strategic research fund for the *marine environment*

SRFME

Strategic Research Fund for the Marine Environment Collaborative Research Project:

Biodiversity of Marine Fauna on the Central West Coast

SRFME Milestone Report #2 – November 2005

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Contents

Cover: A side-gilled sea slug *Umbraculum umbraculum* (Lightfoot, 1786) collected live near Fisherman Islands, Green Head. Photograph: C. Whisson.

Executive Summary

This is the second milestone report for the Central West Coast project being undertaken by the WA Museum and funded by SRFME.

The first fieldwork component of this study, ie. Jurien Bay and Green Head, has been completed.

All specimens 5mm or greater in size collected from this fieldwork have been fine sorted to species level for final identification. All specimens less than 5mm in size have been fine sorted for weight determinations and storage in the Museum collections.

Echinoderm and fish identifications have been completed. Most of the mollusc identifications are completed, the crustaceans collected from quadrats are still to be identified, and sponges from some transects and the quadrats remain to be identified.

So far 96 fish species, 51 echinoderm species, 74 mollusc species, 25 crustacean species and 101 sponge species have been identified.

Four records of species of the isopod family Sphaeromatidae collected in this study are new records for Western Australia. Nine species of echinoderms reported from the area have extended species ranges, seven northwards from the Fremantle – Rottnest area and two southwards from Dongara and Shark Bay.

Preliminary results suggest a greater incidence of temperate species of fishes, molluscs and crustacea occur in the Jurien Bay and Green Head area, supporting the expectation that this region has a dominance of temperate species.

Preliminary results from the mollusc identifications found 20% of the species were west coast endemics. This figure falls within the range of endemic species (5-25%) previously reported in WA Museum work that has been conducted in the west coast biogeographical overlap zone.

Preliminary results have shown that fewer echinoderm species occur in the Jurien Bay – Green Head area (51 species) than in Albany (81 species) or at Rottnest Island (86 species). This could be for a number of reasons including the sampling methods used not picking up species, and sand habitats not being sampled in this study. It may be that species of this phylum are in low numbers in this area for biological or physical reasons and future analyses of the data may assist with explaining this result.

All identified specimens have been entered into the WA Museum collections database and lodged in the Museum collections.

Acknowledgements

We are very grateful to three volunteers who assisted us in the field: Kaye Grubb, diver, Tenneill Houlahan, boat person, and Elaine Oldham, laboratory assistant. CSIRO generously loaned us additional SCUBA tanks, and provided site data. Ian Stiles and his vessel *Hot Tuna* greatly facilitated our diving activities and provided helpful local knowledge and advice. Tim Daly and the DEP vessel *Zoila* provided our dive platform in the second week of very smooth field operations. Sue Morrison, WA Museum, assisted with additional field supplies in our time of need. Oliver Gomez and Jenny Hutchins, WA Museum, greatly assisted this project by sorting the fauna from rock samples and weed washings and dissecting sponges for infauna and epifauna.

General Overview

1.1 Background

This study is part of a larger program to investigate ecological interactions in Midwest WA coastal reef communities. The WA Museum (WAM) component of the program sits within the program category: Habitat characterisation and benthic community biodiversity studies. The WA Museum focus is documentation of the fauna of the region and specifically examines the diversity of fishes, molluscs, crustaceans, echinoderms, scleractinian corals and sponges of the area. The WA Museum will also have input into determination of other significant space occupying taxa such as ascidians, soft corals, zoanthids and anemones.

In addition to characterising habitats and identifying community biodiversity, the results obtained by the WA Museum will inform other parts of the program such as providing data on major predators and biota associated with trophic linkages. Although marine worms will not be identified in the study, this important infaunal component of the benthic community is being collected and weighed to provide information relevant to trophodynamic studies.

The methodology used in the fieldwork program also provides a basis for detecting longer term changes in the benthic communities of the region. This study will make a significant contribution to determining baseline variability in a warm temperate marine ecosystem in WA by compiling a data set on which comparative studies can be undertaken in the future.

The Midwest region is considered to lie in a biogeographical overlap zone that has a mixture of tropical, temperate and endemic biota. There is little known about the relative proportions of these biota, but it is thought that temperate species may dominate with a smaller proportion of tropical species and endemics. No quantitative studies to date have examined this question thus this study will provide new information into the abundance of species as well as their distributions, and the proportions of the biota that are tropical, temperate or endemic to the west coast.

1.2 Methodology

Four locations were selected for study, Jurien Bay and Green Head localities with a focus on the Jurien Bay Marine Park, and the Cervantes to the South and Dongara to the North. These latter two localities provide a latitudinal component to the study, testing the hypothesis that the faunal biodiversity of Jurien Marine Park is representative of adjacent areas to the north and south of the park in the Midwest region of coastal WA.

Fieldwork conducted in April and May 2005 was in the Jurien Bay and Green Head areas, and was undertaken jointly with a team of CSIRO scientists led by Dr. Russ Babcock.

Preliminary discussions with CSIRO, Murdoch and ECU collaborators identified that sampling should be quantitative and undertaken on a range of sampling scales, i.e. 0.25m^2, 1m^2, 5m^2 and 25m. Two dominant habitats of the region would be sampled, namely reefs and seagrasses. Although sand habitat is also represented in the region, fieldwork logistics and time constraints did not allow for this habitat to be sampled.

Sampling also had a cross shelf (distance from shore) component with inshore, midshore (exposed and sheltered) and offshore (exposed and sheltered) reefs sampled.

Within sites, dominant cover was recorded and targeted sampling ensured that various covers were sampled. For example at some reef sites *Sargassum* and red foliose algae occurred adjacent to *Ecklonia* dominated areas. In this case quadrats and transects were located in both floral areas.

Seagrass habitats either had beds of *Amphobolis* or *Posidonia* and both types of seagrass were sampled for faunal biodiversity.

A summary of the sampling procedure for reef habitats is presented in Table 1. Procedures for seagrass habitats are summarised in Table 2.

Fish were surveyed by two additional methods. Trawling was undertaken in a seagrass habitat to collect cryptic fishes, and a reef site was selected as a rotenone station, again to assess fish diversity not detected in visual census transects.

A total of 16 sites were examined by the WA Museum staff at Jurien Bay and Green Head. One site where CSIRO collected (North Point) could not be accessed by the WA Museum because of a large swell and onshore sea and winds on the day sampling was attempted.

Table 1. Fieldwork sampling program for reef habitats at Jurien Bay and Green Head.

Taxon	*Sampling scale*			
	0.25m^2 quadrat	**1m^2 quadrat**	**5m^2 transect**	**25m transect**
	Replication			
	n = 5	**n = 5**	**n = 3**	**n = 3**
Algae	**CSIRO** Harvest quadrat			
Crustaceans	**CSIRO/WAM** Sieved from harvested algae and rock		**WAM** Crustacea larger than 1cm collected for ID	
Molluscs	**CSIRO/WAM** Sieved from harvested algae and rock	**CSIRO** Molluscs larger than 1cm counted and measured in situ	**WAM** Molluscs larger than 1cm collected for ID	
Sponges	**CSIRO/WAM** Photographed then harvested from quadrat		**WAM** Sponges larger than 1cm counted, measured in situ and collected for ID	
Echinoderms	**CSIRO/WAM** Sieved from harvested algae and rock	**CSIRO** Echinoderms larger than 1cm counted and measured in situ	**WAM** Echinoderms larger than 1cm counted, measured in situ and collected for ID	
Ascidians	**CSIRO** Harvested from quadrat	**CSIRO** Ascidians larger than 1cm counted and measured in situ		
Corals		**CSIRO** Small corals e.g. *Plesiastrea* counted in situ	**WAM** Corals larger than 1cm counted and measured in situ, and collected for ID	
Fish				**WAM** Visual census
Habitat				**WAM** Video transect

Table 2. Fieldwork sampling program for seagrass habitats at Jurien Bay and Green Head.

Taxon	*Sampling scale*			
	0.25m^2 quadrat	**1m^2 quadrat**	**5m^2 transect**	**25m transect**
	Replication			
	n = 5	**n = 5**	**n = 3**	**n = 3**
Seagrass	**CSIRO** Harvest quadrat			
Crustaceans	**CSIRO/WAM** Sieved from harvested rock		**WAM** Crustacea larger than 1cm collected for ID	
Molluscs	**CSIRO/WAM** Sieved from harvested rock	**CSIRO** Molluscs larger than 1cm counted and measured in situ	**WAM** Molluscs larger than 1cm collected for ID	
Sponges	**CSIRO/WAM** Photographed then harvested from quadrat		**WAM** Sponges larger than 1cm counted, measured in situ and collected for ID	
Echinoderms	**CSIRO/WAM** Sieved from harvested rock	**CSIRO** Echinoderms larger than 1cm counted and measured in situ	**WAM** Echinoderms larger than 1cm counted, measured in situ and collected for ID	
Ascidians	**CSIRO** Harvested from quadrat	**CSIRO** Ascidians larger than 10mm counted and measured in situ		
Corals		**CSIRO** Small corals e.g. *Plesiastrea* counted in situ	**WAM** Corals larger than 1cm counted and measured in situ and collected for ID	
Fish				**WAM** Visual census
Habitat				**WAM** Video transect

Table 3. List of sites sampled.

