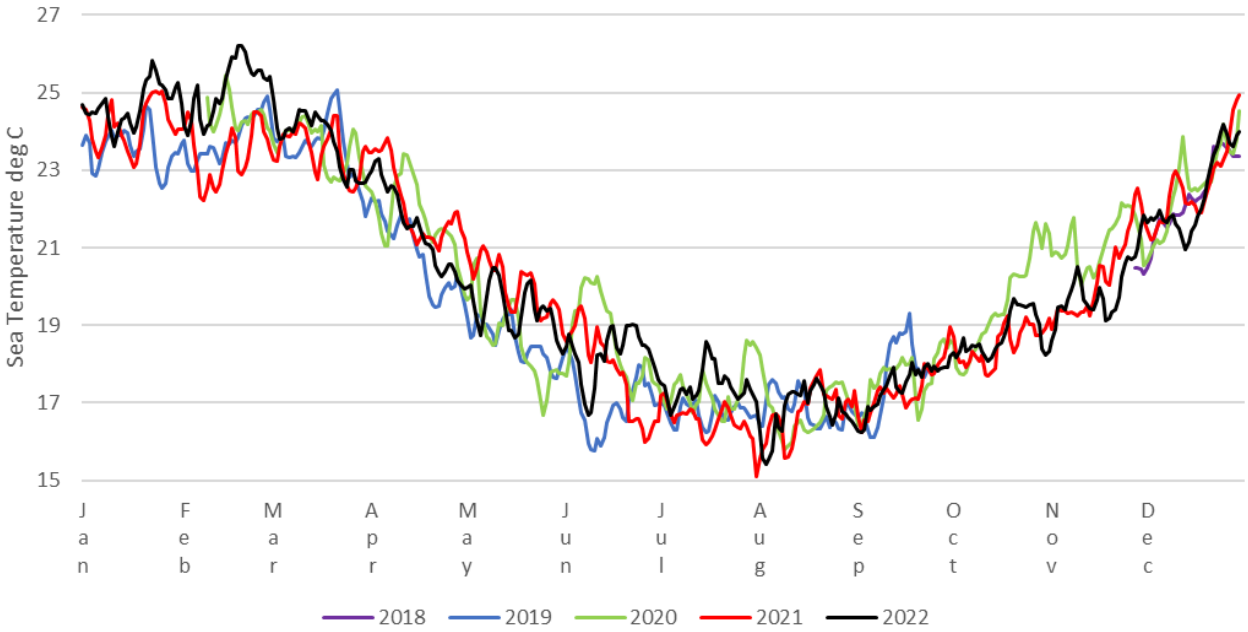

Fig. 10 Daily average sea temperature in Port Coogee Marina (See Fig. 1 for logger location)

Table 2 Monthly Mean Sea Temperature in Port Coogee Marina (see Fig. 1 for logger location)

Date	2018	2019	2020	2021	2022
Jan		23.6	no data	24.2	24.7
Feb		23.8	24.4	23.4	25.1
Mar		23.6	23.6	23.5	23.8
Apr		20.9	21.9	22.1	21.6
May		18.6	18.7	20.1	19.5
Jun		17.0	18.6	17.8	18.3
Jul		16.8	17.3	16.6	17.5
Aug		16.8	16.9	16.7	16.8
Sep		17.6	17.6	17.3	17.4
Oct		no data	19.5	18.5	18.8
Nov	20.5	no data	21.1	20.2	19.8
Dec	22.3	no data	22.5	22.6	22.3

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5.0 POINTS OF INTEREST

5.1 West Australian Salmon

A school of juvenile West Australian Salmon were filmed in the Marina on 14 March 2022. In their juvenile stage (also referred to as Salmon Trout) they have similar markings to mature Australian Herring, although can be distinguished by having yellow pectoral fins with a dark spot at the base, and a thin dark margin to the tail (Herring only display the dark tips on the tail—not the thin dark margin).

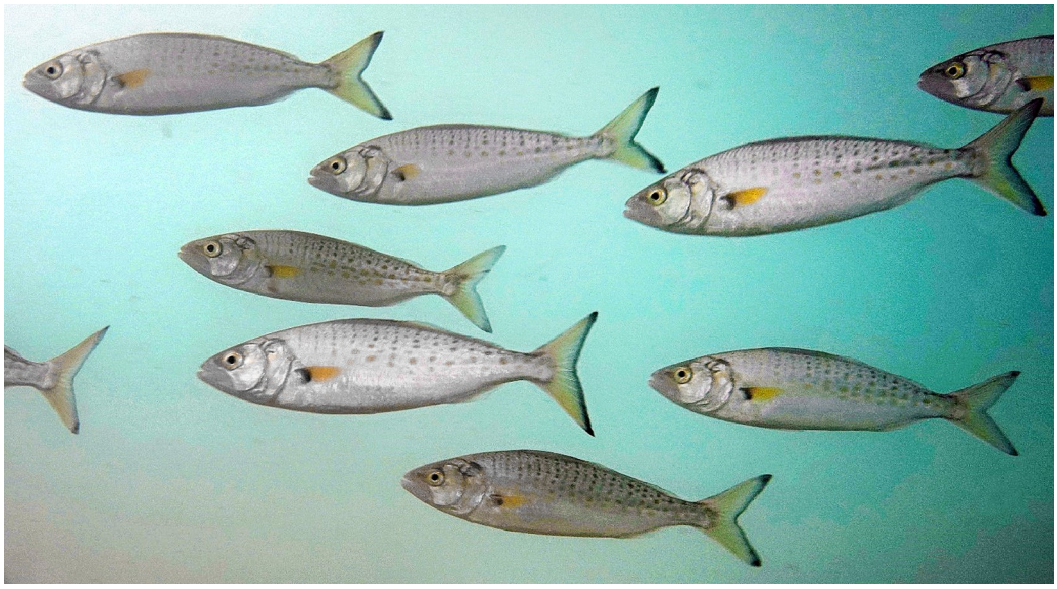

Fig. 11 West Australian Salmon (*Arripis truttaceus*) at Port Coogee Marina in March 2022