Transect		Quadrat		Site Locale	Latitude	Longitude	Habitat	Depth (m)
Site Code JWAM	Date	Site Code CSIRO	Date					
1	27/04/05	1	27/04/05	North Essex	30° 21.13'S	115° 00.15'E	Reef, *Ecklonia*, low algae	3.0-4.5
2	27/04/05	2	27/04/05	Seaward Ledge	30° 17.39'S	114° 58.36'E	Reef, *Ecklonia*	5.0-7.6
3	27/04/05	3	27/04/05	Inside Favourite Island	30° 17.02'S	115° 00.09'E	*Posidonia* with reef lumps, red foliose	4.0-7.3
4	28/04/05	BR	26/04/05	Booker Rocks	30° 20.71'S	115° 02.25'E	Reek, *Ecklonia*, large corals, *Amphibolis antartica*/red foliose	5.0-6.9
4a	28/04/05	4	28/04/05	Booker Rocks	30° 20.71'S	115° 02.25'E	*Amphibolus*, sand, *Syringodium*, rocks	7.5
5	28/04/05	WR	26/04/05	Wire Reef	30° 17.85'S	115° 01.17'E	Reef, *Ecklonia*, *Sargassum*, sand, *Amphibolis griffithii* /red foliose	7.5-7.7
5a	04/05/05	5	28/04/05	Wire Reef	30° 17.85'S	115° 01.17'E	*Amphibolus*, *Posidonia*	8.3
6	01/05/05	6	01/05/05	SW of Escape Island	30° 20.36'S	114° 58.81'E	Reef, *Ecklonia*, red foliose	12.0-13.0
7	01/05/05	7	01/05/05	SW of Escape Island	30° 20.34'S	115° 05.88'E	Reef, *Ecklonia*, fucoid/mixed brown	6.5-11.0
8	01/05/05	8	01/05/05	SW of Essex Rocks	30° 21.15'S	114° 59.30'E	Reef, *Ecklonia*, caves, red foliose	7.0-11.0
9	Not Sampled	9	01/05/05	North Point	30° 12.05'S	115° 58.04'E	Fucoid algae	5.0
10	02/05/05	10	02/05/05	SE of Fisherman Islands	30° 08.10'S	114° 58.40'E	Reef, mixed browns, coral, *Posidonia*, low algae/fucoid/*Sargassum*	4.0-7.3
11	02/05/05	11	02/05/05	W of Dry Lump	30° 07.32'S	114° 56.79'E	Pavement, reds over sand, *Sargassum*/red foliose/*Ecklonia*	5.0-6.2
12	03/05/05	12	03/05/05	W of Dry Lump	30° 07.31'S	114° 56.53'E	Reef, *Ecklonia*, holes, overhangs, *Ecklonia*/red foliose	8.0-12.9
13	03/05/05	13	03/05/05	Julia Rocks	30° 09.36'S	114° 59.72'E	Low reef, sandy edges, *Amphibolus*, red foliose	2.5-4.7
14	03/05/05	14	03/05/05	NW of Julia Rocks	30° 09.34'S	114° 59.83'E	*Halophila*, *Amphibolus griffithii*	5.0-5.6
15	03/05/05	15	03/05/05	E of Fisherman Islands	30° 08.08'S	114° 58.43'E	*Posidonia*, some *Amphibolus*, brown algae	7.0-7.7

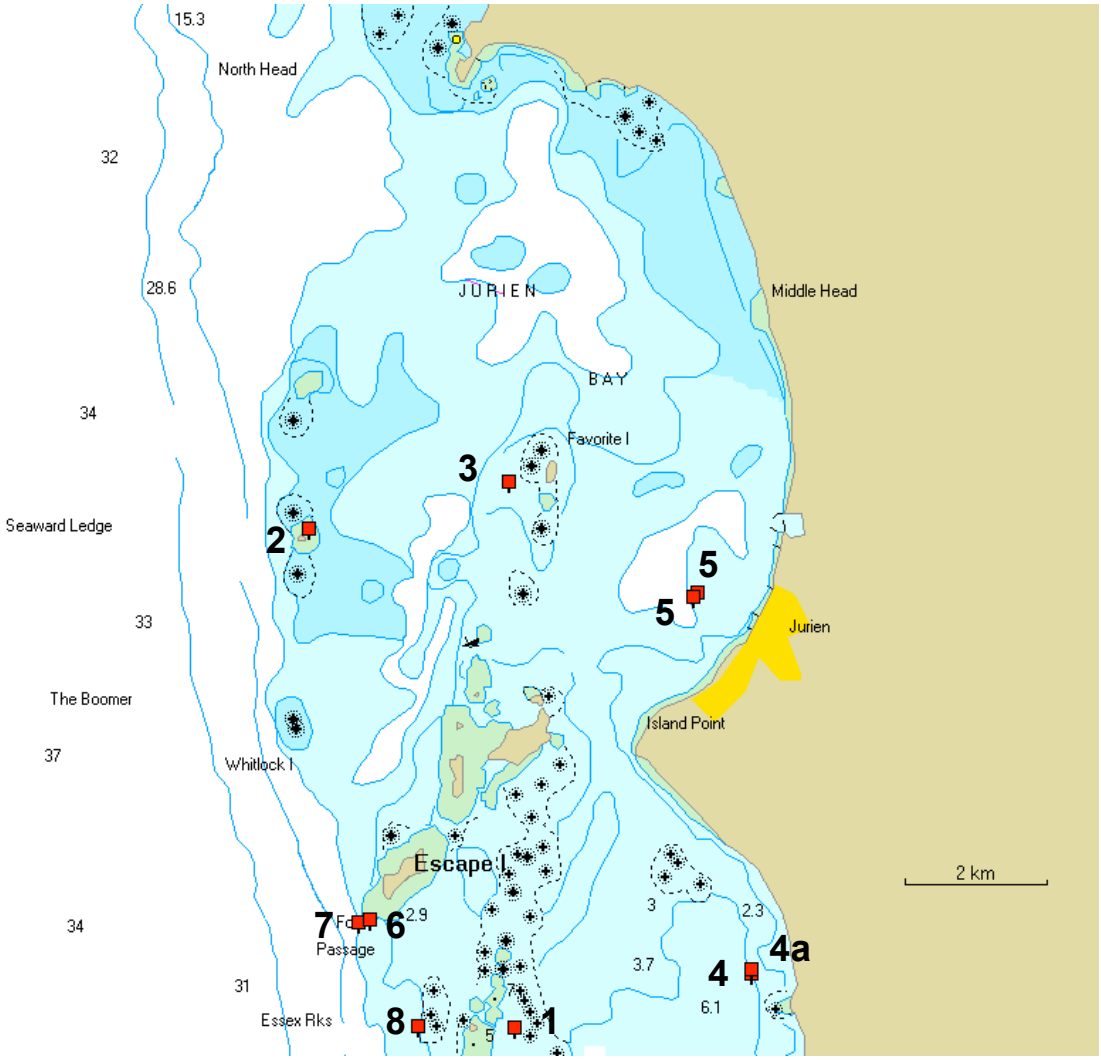

Figure 1. Map of Jurien sites sampled.

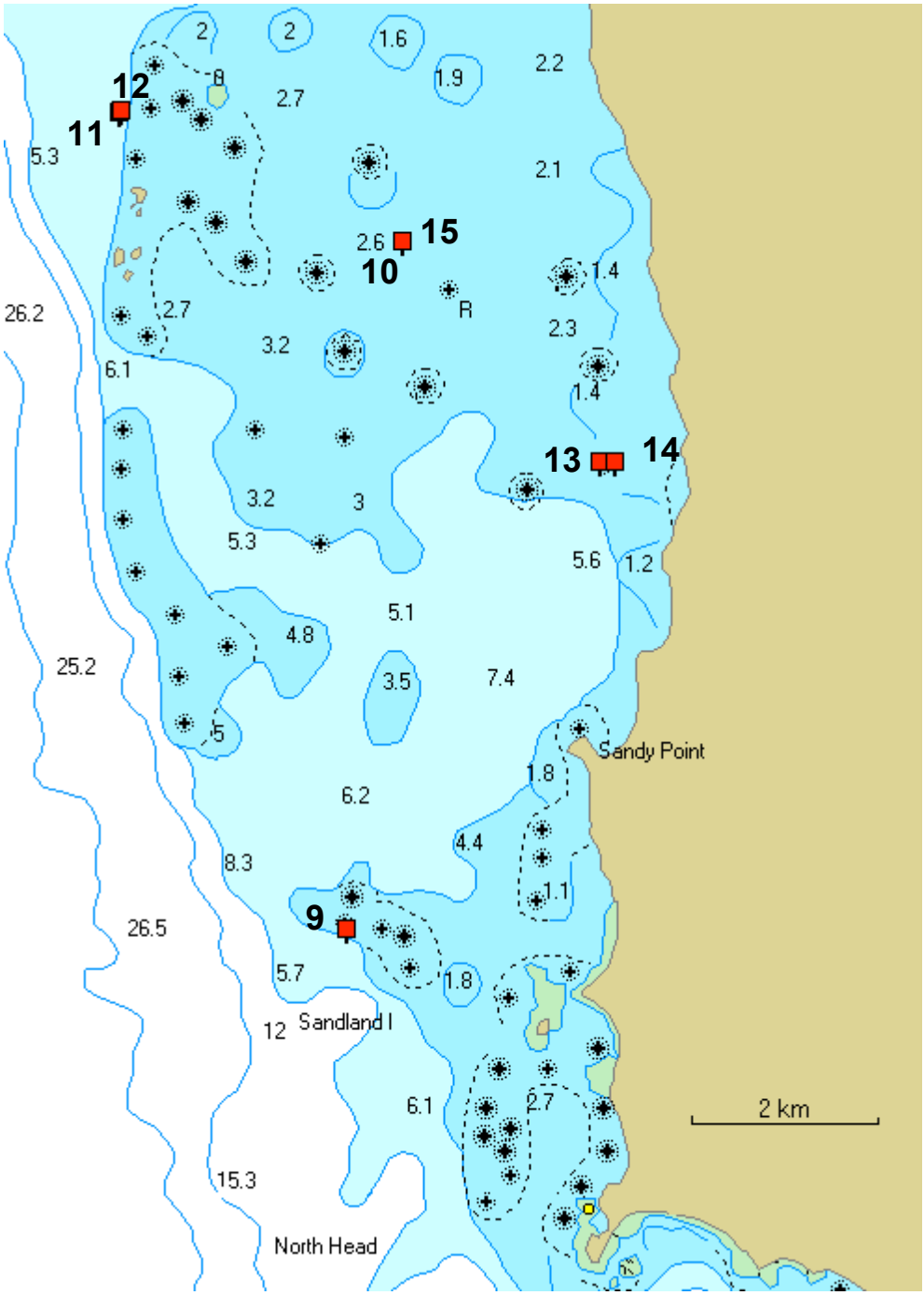

Figure 2. Map of Green Head sites sampled.

1.3 Habitat Survey

Transects 25m^2

Three 25m^2 transects were filmed at each site for habitat documentation. Footage was taken approximately 1m from the seabed. Each transect was completed in an average of 8 minutes.

1.4 Invertebrate Methodology

Sample collection and sorting methods

Quadrats 1m^2 and 0.25m^2

Field Methods

1m^2 Quadrats

CSIRO sampled 1m^2 quadrats. Any ascidians, molluscs and scleractinian corals greater than or equal to 5mm were identified and measured *in situ*. Voucher specimens were collected for later confirmation of identification by the WA Museum. Field data obtained by CSIRO for the 1m^2 quadrats was shared with the museum to supplement WA Museum quadrat data.

0.25m^2 Quadrats

One-quarter of each of the five 1m^2 quadrats was intensively sampled. All flora and fauna taken from this area, in addition to approximately 3cm of sampled substrata, was bagged for sieving of sessile benthos, cryptic species and infauna, in the laboratory. Rock diggings, seagrass clippings and algal samples were collected from the destructive 0.25m^2 quadrats.

0.25m^2 Rock

Due to time constraints, only rock samples collected from the 0.25m^2 destructive quadrats by CSIRO were sorted by WA Museum staff in the field. Each sample was first washed and the washings passed through a series of three sieves (8.0mm, 4.0mm and 1.7mm). The sample was then examined for any large encrusting organisms, such as sponges, ascidians and corals that could be removed whole. Any large free-living animals were also removed at this point. If necessary, the rock was then broken with hammer and chisel into thumbnail-sized pieces. All the pieces were then re-washed and the washings passed through the sieves. Before disposal, a quick examination of the washed rock pieces was made for any remaining boring or cryptic species. Due to time constraints, at this point only those animals that were easy to remove were taken.

Animals collected in the sieves were washed into trays for sorting. Only primary sorting of this sieved material was achieved in the field. Fauna from the sieve washings of each sample were sorted to phyla, preserved in 75% special methylated ethanol and transported back to the WA Museum.

Transects 5m^2

Field Methods

Three 5m^2 transects were sampled for sponges, scleractinian coral, crustaceans, echinoderms and molluscs. All colonies and individuals were counted and measured for area of cover. Large areas of zoanthids and soft coral colonies were also counted and measured. One voucher specimen of each species found was collected for identification and lodgement into the WA Museum collections. In many instances, sponges were too numerous and small to measure *in situ*. These specimens were collected and measured before preservation. Specimens were then transferred to the WA Museum for examination.

Preliminary Sorting

At the conclusion of each day, all data sheets with transect numbers, recorded species, numbers of individuals/colonies recorded, and size of colonies/individuals were transposed to a field notebook. All specimens collected were sorted into species groups, counted, measured and added to the transect data records. All specimens were labelled and preserved for transfer to the WA Museum.

Laboratory Methods

0.25m^2 Quadrats

Rock Samples

Animals from each sample were grouped by phyla, then sorted into two size classes; microfauna (<5mm) and macrofauna (≥5mm). The live-taken macrofauna were used for counts, weights and compiling species lists. Microfauna (including dead animals) were collected to supplement species lists. However, as these were often present in large numbers, it was not practical to collect all individuals for counts.

Algal & Seagrass Samples

Animals from each sample were in the first instance given to CSIRO for preliminary identification and measuring, as part of an ongoing seasonal central coast study. Animals from each phyla were sorted into two size classes, microfauna (<5mm) and macrofauna (≥5mm), with the molluscs and crustaceans identified by CSIRO to species level (where possible).

Live-taken animals greater than or equal to 5mm were used for counts and weights by CSIRO. Live-taken microfauna (<5mm) and/or freshly dead-taken molluscs were retained to contribute to WA Museum species lists, but as these were often present in large numbers, it was not practical to collect all individuals for counts. This material was then returned to the WA Museum for confirmation of identifications. Data obtained by CSIRO will be used to complement the WA Museum quadrat data.

Live-taken crustaceans, molluscs and echinoderms, greater than or equal to 5mm were identified by the WA Museum to species level (where possible) and counted. Where time permitted, the identification of live-taken microfauna and/or freshly dead-taken molluscs was undertaken to expand species lists.

Transects 5m^2

Sponges were dissected for cryptic molluscs, crustaceans and echinoderms, and these groups passed to relevant WA Museum personnel.

1.5 Vertebrate Methodology

Methodology for collection and interpretation of fish data from the 25m transects is presented in the Fishes Section (Page 21).

2.0 Crustaceans

Melissa Titelius

2.1 Introduction

Relatively few studies have been made to document the crustacean fauna of the Western Australian mid-west region (Trigg Island north to Kalbarri) (CALM, 2005). The WA Museum crustacean collections hold a number of records from the bioregion but they are largely incidental collections. In 1998, CALM conducted a survey of the Jurien Bay region as part of the planning for the then proposed marine park. It was the first attempt to systematically document the marine invertebrate fauna in the region but was limited to species easily observed (CALM, 2005). As crustaceans are typically cryptic in colour and nature, and many are very small, few species were detected.

The present study aims to expand on current knowledge of the crustacean biodiversity of the mid west region and provide the most thorough documentation of the fauna to date. This report documents the preliminary findings from the 5m transect surveys conducted during the 2005 April-May expedition to Jurien Bay and Green Head.

2.2 Methodology

Laboratory Work

Collection and preservation techniques for all invertebrate collected in this study are detailed in the general methods section.

Final sorting of the $5m^2$ transect collections was carried out in the WA Museum. The crustaceans were separated out from the other phyla in preparation for identifications. Specimens were then identified to the lowest taxonomic level possible in the report timeframe. More complete identifications for the material will be achieved before the final report submission in November 2006. No attempt has been made at this stage to identify the small crustaceans of the Order Amphipoda. The group is very specious and difficult to identify. For the purpose of this report they are grouped simply as Amphipoda.

The taxonomic order used in this report follows Martin & Davis (2001) and Davie (2002).

2.3 Results

Species Diversity
A total of 25 crustacean species (excluding Amphipoda) have been identified from the $5m^2$ transect samples (Table 4). The isopods were the most diverse of the crustacean groups accounting for 12 of the 25 species. The majority of these (eight species) fall into the family Sphaeromatidae. The other two isopod families recorded, Paranthuridae and Stenetriidae, had relatively fewer species with one and three species respectively. The sponge associated isopod *Amphoroidella elliptica* (Sphaeromatidae) was the most widespread species in the collections, occurring at five of the 16 stations sampled (Table 4). The stenetriid isopod *Stenetrium* sp.1 occurred at four stations.

Collections of the order Decapoda were only slightly less diverse in species than the isopods recording 11 species from eight families: Alpheidae, Porcellanidae, Diogenidae, Dromiidae, Majidae, Hymenosomatidae, Pilumnidae and the Trapeziidae. Of these only the alpheids recorded more than one species from the collections (four species). The decapod species were not widely spread with only the porcellanid crab *Ancylocheles gravelei*, being recorded at three sites. The remaining 10 species were recorded from two or less sites.

A single species of barnacle, *Acasta* sp. (Order Sessilia: Family Archaeobalanidae) was recorded from a sponge taken from south west of Escape Island (JWAM 6) and one specimen of an

unidentified mysid shrimp, Mysid sp.1 (Order Mysida) was collected from Booker Rocks (JWAM 4a).

The highest diversity of crustaceans, measured by number of species, was recorded at Booker Rocks (JWAM 4a, eight species) and inside Favourite Is. (JWAM 3, six species). Eight stations recorded two or less species.

The known distributions of 17 of the identified species are given in Table 4. Eleven species (65%) have southern distributions, four have west coast distributions (24%), and two species are of northern distribution (12%). Four new records for Western Australia are recorded for the isopod family Sphaeromatidae: *Amphoroidella elliptica*, *Cymodoce septemdentata*, *Haswellia glauerti* and *Pseudocerceis trilobite.* The single specimen of *Oxinosphaera australis* in these collections extends the species range north from Cottesloe, WA. Note that while the stenetriid isopods were not fully identified the family has only been recorded from southern areas within Australia (Poore, 2002). The *Stenetrium* species listed here are therefore tentatively given a southern distribution (Table 4) and are included in the above results.

Comment on the diversity and biogeography of the Amphipoda is not possible at this point but it can be noted they are widely spread as a group occurring at 10 of the 16 sites sampled.

2.4 Discussion

Transect Crustaceans
The crustaceans collected from the $5m^2$ transects are generally small species groups such as the Amphipoda and Isopoda. This is likely a result of the transect sampling which is designed more specifically to document occurrence and coverage of the large sedentary invertebrates. Larger crustaceans were only taken from the transect line if they were obvious. However crustaceans are mostly cryptic in their behaviour and colouring making them hard to detect. Many have formed close associations with the invertebrates they shelter in or are well camouflaged in colour and form to the algae canopy. The more freely roaming species usually shelter during the day within the reef systems only becoming more active at night.

The crustaceans reported here are largely the result of incidental collection off, or in, the various sedentary invertebrates sampled from the transect lines. Many of the species reported here are known associates of sponges. The sphaeromatid isopod, *Amphoroidella elliptica*, is found living on the surface of sponges (Hale, 1929) and the two species of *Oxinosphaera* (Sphaeromatidae) burrow holes into sponges in which they then live (Christine Hass pers. com.). Similarly, the barnacle genus *Acasta* is only found embedded in the tissue of sponges. While the alpheid shrimp are not fully identified many members of the genus are known to live in association with sponges, even utilising the internal canals (Poore, 2004).

The decapod species of *Halicarcinus ovatus* (Hymenosomatidae), *Pilumus rufopunctatus* (Pilumnidae), *Fultodromia spinifera* (Dromiidae) and *Calcinus dapsiles* (Diogenidae) have been recorded from a variety of habitats including sheltering in sponges, tunicates and other sedentary marine invertebrates (Hale, 1927; Davie, 2002; Poore, 2004).

Biogeography
These preliminary findings show a fauna dominated by southern species (65%) and a strong west coast faunal component (24%). The study area sits well within the overlap zone of the warm temperate and the tropical bioregions however only two species (12%) with northern distributions were recorded. It is expected a stronger tropical component will become apparent as the material from the rock and weed quadrats are identified. CALM reported a 35% tropical component from their survey of the Jurien marine fauna in 1998 (CALM, 2005) and Jones & Morgan (1993) reported a 39% tropical Indo-west Pacific component in the crustacean fauna recorded at Rottnest Island, 200km south of Jurien.

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Table 4. Crustacean species list and presence absence table for Jurien Bay & Green Head 5m^2 Transects.
Note results from 3 transects at each site combined.
A = species not separated out.