5.2 Seastars

Five species of Seastars were observed and photographed during the 2022/23 survey, including The Australian Cushion Star and Crassa Seastar, both of which are endemic to WA.

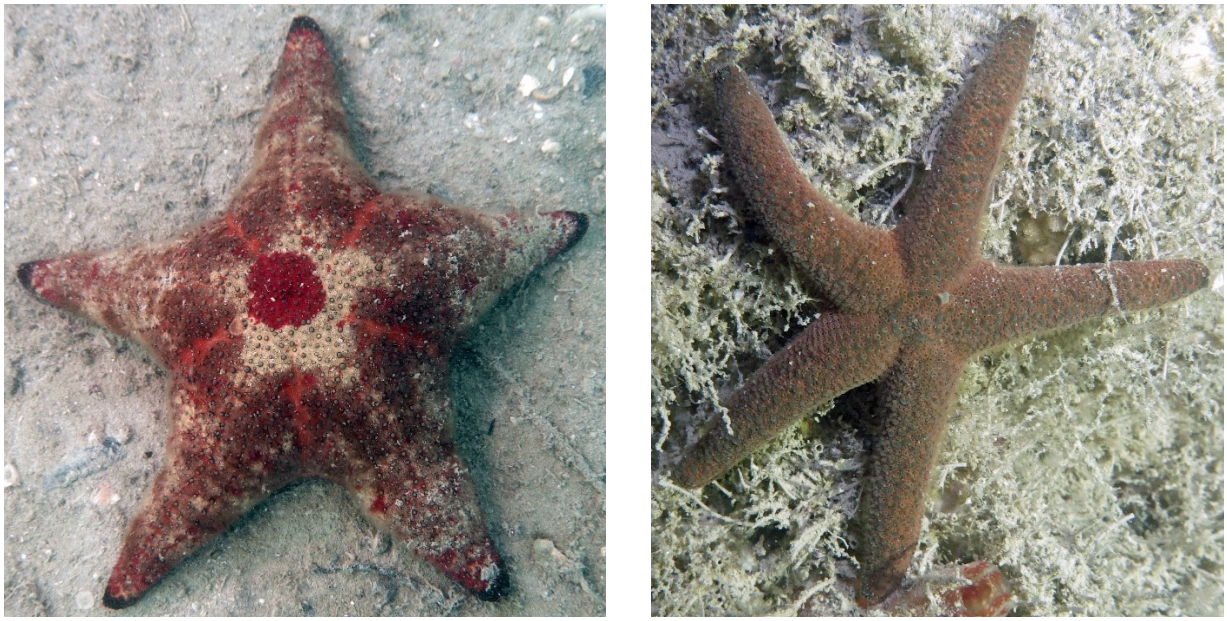

Fig. 12 Australian Cushion Star (*Anthenea australiae*) (left) and Crassa Seastar (*Nepanthea crassa*) in Port Coogee Marina, February 2023

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5.3 Whitebarred Goby

The Whitebarred Goby (*Amblygobius phalaena*) is one of the more striking fish species that is common in the Marina, growing up to around 15cm total length. It is usually seen in pairs, inhabiting holes in the rock walls or burrows in the soft sediment on the Marina floor where it lays its eggs. It appears to have adapted well to the Marina environment, with nearly 100 counted during the surveys, and it is often seen taking up and then spitting out mouthfuls of sand from which it extracts algae and small invertebrates. Port Coogee is at the southern range limit for this usually more tropical species in WA, so it is somewhat surprising that it is thriving here.

Fig. 13 A large, adult Whitebarred Goby (*Amblygobius phalaena*) at Port Coogee Marina in February 2023

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APPENDIX 1: Combined fish species recorded in Port Coogee Marina during the 2018-19 and 2022-23 surveys (in phylogenetic order)

	FAMILY	Common Name	Species Name (ǂ endemic)	2018/19	2022/23	TOTAL
1	ORECTOLOBIDAE	Spotted Wobbegong	*Orectolobus maculatus*	1		1
2	TRYGONORRHINIDAE	Southern Fiddler Ray	*Trygonorrhina dumerilii*	1		1
3	UROLOPHIDAE	Western Shovelnose Stingaree	*Trygonoptera mucosa*	1	1	1
4	MURAENIDAE	Highfin Moray	*Gymnothorax pseudothyrsoideus*	1	1	1
5	CLUPEIDAE	Scaly Mackerel	*Sardinella lemuru*	1		1
6	CLUPEIDAE	Blue Sprat	*Spratelloides robustus*	1	1	1
7	ENGRAULIDAE	Australian Anchovy	*Engraulis australis*	1		1
8	PLOTOSIDAE	Estruary Cobbler	*Cnidoglanis macrocephalus*		1	1
9	PLOTOSIDAE	Striped Catfish	*Plotosus lineatus*	1	1	1
10	MUGILIDAE	Yelloweye Mullet	*Aldrichetta forsteri*	1	1	1
11	MUGILIDAE	Sea Mullet	*Mugil cephalus*	1		1
12	ATHERINIDAE	Common Hardyhead	*Atherinomorus vaigiensis*	1	1	1
13	ATHERINIDAE	Silver Fish	*Leptatherina presbyteroides*	1	1	1
14	HEMIRAMPHIDAE	Southern Garfish	*Hyporhamphus melanochir*		1	1
15	SYNGNATHIDAE	Tiger Pipefish	*Filicampus tigris*	1		1
16	SYNGNATHIDAE	West Australian Seahorse	*Hippocampus subelongatus*	1	1	1
17	SYNGNATHIDAE	Knobby Seahorse	*Hippocampus tuberculatus*	1		1
18	SYNGNATHIDAE	Rhino Pipefish	*Histiogamphelus cristatus*	1		1
19	SYNGNATHIDAE	Javelin Pipefish	*Lissocampus runa*	1		1
20	SYNGNATHIDAE	Spotted Pipefish	*Stigmatopora argus*	1		1
21	PEGASIDAE	Slender Seamoth	*Pegasus volitans*	1		1
22	TETRAROGIDAE	Soldier	*Gymnapistes marmoratus*	1	1	1
23	TRIGLIDAE	Red Gurnard	*Chelidonichthys kumu*	1		1
24	NEOSEBASTIDAE	Little Gurnard Perch	*Maxillicosta scabriceps*		1	1
25	PLATYCEPHALIDAE	Longhead Flathead	*Leviprora inops*	1	1	1
26	PLATYCEPHALIDAE	Southern Bluespotted Flathead	*Platycephalus speculator*		1	1
27	PLATYCEPHALIDAE	Yellowtail Flathead	*Platycephalus westraliae*	1		1
28	SERRANIDAE	Blowhole Perch	*Caesioscorpis theagenesǂ*	1	1	1
29	APOGONIDAE	Western Gobbleguts	*Ostorhinchus rueppellii*	1	1	1
30	APOGONIDAE	Western Striped Cardinalfish	*Ostorhinchus victoriae*	1	1	1
31	APOGONIDAE	Wedgehead Siphonfish	*Siphamia cuneiceps*	1		1
32	LATIDAE	Spikey Bass	*Hypopterus macropterusǂ*	1		1
33	LATIDAE	Black Sand Bass	*Psammoperca datnoides*		1	1
34	POMATOMIDAE	Tailor	*Pomatomus saltatrix*		1	1
35	SILLAGINIDAE	Southern School Whiting	*Sillago bassensis*	1	1	1
36	SILLAGINIDAE	Western Trumpeter Whiting	*Sillago burrus*		1	1
37	SILLAGINIDAE	Trumpeter Whiting	*Sillago maculata*	1	1	1
38	CARANGIDAE	Silver Trevally	*Pseudocaranx georgianus*	1	1	1
39	CARANGIDAE	Yellowtail Scad	*Trachurus novaezelandiae*	1	1	1
40	NEMIPTERIDAE	Western Butterfish	*Pentapodus vittaǂ*	1	1	1
41	GERREIDAE	Common Silverbiddy	*Gerres subfasciatus*	1	1	1
42	GERREIDAE	Silverbelly	*Parequula melbournensis*	1		1
43	SPARIDAE	Black Bream	*Acanthopagrus butcheri*	1	1	1
44	SPARIDAE	Snapper	*Chrysophrys auratus*	1		1

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APPENDIX 1 (cont'd): Combined fish species recorded in Port Coogee Marina during the 2018-19 and 2022-23 surveys (in phylogenetic order)