SPECIES	# Stns	JWAM SITES																DISTRIBUTIONS
		1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	
Order Sessilia																		
Family **Archaeobalanidae**																		
Acasta sp.	1								x									
Order Mysida																		
Mysid sp.1	1					x												
Order Amphipoda (11)	10	A		A		A		A	A	A	A			A	A	A	A	
Order Isopoda																		
Family **Paranthuridae**																		
Paranthurid sp.1	1					x												
Family **Sphaeromatidae**																		
Amphoroidella elliptica com. nov. (Baker, 1929)	5			x		x			x					x	x			SA, now WA
Haswellia emarginate (Haswell, 1881) Sub-adult, Id slightly doubtful	1														x			VIC, SA and now WA
Haswellia glauerti Baker, 1928	1				x													WA, L west coast
Cymodoce septemdentata Baker, 1910	2	x					x											VIC, SA & now WA
Oxinosphaera australis comb. nov. (Baker, 1929)	1								x									WA, Cottesloe, now Jurien Bay
Oxinosphaera tuberculosa comb. nov. (Stebbing, 1873)	1								x									Widespread: VIC, TAS, SA, WA to NW Cape.
Pedinura flindersia Bruce, 2003	1			x														VIC, SA, WA to Dongara.
Pseudocerceis trilobita (Baker, 1908) Immature, Id slightly doubtful	2				x	x												SA, now WA.
Family **Stenetriidae**																		
Stenetrium sp.1	4	x				x	x			x								Likely sthn distribution
Stenetrium sp.2										x								Likely sthn distribution
Stenetrium sp.3	1					x												Likely sthn distribution

SPECIES	# Stns	JWAM SITES																DISTRIBUTIONS
		1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	
Order Decapoda																		
Infraorder Caridea																		
Family **Alpheidae**																		
Synalpheus sp.1	2			x								x						
Synalpheus sp.2	2					x		x										
Synalpheus sp.3	2						x			x								
Synalpheus?	1						x											
Infraorder Anomura																		
Family **Porcellanidae**																		
Ancylocheles gravelei Sankolli, 1963	3			x						x		x						NSW, QLD, NT, WA, S to Esperance
Family **Diogenidae**																		
Calcinus dapsiles Morgan, 1989	2					x									x			WA, central & lower West coast
Infraorder Brachyura																		
Family **Dromiidae**																		
Fultodromia spinifera? (Montgomery, 1931)	1							x										WA, lower West coast & northwest coast.
Family **Majidae**																		
Anacinetops?	1							x										
Family **Hymenosomatidae**																		
Halicarcinus ovatus Stimpson, 1858	2			x											x			NSW, VIC, TAS, SA & WA (lower West coast)
Family **Pilumnidae**																		
Pilumnus rufopunctatus Stimpson, 1858	2	x								x								NSW, VIC, SA, WA (lower & northwest coast)
Family **Trapeziidae**																		
Trapezia cymodoce (Herbst, 1801)	1			x														NSW, QLD, NT & WA (S to lower west coast)
TOTAL NO. SPECIES PER SITE		3	0	6	2	8	4	3	4	4	0	2	0	1	4	0	0	
Sites at which amphipods occurred.		A		A		A		A	A	A	A			A	A	A	A	

3.0 Echinoderms

Loisette Marsh

3.1 Introduction

The present survey to some extent fills a gap between the better-known echinoderm faunas of Rottnest Island and the Houtman Abrolhos discussed by Marsh and Pawson (1993) and Marsh (1994) respectively. However, these two locations are offshore and thus more exposed to the influence of the Leeuwin Current giving them a higher proportion of tropical species. There are no comparable studies of echinoderms anywhere else on the west coast so this work is a valuable contribution to the knowledge of the Western Australian marine fauna.

3.2 Methodology

Field and Laboratory Methods

Large echinoderms were collected by hand from transects and quadrats while smaller ones were sorted in the laboratory from algae, seagrass and rocks from transects and quadrats. No dredge samples of soft substrates were made.

Specimens were identified to species level wherever possible using a stereomicroscope with variable-objective lens and x6 and x12.5 eyepieces.

Holothurians were dissected wherever possible to check the internal anatomy and skin samples taken. These were dissolved on a microscope slide in sodium hypochlorite and temporarily mounted for examination using a compound microscope.

Problems with identifications came from two sources – the first being that many specimens were very small juveniles, particularly echinoids, which had not yet developed adult characteristics, and the second problem stemmed from the fragility of small crinoids and ophiuroids, many of which were badly damaged or fragmentary, and some of which were impossible to identify.

Taxonomic order of classes and families in Table 5 follows Clark and Rowe (1971) while genera and species are in alphabetical order within each family.

3.3 Results and Discussion

Overall the species richness is rather low in view of the intensity of sampling. There is a total of 51 species of echinoderms, made up of five species of crinoids (in three families), 10 species of asteroids (in five families), 23 species of ophiuroids (in seven families), eight species of echinoids (in five families) and five species of holothurians in four families.

Nine species represent extensions of range, seven northwards, mostly from the Fremantle-Rottnest area and two are southern extensions, one from Dongara and one from Shark Bay.

Crinoidea

This class (feather stars) is represented by only five species from three families. The family Comasteridae with several tropical and temperate species in south-western Australia usually predominates in samples but here is represented only by *Comatulella brachiolata,* not previously recorded north of the Fremantle area. There are three species of the family Antedonidae and one of the family Aporometridae, this latter species, *Aporometra occidentalis* has not previously been recorded north of the Perth metropolitan area and is endemic to southern and south-western Australia.

Asteroidea

Taxonomic note: Recent generic and specific changes to common species of Asterinidae are likely to cause confusion so they are outlined here to make the situation clear. *Meridiastra gunnii* is now the correct name for the purple six-rayed species previously called *Patiriella brevispina* (see O'Loughlin and Waters 2004). This change left the species previously recognised as *P. gunnii* nameless. O'Loughlin *et al.* (2003) found from detailed morphology supplemented by DNA analysis that "*P. gunnii*" consists of three species, an eastern *P.oriens*, a southern Australian *P. medius* and a western *P. occidens*, O'Loughlin and Waters (2004) then referred these species to the genus *Meridiastra* O'Loughlin 2002 as they are not congeneric with the type species of *Patiriella*. Asteroidea are here represented by 10 species in five families, all are south-western Australian species. One an asteriid, *Uniophora dyscrita* has not previously been found north of Lancelin, the remainder are all species that would be expected from the mid-west coast. Three are south-west endemic species.

Ophiuroidea

Brittle stars were the most speciose group collected, partly due to the sampling methods where small species were extracted from samples of rock, algae and sponges. Twenty three ophiuroid species were collected, 11 northern species, four southern, three south-west endemic species, one circum-Australian and one cosmopolitan species.

One tropical species has a small extension of range southwards, from Dongara to Jurien while another, tentatively identified, has not previously been found south of Shark Bay.

Of interest are the records of *Amphiura ptena*, a west coast endemic species, which has rarely been collected previously.

Echinoidea

Sea urchins are represented by only eight species, many of which are very small juvenile specimens, which are difficult to identify with certainty as they have not developed adult characters and some species appear to be only represented by juveniles, adding to the uncertainty. Two of the species have a southern Australian distribution, one is a tropical species of sand dollar, *Peronella lesueuri*, which extends to the south coast of W.A., while five are south-western Australian endemic species.

One adult *Amblypneustes* sp. could not be referred to a species and is only represented by a single specimen. One of the small specimens was tentatively identified as *Pseudechinus hesperus*, previously only known from Rottnest Island. A large number of juveniles were tentatively referred to *Temnopleurus michaelseni* but no adults were found, this species has not been recorded north of Fremantle. The most common species is *Holopneustes porosissimus*, found at eight sites; most of these could be identified at a small size, since a good size-range linking them to adult specimens was present, 61 specimens were juveniles.

Holothuroidea

Sea cucumbers are represented by only five species, all but one either juveniles or very small species. *Holothuria hartmeyeri* is only represented by juveniles, which have the very distinctive spicules of the adults. One species, *Stichopus mollis*, is a widespread southern species, the remainder are endemic to the south-west, two extending to South Australia. The range of *Australocnus occiduus* is extended northwards from Rottnest Island to Jurien, *Trachythyone glebosa* has not previously been recorded on the west coast, the range is extended from Albany to Jurien and a *Taeniogyrus*, tentatively referred to *T. heterosigmus* has only previously been recorded from Bunbury. The original description, from an incomplete specimen, lacks details which would confirm the identification.

Thus, the holothurians provide some valuable new records.

Quantitative assessment (very preliminary)

Species recorded as cf of a species are included in counts of that species. The total number of echinoderms recorded on transects was 20 and in quadrats 47. The maximum number on a transect was seven and in a quadrat 15, the mean number per transect was 2.5 and in a quadrat 8.2. On six transects no echinoderms were recorded while one was the lowest number in a quadrat.

Preliminary counts of species associated with particular substrates indicate that the greatest number (25 species) were collected from algae, 21 from seagrass and sand, 14 species from rock and 11 from sponges.

A total of 51 species is represented in this collection, much fewer than from other localities studied in south-western Australia: at Albany 83 species (Marsh, 1991); at Rottnest Island 86 species (Marsh and Pawson, 1993) while the Houtman Abrolhos, where the influence of the Leeuwin Current is more pronounced, and tropical species predominate, 172 species were recorded (Marsh, 1994).

Despite the low number of species this collection contains some valuable material with extensions of the known distribution of nine species.

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Table 5. Echinoderms from quadrat (Q) and transect (T) surveys of Jurien Bay and Green Head and species distributions (Dist.) .
S = Southern Australian, W = SW Australian endemic, N = Northern (tropical), O = Other (cosmopolitan, circum Australian).
***** = New records for mid-west coast.

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist.**																	
CRINOIDEA																		
COMASTERIDAE																		
Comatulella brachiolata (Lamarck, 1816)	S*			Q														
cf. *Comatulella brachiolata* (Lamarck, 1816)											Q							
APOROMETRIDAE																		
Aporometra occidentalis H.L. Clark, 1938	S*					Q			Q	Q						Q		
ANTEDONIDAE																		
Antedon incommoda Bell, 1888	S			T, Q						T					T, Q			
Antedon cf. *incommoda* Bell, 1888		Q		T, Q							Q							
Antedon cf. *iris* (A.H. Clark, 1912)	N								T	T								
Euantedon sp.	S	T																
ASTEROIDEA																		
ASTERINIDAE																		
Meridiastra gunnii (Gray, 1840)	S	T, Q		Q			Q	Q				Q						
Meridiastra occidens (O'Loughlin, *et al.*, 2003)	S	T, Q																
Nepanthia crassa (Gray, 1847)	W					Q											Q	Q
ASTEROPSEIDAE																		
Petricia vernicina (Lamarck, 1816)	S				T		T						T, Q					
GONIASTERIDAE																		
Pentagonaster dubeni Gray, 1847	S	Q			T, Q		T						T			T		
OPHIDIASTERIDAE																		
Bunaster variegatus H.L. Clark, 1938	W												Q					
Fromia polypora H.L. Clark, 1916	S						Q, T								T			
ASTERIIDAE																		
Allostichaster polyplax (Muller and Troschel, 1844)	S				T, Q		Q			Q						Q		
Coscinasterias muricata Verrill, 1867	S	Q			T						Q	Q	Q					
Uniophora dyscrita H.L. Clark, 1923	W*																	Q