	FAMILY	Common Name	Species Name (ǂ endemic)	2018/19	2022/23	TOTAL
45	SPARIDAE	Tarwhine	*Rhabdosargus sarba*	1	1	1
46	MULLIDAE	Blacksaddle Goatfish	*Parupeneus spilurus*	1		1
47	MULLIDAE	Bluespotted Goatfish	*Upeneichthys vlamingii*	1		1
48	MULLIDAE	Australian Goatfish	*Upeneus australiae*		1	1
49	PEMPHERIDAE	Rough Bullseye	*Pempheris klunzingeri*	1	1	1
50	MONODACTYLIDAE	Western Pomfred	*Schuettea woodwardi*	1	1	1
51	ARRIPIDAE	Australian Herring	*Arripis georgianus*	1	1	1
52	ARRIPIDAE	West Australian Salmon	*Arripis truttaceus*	1	1	1
53	GIRELLIDAE	Zebrafish	*Girella zebra*	1	1	1
54	KYPHOSIDAE	Western Buffalo Bream	*Kyphosus cornelii*ǂ	1	1	1
55	KYPHOSIDAE	Silver Drummer	*Kyphosus sydneyanus*	1	1	1
56	MICROCANTHIDAE	Stripey	*Microcanthus strigatus*	1	1	1
57	MICROCANTHIDAE	Moonlighter	*Tilodon sexfasciatus*		1	1
58	SCORPIDIDAE	Banded Sweep	*Scorpis georgiana*	1	1	1
59	CHAETODONTIDAE	Western Talma	*Chelmonops curiosus*	1	1	1
60	ENOPLOSIDAE	Old Wife	*Enoplosus armatus*	1	1	1
61	TERAPONTIDAE	Western Striped Grunter	*Helotes octolineatus*	1	1	1
62	LATRIDAE	Magpie Morwong	*Goniistius gibbosus*ǂ	1	1	1
63	LATRIDAE	Redlip Morwong	*Goniistius rubrolabiatus*ǂ	1	1	1
64	POMACENTRIDAE	McCulloch's Scalyfin	*Parma mccullochi*ǂ	1	1	1
65	POMACENTRIDAE	Western Scalyfin	*Parma occidentalis*		1	1
66	POMACENTRIDAE	Miller's Damsel	*Pomacentrus milleri*	1	1	1
67	LABRIDAE	Baldchin Groper	*Choerodon rubescens*ǂ	1	1	1
68	LABRIDAE	Western King Wrasse	*Coris auricularis*ǂ	1	1	1
69	LABRIDAE	Blue Weed-whiting	*Haletta semifasciata*	1	1	1
70	LABRIDAE	Little Weed Whiting	*Neoodax balteatus*	1	1	1
71	LABRIDAE	Brownspotted Wrasse	*Notolabrus parilus*	1	1	1
72	LABRIDAE	Bluethroat Rainbow Wrasse	*Suezichthys cyanolaemus*		1	1
73	PINGUIPEDIDAE	Wavy Grubfish	*Parapercis haackei*	1	1	1
74	TRIPTERYGIIDAE	Blackhead Threefin	*Enneapterygius larsonae*ǂ	1	1	1
75	BLENNIIDAE	Germain's Blenny	*Omobranchus germaini*	1	1	1
76	BLENNIIDAE	False Tasmanian Blenny	*Parablennius postoculomaculatus*ǂ	1	1	1
77	BLENNIIDAE	Shorthead Sabretooth Blenny	*Petroscirtes breviceps*	1	1	1
78	BLENNIIDAE	Crested Sabretooth Blenny	*Petroscirtes mitratus*		1	1
79	CALLIONYMIDAE	Finger Dragonet	*Dactylopus dactylopus*	1	1	1
80	CALLIONYMIDAE	Painted Stinkfish	*Eocallionymus papilio*	1	1	1
81	CALLIONYMIDAE	Longspine Dragonet	*Pseudocalliurichthys goodladi*ǂ	1	1	1
82	GOBIIDAE	Striped Sandgoby	*Acentrogobius pflaumii*	1	1	1
83	GOBIIDAE	Whitebarred Goby	*Amblygobius phalaena*	1	1	1
84	GOBIIDAE	Bridled Goby	*Arenigobius bifrenatus*	1	1	1
85	GOBIIDAE	Dusky Frillgoby	*Bathygobius fuscus*	1	1	1

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APPENDIX 1 (cont'd): Combined fish species recorded in Port Coogee Marina during the 2018-19 and 2022-23 surveys (in phylogenetic order)

	FAMILY	Common Name	Species Name (ǂ endemic)	2018/19	2022/23	TOTAL
86	GOBIIDAE	Sculptured Goby	*Callogobius mucosus*		1	1
87	GOBIIDAE	Twospot Eviota	*Eviota bimaculata*	1	1	1
88	GOBIIDAE	Southern Longfin Goby	*Favonigobius lateralis*	1	1	1
89	SPHYRAENIDAE	Striped Barracuda	*Sphyraena obtusata/pinquis*	1	1	1
90	XIPHIIDAE	Swordfish	*Xiphias gladius*	1		1
91	PARALICHTHYIDAE	Smalltooth Flounder	*Pseudorhombus jenynsii*	1	1	1
92	MONACANTHIDAE	Spinytail Leatherjacket	*Acanthaluteres brownii*	1	1	1
93	MONACANTHIDAE	Bridled Leatherjacket	*Acanthaluteres spilomelanurus*		1	1
94	MONACANTHIDAE	Toothbrush Leatherjacket	*Acanthaluteres vittiger*	1	1	1
95	MONACANTHIDAE	Sixspine Leatherjacket	*Meuschenia freycineti*		1	1
96	MONACANTHIDAE	Horseshoe Leatherjacket	*Meuschenia hippocrepis*	1	1	1
97	MONACANTHIDAE	Fanbelly Leatherjacket	*Monacanthus chinensis*	1	1	1
98	ARACANIDAE	Western Smooth Boxfish	*Anoplocapros amygdaloides*	1	1	1
99	ARACANIDAE	Whitebarred Boxfish	*Anoplocapros lenticularis*	1		1
100	TETRAODONTIDAE	Stars and Stripes Puffer	*Arothron hispidus*		1	1
101	TETRAODONTIDAE	Weeping Toadfish	*Torquigener pleurogramma*	1	1	1
102	DIODONTIDAE	Globefish	*Diodon nicthemerus*		1	1
			TOTAL	**85**	**81**	**102**

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APPENDIX 2: Fish photographs taken during the 2022/23 marine survey in Port Coogee Marina

Anoplocapros amygdaloides

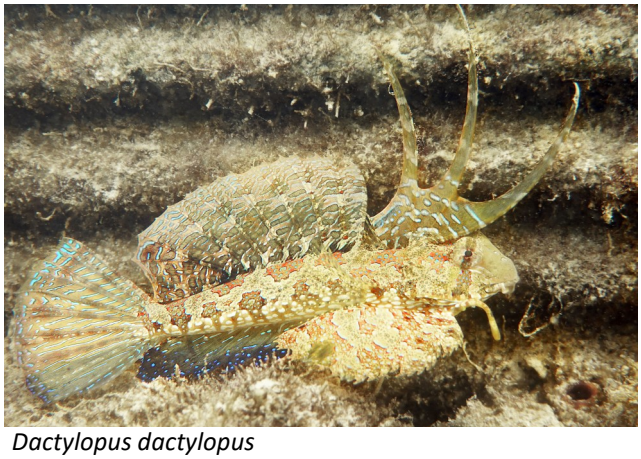
Acanthopagrus butcheri

Arothron hispidus

Bathygobius fuscus

Caesioscorpis theagenes

Choerodon rubescens



Dactylopus dactylopus

Enneapterygius larsonae

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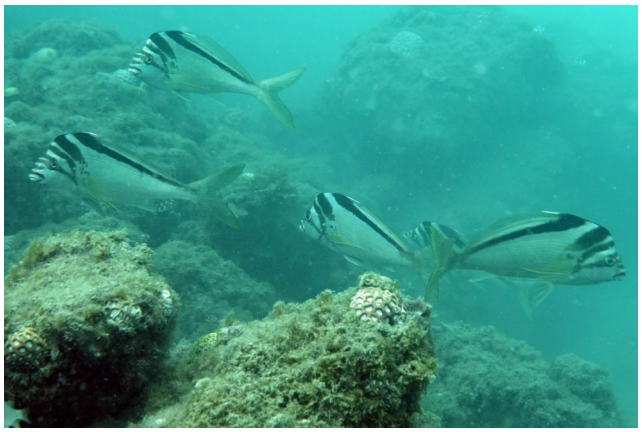
APPENDIX 2 (cont'd): Fish photographs taken during the 2022/23 marine survey in Port Coogee Marina

Eviota bimaculata

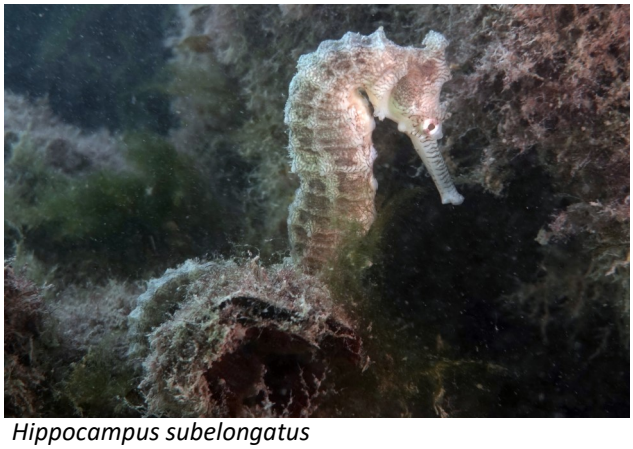
Girella zebra



Goniistius gibbosus

Goniistius rubrolabiatus

Gymnothorax pseudothyrsoideus



Hippocampus subelongatus

Hippocampus subelongatus

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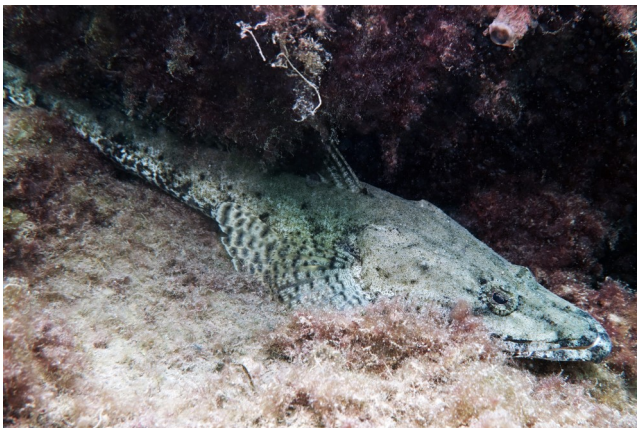
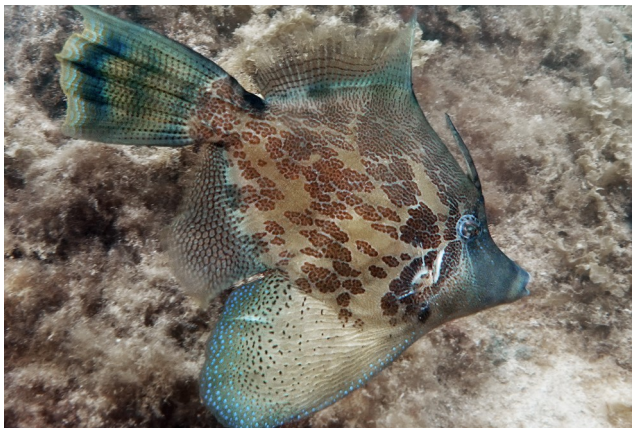
APPENDIX 2 (cont'd): Fish photographs taken during the 2022/23 marine survey in Port Coogee Marina