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist.**																	
OPHIUROIDEA																		
OPHIACANTHIDAE																		
Ophiacantha alternata A.M. Clark, 1966	S						Q		Q	Q	Q							
Ophiacantha sp.										Q								
AMPHIURIDAE																		
Amphipholis squamata (Delle-Chiaje, 1828)	O			Q		Q	Q			Q		Q				Q		
Amphistigma minuta H.L. Clark, 1938	S					Q												
Amphiura cf. *catephes* H.L. Clark, 1938	N*									Q								
Amphiura constricta Lyman, 1879	O		Q	Q	T, Q	Q			Q	Q		Q		Q		Q		
Amphiura cf. *constricta* Lyman, 1879						Q					Q	Q						
Amphiura micra H.L. Clark, 1938	N	Q			Q													
Amphiura cf. *microsoma* H.L. Clark, 1915	N				Q													
Amphiura ptena H.L. Clark, 1938	W			Q					Q	Q		Q		Q				
Amphiura sp.						Q			Q									
OPHIACTIDAE																		
Ophiactis luteomaculata H.L. Clark, 1938	N*							Q	Q		Q							
Ophiactis macrolepidota Marktanner-Turneretscher, 1887	N	Q		Q														
Ophiactis cf. *macrolepidota* Marktanner-Turneretscher, 1887																Q		
Ophiactis modesta Brock, 1888	N					Q												
Ophiactis savignyi (Muller and Troschel, 1842)	N	T, Q		Q	Q	Q			T, Q	T			T, Q	Q				
Ophiactis sp.					Q													
OPHIOTRICHIDAE																		
Macrophiothrix spongicola Stimpson, 1855	S	T			Q						Q		Q		T, Q			
cf *Macrophiothrix sp.*				Q														
Ophiothrix caespitosa Lyman, 1879	S			T, Q	T				T, Q	T					T			
Ophiothrix ciliaris (Lamarck, 1816)	N									T								
Ophiothrix sp.									Q									
OPHIOCOMIDAE																		
Ophiocoma dentata (Muller and Troschel, 1842)	N				Q													
Ophiocoma occidentalis H.L. Clark, 1938	W	Q		Q	Q	Q										Q		
Ophiocoma cf. *occidentalis* H.L. Clark, 1938						Q												
Ophiocomella sexradia (Duncan, 1887)	N	T, Q																

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist.**																	
OPHIODERMATIDAE																		
Ophioconis opacum (H.L. Clark, 1928)	W			Q			T, Q	T, Q										
OPHIURIDAE																		
Ohioplocus imbricatus (Muller and Troschel, 1842)	N				Q													
ECHINOIDEA																		
CIDARIDAE																		
Phyllacanthus irregularis Mortensen, 1928	W						T						T					
DIADEMATIDAE																		
Centrostephanus tenuispinus H.L. Clark, 1914	W							Q			T							
TEMNOPLEURIDAE																		
Amblypneustes leucoglobus Doderlein, 1914	W	Q		Q			Q	Q					Q			Q		
Amblypneustes cf. *leucoglobus* Doderlein, 1914								Q										
Amblypneustes sp.							Q											
Holopneustes porosissimus L. Agassiz, 1846	S	Q	Q	Q					Q	T, Q	Q	Q			Q			
cf. *Holopneustes porosissimus* L. Agassiz, 1846				Q														
cf. *Pseudechinus hesperus* H.L. Clark, 1938	W	Q				Q					Q					Q		
Temnopleurus cf. *michaelseni* (Doderlein, 1914)	W*			Q	Q	Q	Q	Q								Q		
ECHINOMETRIDAE																		
Heliocidaris erythrogramma (Valenciennes, 1846)	S	T	T, Q	T	Q		T, Q						T, Q			T	Q	
cf. *Heliocidaris erythrogramma* (Valenciennes, 1846)							Q											
LAGANIDAE																		
Peronella lesueuri (Valenciennes, 1841)	N							Q										
HOLOTHUROIDEA																		
HOLOTHURIIDAE																		
Holothuria (Thymiosycia) hartmeyeri Erwe, 1913	W	Q					Q	Q										Q
STICHOPODIDAE																		
Stichopus mollis (Hutton, 1872)	S			T		T												
CUCUMARIDAE																		
Australocnus occiduus O'Loughlin and O'Hara, 1992	W*					Q					Q							
Trachythyone glebosa O'Loughlin and O'Hara, 1992	W*						Q											
CHIRIDOTIDAE																		
Taeniogyrus cf. *heterosigmus* Heding, 1931	W*							Q										

4.0 Fishes

Glenn Moore

4.1 Introduction

Some 245 species of fishes have been reported from the Jurien Region. Most of these have been formally reported (Hutchins, 1994; Burt and Anderson, 1997), others are known from collections in the WA Museum and a few have been recorded from anecdotal observational reports from reliable sources. The fauna includes protected species such as *Carcharias taurus* (a single record in 1914) and *Phycodurus eques* (last observed in 2005). It also includes several species that are important in commercial or recreational fisheries (e.g. *Glaucosoma hebraicum*, *Pagrus auratus*, *Choerodon rubescens*).

The present survey attempted to document the fish fauna in a quantifiable manner so as to provide a baseline from which further studies or comparisons can be made (Halford and Thompson, 1994). However, it is well known that visual census methods, while reliable for large, conspicuous or active diurnal species, often overlook the small, cryptic or nocturnal species. In order to document some of these species, limited qualitative collections were also undertaken.

4.2 Methodology

Transects 250m^2 (25m x 10m)

Fish at each site were counted along three 250m^2 transects. All fish observed within 5m either side of a 25m transect were counted. During each transect, time was spent searching for more cryptic species by examining ledges, overhangs, holes, etc. Each transect was completed in 10 - 15 minutes.

Trawling

In an attempt to collect cryptic reef species, two short shots (approximately 10 minutes each) were conducted in seagrass habitats between Favourite and Boullanger Islands. Depths were approximately 3-4m, and both *Posidonia* and *Amphibolus* were collected, along with a range of red and brown algae. A small weighted box trawl (60cm x 30cm) was towed behind the boat within the habitat. The contents of the trawl were emptied onto the deck and sorted. Specimens of all fish were collected for later identification.

Rotenone

In an attempt to collect cryptic reef species, one small patch of reef (7m depth) at Wire Reef (near Site JWAM5) was selected for a rotenone station. A mix of the piscicide rotenone was released into the crevices, ledges, overhangs etc of an area of reef measuring approximately 5m x 2m. All fish that could be caught were collected for later identification. The station was monitored for around 75 minutes.

Quadrat Samples and Opportunistic Sightings

Small cryptic fishes discovered incidentally during the sorting of the quadrat material (see invertebrate sections) were identified in the laboratory.

Several species were opportunistically observed while swimming between transects, or while assisting with other activities. Where these species were not also recorded on a census transect, their presence is noted.

Data Analysis

Data were analysed using PRIMER (for Windows v.5). Data analysis was restricted to those species recorded during the censuses.

4.3 Results

A total of 76 species of fishes (~4500 individuals) were recorded during the visual censuses (Table 6, at end of section). A further 20 species were added from opportunistic sightings and the trawl, rotenone and quadrat collections (Table 6). Occurring in every site, the community was dominated by the wrasse *Coris auricularis* which accounted for more than 35% of all individuals observed.

Warm-temperate species were dominant, although sub-tropical fish were numerically the most abundant (Figure 3). The community does have influences from more northern tropical waters.

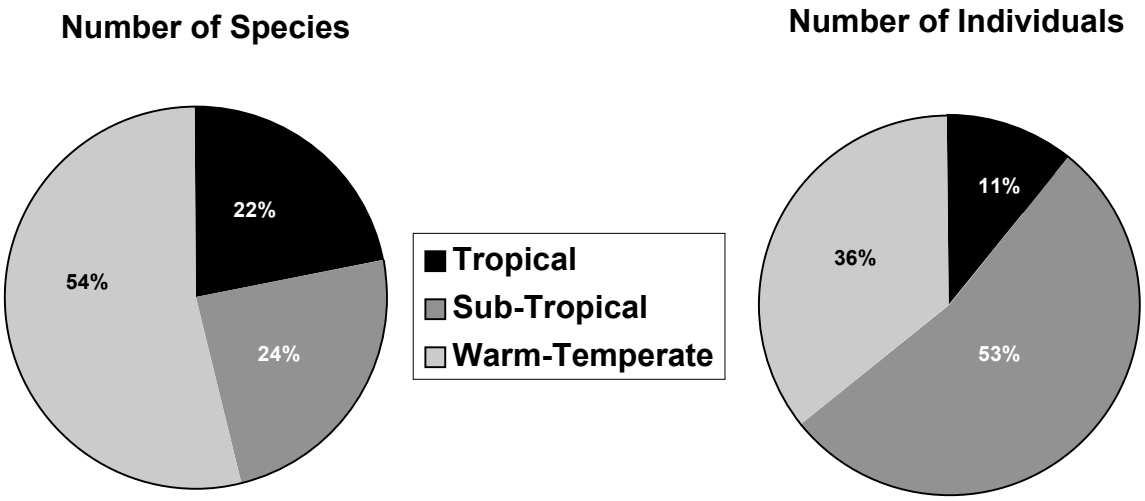

Figure 3. Composition of Jurien fish community, based on number of species and number of individuals. Distribution classifications after Hutchins (1994).

There was considerable variation in species richness between sites of the same habitat, however reef sites were consistently more diverse than seagrass sites (Table 7). Furthermore, reef habitats maintained much higher population densities than seagrass habitats (Table 7).

Table 7. Summary of species richness and number of individuals for each site in the two major habitat groupings at Jurien.

	Seagrass		Reef	
	Mean	Range	Mean	Range
Species	10	4 – 15	22	13 – 28
Individuals	55	14 – 123	353	122 – 608

The four seagrass sites were generally more species rich than they were densely populated (Figure 4) and significantly dissimilar to the combined reef sites (ANOSIM (seagrass vs reef); R = 0.857; p = 0.001). When the reef habitats are examined by distance from the shore (gradient), the inshore reefs (Sites 4, 5 and 13) clearly hold the greatest fish diversity and maintain the most individuals (Figure 4). Midshore and offshore reefs are remarkably similar (Figure 4). Analysis of Similarity detected a significant difference between sites based on gradient from shore (ANOSIM (in vs. mid vs. off)*;* R = 0.225; p = 0.048).

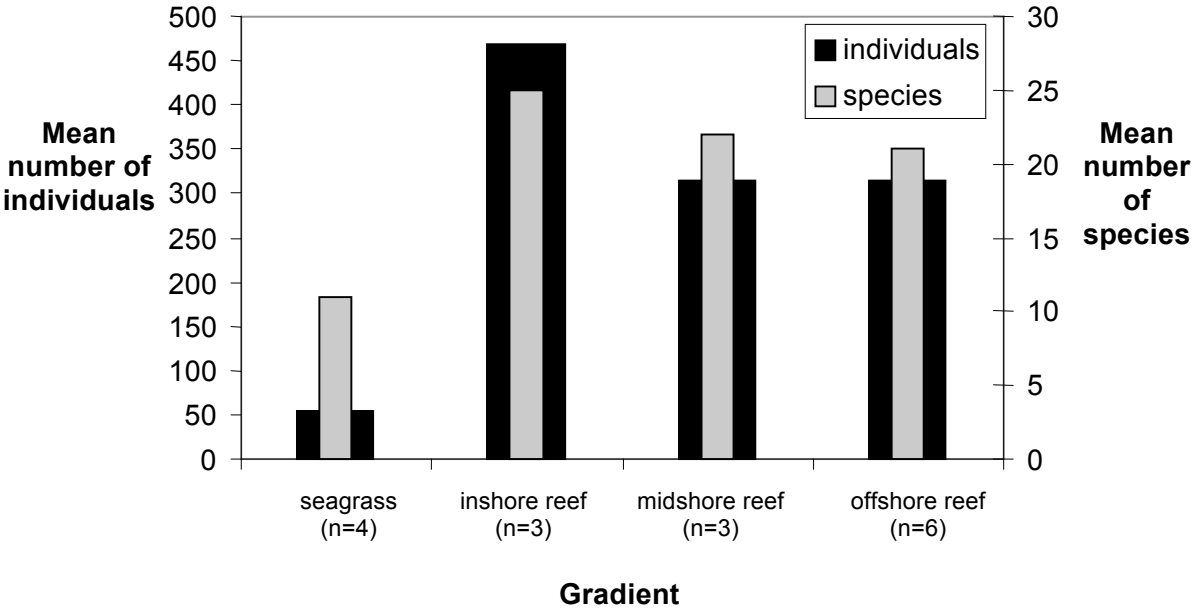

Figure 4. Species richness and number of individuals for each habitat (reefs as gradient from shore) at Jurien.

Multidimensional Scaling analysis established clear distinctions that separate the fish communities within seagrass habitats from the reef habitats (Figure 5). For the most part, each of the three reef habitats fell out into groupings, although there is some overlap (Figure 5). The 'outliers' - sites JWAM3 and JWAM11 - both had habitats that were not pure reef.

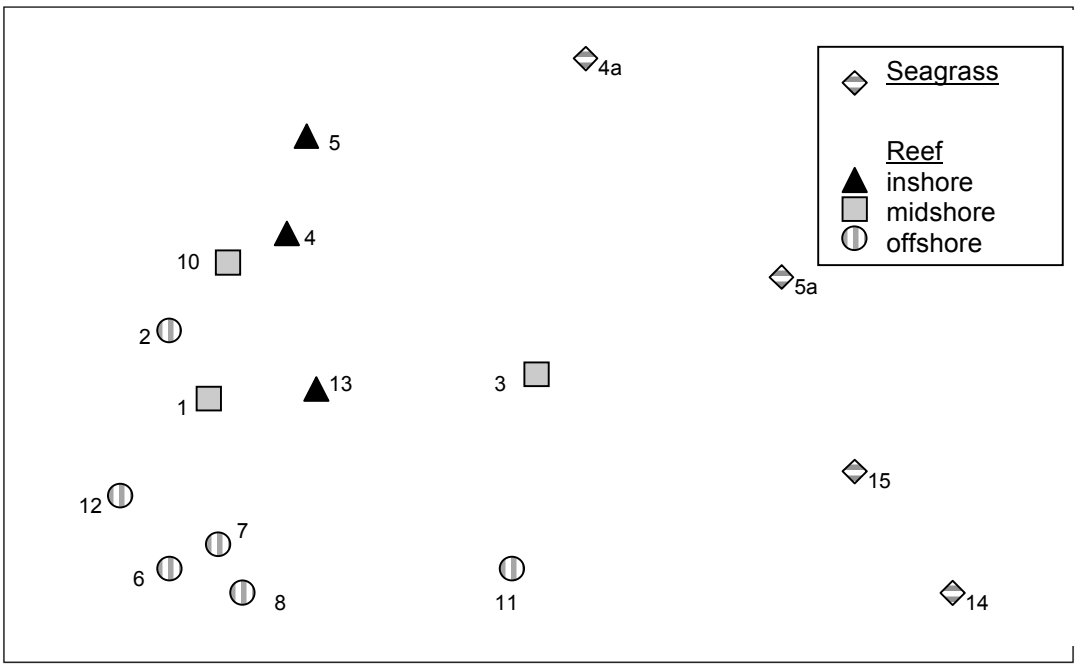

Figure 5. Multidimensional Scaling plot of log transformed species abundance data from Jurien (Stress coefficient = 0.11). Numerals refer to JWAM site numbers.

Similarity Percentage analysis using species abundance data indicates that several species can be considered typical of reef or seagrass habitats and contribute most towards the 'similarity' within each main habitat (Table 8). Furthermore, a set of species can be considered responsible for the detected 'dissimilarity' between the two habitat types (Table 8).

Table 8. Similarity Percentage analysis using species abundance data from the two major habitat groupings at Jurien. Listed are the five most important representative species for each habitat and the percentage each contributes to the similarity coefficient. Also listed are the five most important representative species to differentiate the habitats and the percentage each contributes to the dissimilarity coefficient.

Similarity (seagrass)		Similarity (reef)		Dissimilarity (seagrass/reef)	
Species	%	Species	%	Species	%
Halichoeres browfieldi	40	*Coris auricularis*	60	*Coris auricularis*	34
Coris auricularis	31	*Parma mccullochi*	8	*Parma mccullochi*	6
Notolabrus parilus	11	*Notolabrus parilus*	7	*Pomacentrus milleri*	6
Apogon victoriae	4	*Kyphosus cornelii*	4	*Apogon victoriae*	5
Pentapodus vitta	4	*Pomacentrus milleri*	3	*Kyphosus cornelii*	5

4.4 Discussion

In general, both the fish community structure and the most abundant species observed were consistent with those expected in the region and no species considered rare or extra-limital were observed. The composition of the fish fauna compares favourably with that reported by Hutchins (1994) and was dominated by warm-temperate species with a strong tropical influence. Seven of the ten most abundant species were also in the top ten species reported by Hutchins (1994).

Burt and Anderson (1997) reported 62 species of fishes from Jurien Bay (c.f. 96 species in the present study), however there are many identification mistakes and dubious identifications in that report (e.g. several listed species have an eastern Australian distribution). Furthermore the present survey detected a far greater site diversity than that reported by Burt and Anderson (1997). Seagrass sites averaged 10 species per site (compared with 7 by Burt and Anderson, 1997) and reef sites proved to be much richer (22 species per site compared with 13). However, based on samples from the trawls and rotenone collections, and WA Museum records, there is clearly an even higher diversity than either of these transect-based surveys. Hutchins (1994) reported 171 species for the area ranging from Port Denison to Jurien Bay. That number of species was achieved by surveying across different years and seasons (including effects of phenomena such as the Leeuwin Current) and with a goal of maximising diversity rather than providing a repeatable, quantified survey.

Not surprisingly, reefs clearly provide refuge for a diverse assemblage of fishes by offering a complex structure and greater range of habitat choices. Not only are there perforated limestone reefs, but a complicated invertebrate cover including corals and sponges, and a thick canopy of macroalgae. The reef sites considered to be 'inshore' (JWAM4, 5, 13) are the most important fish habitats in terms of both species richness and abundance, while the more exposed reefs are less utilised. This is consistent with the findings of Hutchins (1994) who noted that the lagoon-like areas supported more diverse faunas than the rich macroalgal communities of the exposed reefs. By contrast, seagrass habitats are often mono-specific stands, although sometimes with a dense canopy or punctuated with patchy rocks, and contain a more depauperate fauna.

For the most part, Multidimensional Scaling analysis supports the habitat decisions we made for each site. The four seagrass sites were clearly quite distinct communities. The three types of reef sites generally lumped together, supporting the assessments we made. There were two notable exceptions. The 'mid-shelf' reef site JWAM3 is a clear outlier and seems to fall midway between the reef sites and the seagrass sites. This site, although selected as a reef site, was actually

dominated by *Posidonia* but had large lumps of reef interspersed throughout the meadows. It should probably be considered a mixed reef/seagrass habitat. Similarly, site JWAM11 falls out somewhere between the two major habitat divisions. This area was a low profile limestone pavement with various small red algae over sand. Although not seagrass, the structure of the habitat resembled a meadow more than it did the complex structure of the larger reefs. Burt and Anderson (1997) found fish diversity to decrease with decreasing reef rugosity and/or increasing bare sand.

Hutchins (1994, p.4) referred to the most abundant species from an area as representing the 'faunal signature' of the region. In the context used by Hutchins, the faunal signature provides the distinctive character of the whole region. Here, by way of Similarity Percentage analysis, this concept can be further refined and the faunal signature of each habitat type determined. Using a more sophisticated model, incorporating both presence/absence and abundance across sites of the same habitat type, a list of the five most characteristic species of each habitat shows distinct communities. Although the ubiquitous wrasses *Coris* and *Notolabrus* are part of the signature of both habitats, their relative abundances combined with the presence of other, more distinguishing species make the two communities quite distinct. Dissimilarity of the two habitats is largely affected by the abundance of the wrasse *Coris auricularis* and the presence of the site-attached, reef dwelling damselfishes *Parma mccullochi* and *Pomacentrus milleri*. Both of the latter species favour reefs with ledges and overhangs (Hutchins and Swainston, 1986).

The fish communities of Jurien Bay are clearly influenced by the habitats. A cursory, qualitative assessment of the habitats (largely based on structural complexity) is sufficient to detect differences in the assemblage of the fish communities. As a more detailed biological picture of each of the habitats (and sites) develops from the analysis of the invertebrate and floral communities, it should be possible to construct a more sophisticated understanding of the fish communities of the region.

4.5 References

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Table 6. Fish species presence for study sites at Jurien Bay. Site numbers refer to JWAM sites and species presence is indicated with a '+'. Ranking of ten most numerically abundant species is indicated in square brackets.