Kyphosus cornelii



Leviprora inops



Monacanthus chinensis

Neoodax balteatus

Omobranchus germaini

Ostorhinchus rueppellii

Parablennius postoculomaculatus

Petroscirtes breviceps

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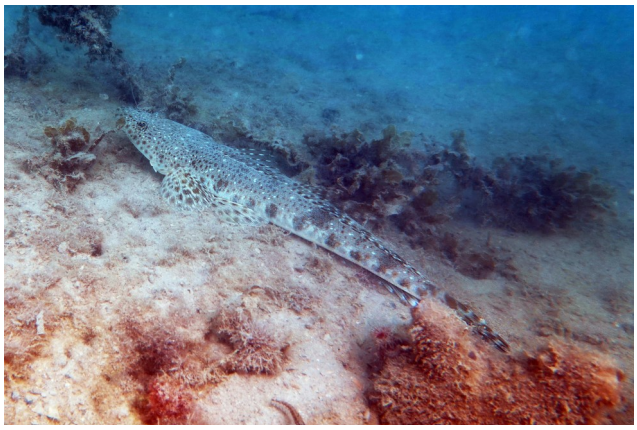
APPENDIX 2 (cont'd): Fish photographs taken during the 2022/23 marine survey in Port Coogee Marina



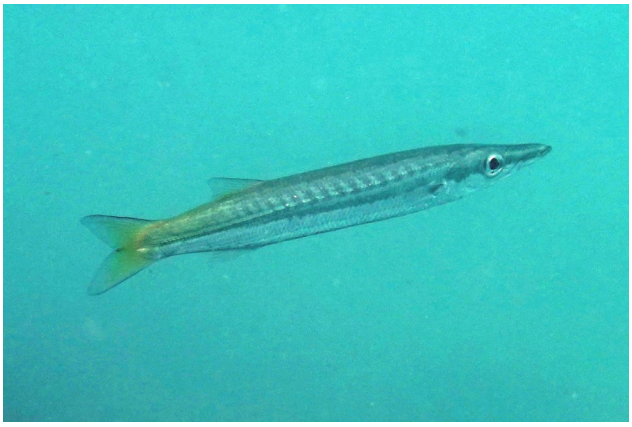
Platycephalus speculator

Plotosus lineatus

Rhabdosargus sarba

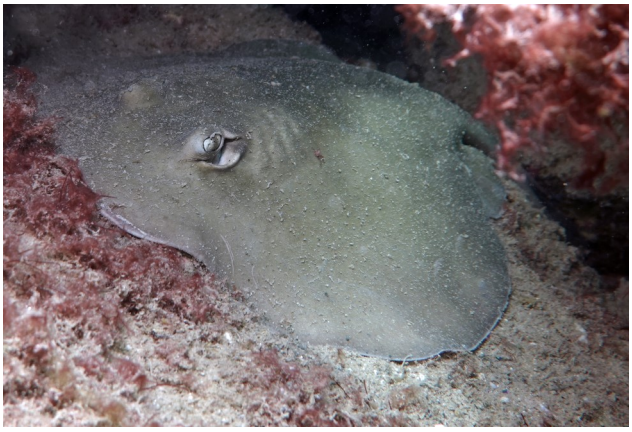
Schuettea woodwardi

Scorpis georgiana



Sphyraena obtusata/pinquis

Trachurus novaezelandiae



Trygonoptera mucosa

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APPENDIX 3: Non-fish species observed during the 2022/23 survey in the Marina (IDs subject to confirmation)

Australian Spotted Jelly (*Phyllorhiza punctata*)

Giant Australian Cuttlefish (*Sepia apama*)

Star Octopus (*Octopus djinda*)

Western Rock Lobster (*Panulirus cygnus*)

Round Crab (*Actaea* sp.)

Rock-pool Shrimp (*Palaemon serenus*)

Ridged Swimming Crab (*Charybdis natator*)

Round Crab (Family Xanthidae)

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APPENDIX 3 (cont'd): Non-fish species observed during the 2022/23 survey (IDs subject to confirmation)

Blunt-end Seahare (*Dolabella Auricularia*)

Reticulated Sea Hare (*Aplysia reticulata*)

Saint Vincent's Nudibranch (*Hypselodoris saintvincentius*)

Hypselodoris sp.

Goniobranchus sp.

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APPENDIX 3 (cont'd): Non-fish species observed during the 2022/23 survey (IDs subject to confirmation)

Sea Squirt (Class Ascidiacea)

Sea Squirt (Class Ascidiacea)

Elysia marginata

Goniobranchus sp.

Goniobranchus sp.