Species / Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Dasyatidae																		
Dasyatis brevicaudata (Hutton, 1875)						+				+								
Urolophidae																		
Trygonoptera ovalis Last and Gomon, 1987		+				+												
Myliobatidae																		
Myliobatis australis Macleay, 1881										+								
Muraenidae																		
Gymnothorax prasinus (Richardson, 1848)				+														+
Congridae																		
Conger wilsoni (Bloch and Schneider, 1801)																		+
Plotosidae																		
Paraplotosus albilabrus (Valenciennes, 1840)																		+
Gobiesocidae																		
Alabes hoesei Springer and Fraser, 1976	+	+																
Alabes occidentalis Hutchins and Morrison, 2004						+											+	
Genus A sp.2																	+	
Parvicrepis 'parvipinnis' (Waite, 1906)																	+	
Clingfish unidentified				+		+		+										
Posidonichthys hutchinsi Briggs, 1993																	+	
Bythitidae																		
Dipulus caecus Waite, 1905																		+
Ogilbia sp.																		+

Species Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Syngnathidae																		
Halicampus brocki (Herald, 1953)																		+
Scorpaenidae																		
Pterois volitans (Linnaeus, 1758)											+							
Centropomidae																		
Psammoperca vaigensis (Cuvier, 1828)	+					+					+							
Serranidae																		
Acanthistius serratus (Cuvier, 1828)				+														
Epinephelides armatus (Castelnau, 1875)			+					+		+			+	+				
Othos dentex (Cuvier, 1828)								+	+		+							
Pseudochromidae																		
Labracinus lineatus (Castelnau, 1875)	+	+	+	+	+	+		+	+		+			+				+
Pseudochromis wilsoni (Whitley, 1929)																		+
Plesiopidae																		
Paraplesiops meleagris (Peters, 1869)		+				+				+			+	+				
Trachinops noarlungae Glover, 1974 [10]											+		+					
Glaucosomatidae																		
Glaucosoma hebraicum Richardson, 1845			+										+					
Apogonidae																		
Apogon cookii Macleay, 1881		+																
Apogon fuscus Quoy and Gaimard, 1825						+												
Apogon rueppelli Günther, 1859						+	+								+	+		
Apogon victoriae Günther, 1859 [3]		+	+	+	+	+	+				+			+	+			
Siphamia cephalotes (Castelnau, 1875)			+				+										+	

Species Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Carangidae																		
Pseudocaranx dentex (Bloch and Schneider, 1801)	+								+	+			+					
Trachurus novaezelandiae Richardson, 1843										+								
Arripidae																		
Arripis georgianus (Valenciennes, 1831)																		+
Nemipteridae																		
Pentapodus vitta Quoy and Gaimard, 1824	+		+	+	+	+	+											
Haemulidae																		
Plectorhynchus flavomaculatus (Ehrenberg, 1830)	+				+	+					+			+		+		
Sparidae																		
Pagrus auratus (Bloch and Schneider, 1801)						+												
Rhabdosargus sarba (Forsskål, 1775)						+												
Mullidae																		
Parupeneus chrysopleuron (Temminck and Schlegel, 1843)												+						
Parupeneus spilurus (Bleeker, 1854)	+			+	+			+										
Upeneichthys vlamingii (Cuvier, 1829)							+					+				+		
Pempheridae																		
Parapriacanthus elongatus (McCulloch, 1911)						+												
Pempheris klunzingeri McCulloch, 1911 [8]		+		+		+					+		+	+				+
Pempheris multiradiata Klunzinger, 1880 [5]	+	+	+	+		+		+		+	+		+					
Kyphosidae																		
Girella zebra (Richardson, 1846)		+																
Kyphosus cornelii (Whitley, 1944) [6]	+	+						+	+	+			+	+				
Kyphosus sydneyanus Günther, 1886	+	+							+	+	+	+	+	+				

Species Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Scorpididae																		
Microcanthus strigatus (Cuvier, 1831)																		
Neatypus obliquus Waite, 1905	+			+				+										
Scorpis georgianus *Valenciennes, 1832*								+		+	+			+				+
Tilodon sexfasciatum (Richardson, 1842)													+					
Chaetodontidae																		
Chaetodon assarius Waite, 1905				+		+					+							
Chelmonops curiosus Kuiter, 1986	+	+		+		+			+		+		+	+				
Enoplosidae																		
Enoplosus armatus (Shaw, 1790)	+		+	+		+					+		+	+		+	+	
Pomacentridae																		
Chromis klunzingeri Whitley, 1929	+					+					+							
Chromis westaustralis Allen, 1976		+		+		+					+							
Parma mccullochi Whitley, 1929 [4]	+	+		+	+			+	+	+	+	+	+	+				
Parma occidentalis Allen and Hoese, 1975	+			+				+										
Pomacentrus milleri Taylor, 1964 [2]	+	+	+	+		+		+			+		+	+				+
Stegastes obreptus (Whitley, 1948)	+	+		+							+							
Cheilodactylidae																		
Cheilodactylus gibbosus Richardson, 1841	+			+	+													
Cheilodactylus rubrolabiatus Allen and Heemstra, 1976									+					+				
Sphyraenidae																		
Sphyraena obtusata Cuvier, 1829						+	+											
Labridae																		
Anampses geographicus Valenciennes, 1840	+																	
Austrolabrus maculatus (Macleay, 1881)	+	+	+	+	+	+		+	+	+	+		+					+

Species Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Labridae *cont.*																		
Bodianus frenchii (Klunzinger, 1880)				+					+	+								
Choerodon rubescens *(Günther, 1862)*	+		+	+		+	+		+	+	+		+	+		+		
Coris auricularis (Valenciennes, 1839) [1]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Dotalabrus alleni Russell, 1988			+				+	+	+	+		+		+				
Eupetrichthys angusticeps Ramsay and Ogilby, 1888												+						
Halichoeres brownfieldi (Whitley, 1945) [9]	+		+	+		+	+		+	+	+	+		+	+	+	+	
Notolabrus parilus (Richardson, 1850) [7]	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	
Ophthalmolepis lineolatus (Valenciennes, 1839)		+	+					+	+	+			+					
Pictilabrus laticlavius (Richardson, 1840)	+	+			+					+		+	+					
Pseudolabrus biserialis (Klunzinger, 1880)	+	+	+	+		+		+	+	+	+		+					
Suezichthys cyanolaemus Russell, 1985				+														
Thalassoma lunare Linnaeus, 1758	+												+					
Thalassoma lutescens Lay and Bennett, 1839	+								+		+							
Odacidae																		
Odax acroptilus (Richardson, 1846)		+						+									+	
Odax cyanomelas (Richardson, 1850)	+			+	+			+	+			+	+	+				
Siphonognathus caninus (Scott, 1976)																+	+	
Siphonognathus radiatus (Quoy and Gaimard, 1834)		+						+		+		+					+	
Pinguipedidae																		
Parapercis haackei (Steindachner, 1884)		+		+		+	+											+
Blenniidae																		
Cirripectes hutchinsi Williams, 1988		+																
Laiphognathus multimaculatus Smith, 1955																		+
Plagiotremus rhinorhynchus (Bleeker, 1852)		+		+														
Tripterygiidae																		
Norfolkia brachylepis (Schultz, 1960)																		+

Species / Site	1	2	3	4	4a	5	5a	6	7	8	10	11	12	13	14	15	BOX	ROT
Clinidae																		
Heteroclinus adelaidae Castelnau, 1879																	+	
Gobiidae																		
Barbuligobius boehlkei Lachner and McKinney, 1974																		+
Callogobius depressus (Ramsay and Ogilby, 1886)																		+
Eviota bimaculata Lachner and Karnella, 1980																		+
Priolepis nuchifasciatus (Günther, 1873)																		+
Siganidae																		
Siganus fuscescens (Houttuyn, 1782)		+				+	+											
Monacanthidae																		
Meuschenia flavolineata Hutchins, 1977													+					
Scobinichthys granulatus (Shaw, 1790)					+		+					+				+	+	
Ostraciidae																		
Anoplocapros robustus (Fraser-Brunner, 1941)			+						+									
Aracana aurita (Shaw, 1798)							+											
Tetraodontidae																		
Torquigener pleurogramma (Regan, 1903)			+		+					+	+							
Number of species	30	28	19	30	13	32	15	21	20	23	27	13	24	20	5	10	13	20

5.0 Molluscs

Corey Whisson

5.1 Introduction

The distribution of shallow (<50m) marine molluscs in Western Australian can be divided into three biogeographical regions. In the northern part of the state, extending as far south as North West Cape, exist tropical species that form part of the vast Indo-Pacific fauna. From Cape Leeuwin south along the bottom of the continent, to approximately New South Wales, exist warm temperate species. Between these two biogeographic regions (i.e. between North West Cape and Cape Leeuwin) is the West Coast Overlap Zone, where there is a mixture of tropical and temperate species. Species endemic to this state are found in each of these biogeographic regions, with most occurring in the West Coast Overlap Zone.

Jurien Bay and Green Head are located approximately 266km and 282km north of Perth respectively, and are situated at the centre of the West Coast Overlap Zone. The marine environment at both localities consists of narrow strips of inshore limestone reefs and shallow inshore waters, a feature of the central coast between Perth and Dongara.

The purpose of this interim report is to provide a species list of molluscs recorded during transect surveys at Jurien Bay and Green Head. A species list of quadrat material identified thus far has also been included.

5.2 Methodology

For detailed methodology, refer to Section 1.

For the $5m^2$ transect surveys, all molluscs collected were identified and counted. JWAM 9 was not sampled via transect.

For the $1m^2$ quadrat surveys, the identifications have not yet been completed. Live-taken macro-molluscs (≥5mm) were identified and counted. Where time has permitted, micro-molluscs (<5mm) or freshly dead-taken molluscs have been identified and counted. Polyplacophora collected from quadrats are yet to be identified.

Vouchers of each species from both Jurien Bay and Green Head have been lodged into the collections of the WA Museum.

The taxonomic order used in this report follows Beesley *et al.* (1998).

5.3 Results

$5m^2$ Transects

A total of 33 mollusc species were recorded from the transect surveys, with 15 species being live-taken macro-molluscs (Figure 9). The remaining 18 species were micro-molluscs or freshly dead-taken. Two taxa that could not be identified to species level may prove to be species currently listed from the transects.

For the 20 taxa identified to species level, 9 species were tropical (45%) and 5 were warm temperate (25%). Eight species were endemic to this state (40%).

The maximum number of species (7) was recorded at site JWAM 13, and the lowest number of species (0) was recorded at sites JWAM 5 and JWAM 11. Very few species were found at multiple transect sites. *Astralium tentorium* (Thiele, 1930) was most widespread, occurring at three sites.