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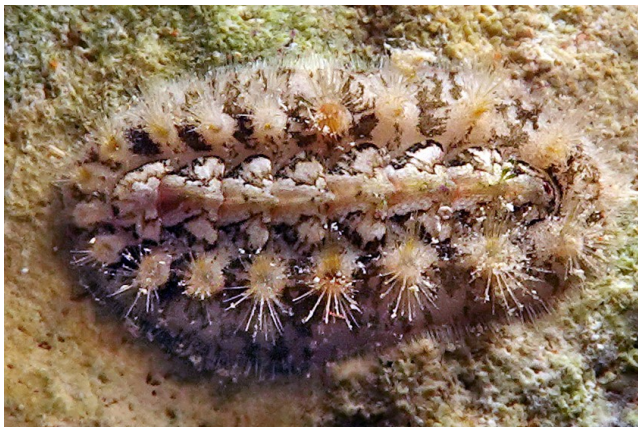
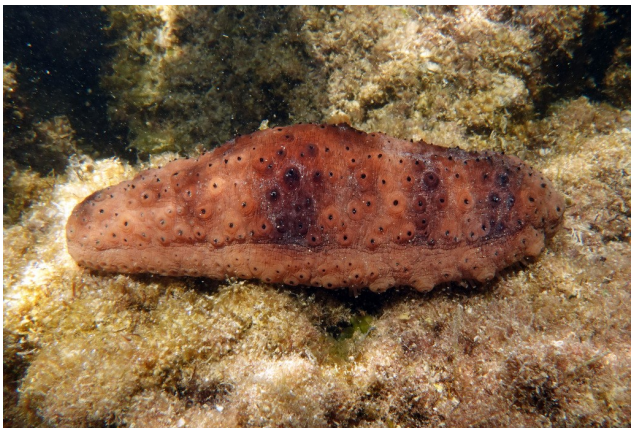
APPENDIX 3 (cont'd): Non-fish species observed during the 2022/23 survey (IDs subject to confirmation)

Chiton (*Lorica volvox*)

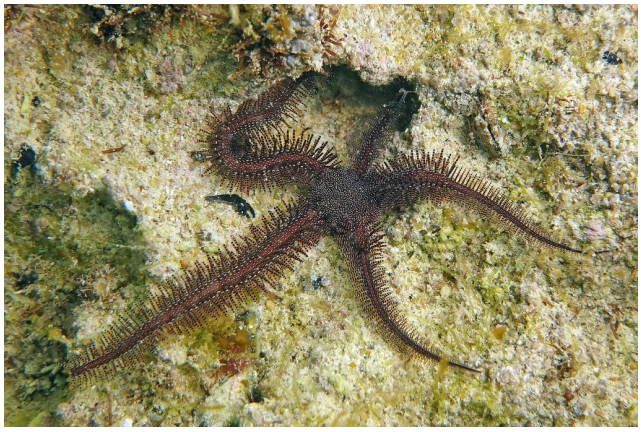
Chiton (*Liolophura hirtosa*)



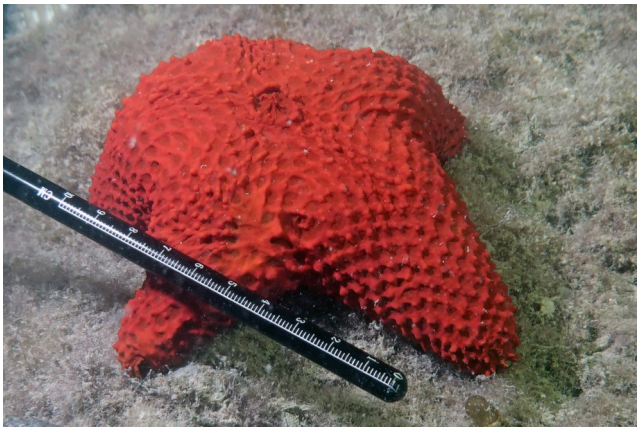
Chiton (*Acanthochitona bednalli*)



Sea Cucumber (Subclass Actinopoda)



Brittle Star (*Clarkcoma canaliculate*)



Striking Seastar (Euretaster insignis)

Eleven-armed Seastar (*Coscinasterias muricata*)

Australian Cushion Star (*Anthenea australiae*)

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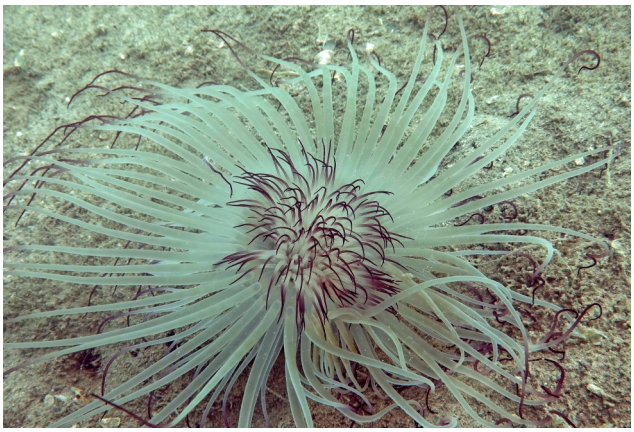
APPENDIX 3 (cont'd): Non-fish species observed during the 2022/23 survey (IDs subject to confirmation)

Segmented Worm (Annelida)

Polychaete Worm (*Odontosyllis* sp.)

Spotted Tiger Flatworm (*Maritigrella fuscopunctata*)



Tube Anemone (*Ceriantharia* sp)

Marine Flatworm (*Notocomplana* sp.)