1m^2 Quadrats

A total of 56 mollusc species have been recorded from the quadrat surveys thus far, with 46 species being live-taken macro-molluscs (Figure 9). The remaining 10 species were micro-molluscs or freshly dead-taken. Seven taxa that could not be identified to species level may prove to be species currently listed from the quadrats.

Overall (5m^2 Transects and incomplete 1m^2 Quadrats)

A total of 74 mollusc species have so far been recorded in the present study, with 52 species being live-taken macro-molluscs (Figure 9). The remaining 22 species were micro-molluscs or freshly dead-taken. Ten taxa that could not be identified to species level may prove to be species already listed.

For the 45 taxa identified to species level, 16 species were tropical (35.6%) and 20 were warm temperate (44.4%). Nine species were endemic to Western Australia (20%).

Evident from the transects, and from part identification of the quadrat surveys, is the high diversity of the gastropod families Columbellidae, Turbinidae and Trochidae. Together, these families account for 25.7% of species recorded thus far. Species of these families appear to be widespread: *Pyrene bidentata* (Menke, 1843) has so far been found at 8 sites, *Astralium tentorium* (Thiele, 1930) at 7, and *Cantharidus lehmanni* (Menke, 1843) at 5 sites.

5.4 Discussion

At the time of this report, 74 species of molluscs have been recorded from the survey. With only part of the quadrat material sorted, and some groups not yet identified (eg. Polyplacophora) it is expected that species numbers will increase considerably. Of those species whose affinities could be determined, there was a relatively even mix of tropical (35.6%) and temperate species (44.4%), with endemic species (20%) less common.

Very few thorough surveys of molluscs from inshore waters along the central West Coast have been undertaken. Burt and Anderson (1997) reported 34 species of molluscs (>10mm) from Jurien Bay, and it is unclear whether these were live-taken. The low diversity recorded during that survey could be attributed to the size of molluscs collected and differences in methodology. A checklist by Wells and Bryce (1997) of the marine molluscs of the nearby offshore Houtman Abrolhos Islands produced 492 species. Tropical species dominated (68.6%), with warm temperate species (20.2%) and species endemic to Western Australia (11.3%) less common.

Jurien Bay is located at the centre of the West Coast Overlap Zone and is one of the few areas where the Leeuwin Current directly impacts on the continental shelf. This current transports larvae of tropical molluscs southward (Morgan & Wells, 1991). Leeuwin Current eddies consistently form in three areas, the Houtman Abrolhos Islands, Shark Bay and Jurien Bay. Because of this close association with the Leeuwin Current, it could be expected that tropical mollusc species might dominate the fauna, as found at the Abrolhos (Wells and Bryce, 1997).

Fifteen species of live-taken molluscs were recorded from transects, whilst 46 species of live-taken molluscs have been recorded from the quadrats thus far. The goal of transect sampling was to collect only the larger (≥10mm) invertebrates, to supplement data collected from quadrats. This aside, the difference in species diversity between sampling methods can be attributed to many molluscs being cryptic and/or nocturnal. Transect sampling alone will not give an accurate account of mollusc diversity in any one area, it should be used to complement the more intensive quadrat work.

As identification of quadrat material is only partly complete, few comments can be made on the distribution of mollusc species between sites and between habitats. Although preliminary, the Trochidae, Turbinidae and Columbellidae families seem the most diverse and widespread molluscs. Most of the species recorded from these families are grazers on epiphytes of seagrass and macroalgae. Seagrass and macroalgae provide surfaces for colonisation, enable cover from

predators, create habitat complexity and are a rich food source for many small benthic invertebrates, particularly because of epiphytic algae (Edgar 1990).

It is estimated that nearly two-thirds of the quadrat survey material has been identified and counted. The remaining material consists of unidentified material and 0.25m^2 weed washings that are currently being processed by CSIRO for a larger central coast study.

Micro-mollusc material primarily sorted during this project was not included for identification in this survey. It will be lodged into the collections of the WA Museum for future taxonomic work. The sorting of such small specimens is a time consuming task and these specimens are a welcome addition to the collections.

5.5 References

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Table 9. Mollusc species from quadrat (Q) and transect (T) surveys of Jurien Bay and Green Head and species distributions (Dist.) .
Trop. = Tropical, Temp. = Temperate and End. = Endemic). [ ] indicates micro-mollusc and/or freshly dead-taken.

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist.**																	
BIVALVIA																		
MYTILIDAE																		
Lithophaga sp.	Trop.										Q			Q	Q			
Septifer bilocularis (Linnaeus, 1758)	Trop.	T								Q	Q	Q		Q	Q	Q		
ARCIDAE																		
Arcidae sp. (juv.)												[Q]						
Barbatia pistachia (Lamarck, 1819)	Trop.	T			T						Q							
Barbatia sp. (juv.)											Q		Q			Q		
PTERIIDAE																		
Pteriidae sp.								T										
MALLEIDAE																		
Malleus meridianus Cotton, 1930	Temp.						Q	Q										
Vulsella sp.										Q		Q						
CHAMIDAE																		
Chama sp.								[Q]										
LUCINIDAE																		
Lucinidae sp.											[Q]							
CARDITIDAE																		
Cardita sp. (juv.)											Q							
TRAPEZIIDAE																		
Trapeziidae sp.													T					
VENERIDAE																		
Irus carditoides (Lamarck, 1818)	Temp.	[T]																
Veneridae sp.												Q						
GASTROCHAENIDAE																		
Gastrochaena sp.									Q									
CLEIDOTHAERIDAE																		
Cleidothaerus albidus (Lamarck, 1819)	Temp.					[Q]												
GASTROPODA																		
HALIOTIDAE																		
Haliotis elegans Phillipi, 1874	End.		[T]															
Haliotis scalaris Leach, 1814	Trop.		[T]											[Q]				
FISSURELLIDAE																		
Fissurellidae sp. (juv.)											Q		Q					
Amblychilepas oblonga (A.Adams, 1851)	Temp.													Q				
Amblychilepas sp.												[Q]						
Diodora cf. *jukesii* (Reeve, 1850)	Trop.													Q				

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist.**																	
TURBINIDAE																		
Astralium tentorium (Thiele, 1930)	End.	T				Q	Q	Q			T,Q				Q	T,Q		
Astralium squamiferum (Koch, 1844)	Temp.					Q		[Q]			T							T
Liotina sp.						[T]												
Phasianella sp.						Q		[T]										
Phasianella cf. *variegata* Lamarck, 1822	End.						Q											
Phasianella ventricosa Swainson, 1822	Temp.								Q	[T]								
Turbo pulcher Reeve, 1842	End.		[T]															
Turbo torquatus Gmelin, 1791	Temp.			Q					Q					Q				
TROCHIDAE																		
Angaria tyria (Reeve, 1843)	Temp.					Q	Q									T,Q		
Cantharidus lehmanni (Menke, 1843)	Temp.			Q	Q	Q			Q					Q				
Cantharidus pulcherrimus (Wood, 1828)	Temp.				Q					Q		Q		Q				
Clanculus consobrinus Tate, 1843	Temp.													Q				
Jujubinus lepidus (Phillipi, 1846)	End.					Q	Q	Q										[T]
Phasianotrochus eximius (Perry, 1811)	Temp.													Q				
Stomatella impertusa (Burrow, 1815)	Trop.	[T]									[Q]		[T],Q					
Trochidae sp.																	[T]	
CERITHIIDAE																		
Bittium sp.										Q								
Cerithium echinatum Lamarck, 1822	Trop.															[T]		
Cerithium sp.											[Q]							
Rhinoclavis ?*articulata* (Adams & Reeve, 1850)	Trop.								[T]									
Rhinoclavis bituberculata (Sowerby, 1865)	Trop.													Q				
TURRITELLIDAE																		
Turritellidae sp. 1																[T]		
PLANAXIDAE																		
?Fossarinae sp.						[Q]												
CAMPANILIDAE																		
Campanile symbolicum Iredale, 1917	End.		T			Q										T,Q	[Q]	
RISSOIDAE																		
Rissoina sp. 1											Q			Q				
Rissoina sp. 2																		[T]
HIPPONICIDAE																		
Antisabia foliacea (Quoy & Gaimard, 1835)	Temp.									[Q]	Q	[Q]		Q				
Hipponix conicus (Schumacher, 1817)	Trop.		T			Q								Q		T,Q	Q	
cf. *Hipponix conicus* (Schumacher, 1817)	Trop.													Q				

Transects (JWAM)		1	2	3	4	4a	5	5a	6	7	8	9	10	11	12	13	14	15
Quadrats (CSIRO)		1	2	3	BR	4	WR	5	6	7	8	9	10	11	12	13	14	15
Species	**Dist**																	
CAPULIDAE																		
Capulus sp.					T													
VERMETIDAE																		
Vermetidae sp.																Q		
NATICIDAE																		
Natica sp.						[Q]												
RANELLIDAE																		
Cymatium labiosum (Wood, 1828)	Trop.															T		
TRIPHORIDAE																		
Triphoridae sp. 1									[T]									
Triphoridae sp. 2															[T]			
MURICIDAE																		
Coralliophila sp. (juv.)										Q								
Coralliophila costularis (Lamarck, 1816)	Trop.															Q		
Cronia avellana (Reeve, 1846)	End.					Q					Q			[Q]	[T]			
Pascula ochrostoma (Blainville, 1832)	Trop.										Q							
Thais orbita (Gmelin, 1791)	Temp.											Q		Q				
TURBINELLIDAE																		
Syrinx aruanus (Linnaeus, 1758)	Trop.																T	
COLUMBELLIDAE																		
Mitrella austrina (Gaskoin, 1851)	Temp.			T	Q			Q		Q	Q			Q				
Mitrella lincolnensis (Reeve, 1859)	Temp.						Q											
Pyrene bidentata (Menke, 1843)	End.			Q,T	Q,T	Q	Q	Q			Q		Q	Q				
NASSARIIDAE																		
Nassarius sp.						[T]												
OLIVIDAE																		
Gracilispira lineata (Kiener, 1844)	Temp.													[Q]				
Oliva australis Duclos, 1835	Temp.								Q									
CONIDAE																		
Conus ?klemae (Cotton, 1953)	Temp.					Q												
Conus klemae (Cotton, 1953)	Temp.										Q							
ARCHITECTONICIDAE																		
Architectonica sp.														Q				
OPISTHOBRANCHIA																		
CHROMODORIDIDAE																		
Chromodoris westraliensis (O'Donoghue, 1924)	End.												T					
Glossodoris atromarginata (Cuvier, 1804)	Trop.															Q		