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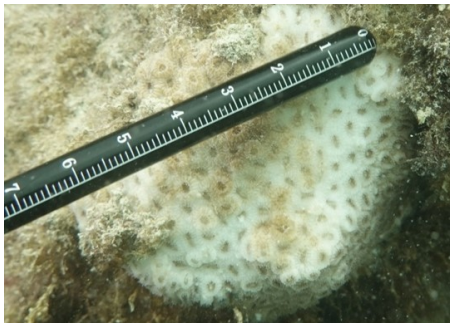
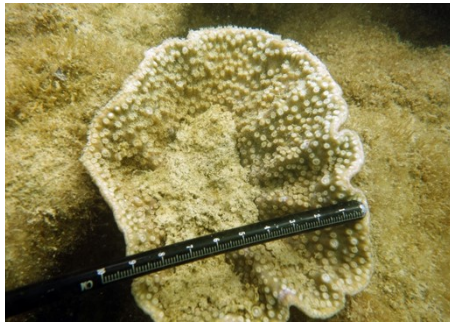
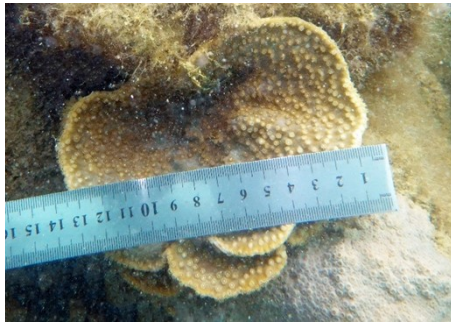
APPENDIX 4: Classification and comparative growth of representative corals in Port Coogee Marina

ID	Family	Species	Feb-19	Mar-22	Feb-23
C1	Plesiastreidae	*Plesiastrea sp.*	 3cm diameter	 6.5cm diameter; partly bleached/dead	 7cm diameter; some dead patches
C2	Dendrophylliidae	*Turbinaria sp.*	 11.5cm max diameter	 11.5cm max diameter	 14cm max diameter
C3	Plesiastreidae	*Plesiastrea sp.*	 4cm max diameter		 5cm max diameter; partial bleaching/death

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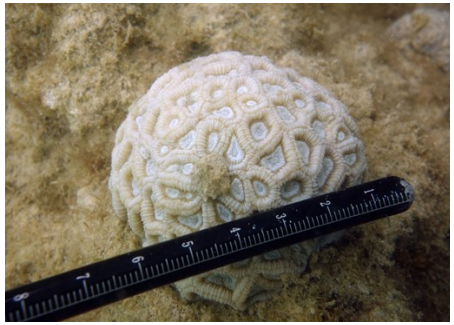
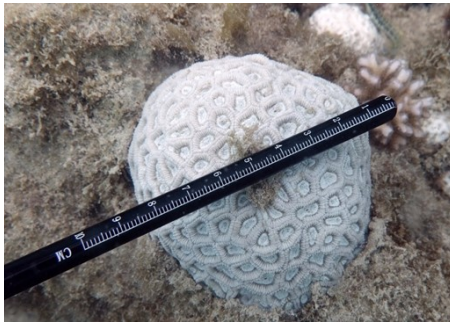
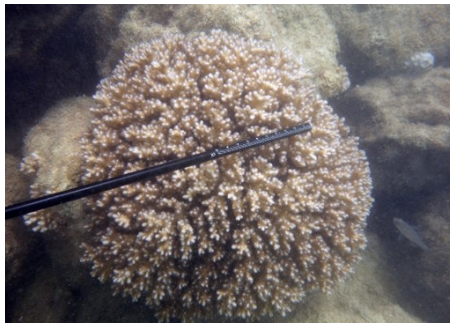
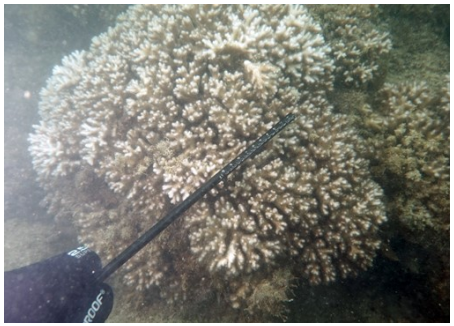
APPENDIX 4 (cont'd): Classification and comparative growth of representative corals in Port Coogee Marina

ID	Family	Species	Feb-19	Mar-22	Feb-23
C4	Pocilloporidae	*Pocillopora damicornis*	 8cm max diameter	Many colonies in the same locality and algal overgrowth has made identification of original colony uncertain.	
C4	Merulinidae	*Favites* sp.	 6cm diameter	 8cm diameter	 10cm diameter
C5	Pocilloporidae	*Pocillopora damicornis*	 30cm max diameter	 45cm+ max diameter	 Numerous nearby *Pocillopora* colonies and algal growth made identification difficult

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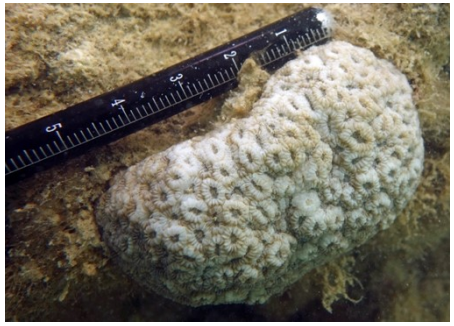
APPENDIX 4 (cont'd): Classification and comparative growth of representative corals in Port Coogee Marina

ID	Family	Species	Feb-19	Mar-22	Feb-23
C6	Merulinidae	*Favites* sp.	 8cm max diameter		 10cm, partly overgrown with algae
C7	Plesiastreidae	*Plesiastrea* sp.	 5cm max diameter; partial bleaching		 max 9cm diameter

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