APPENDIX 1

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Characterising the fish habitats of the Recherche Archipelago: Review of existing information

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Introduction

The Recherche Archipelago is a chain of approximately 105 islands and 1500 islets extending over 470 km of coastline (230 km linear distance)(Lee & Bancroft, 2001). This region is valued for its relatively untouched wilderness, with a healthy tourism industry. The Archipelago is also valued for its marine resources, and is important for numerous commercial fisheries, such as Abalone, Pilchard, Shark and the Southern Rock Lobster.

Geographical setting

Geology and coastal geomorphology

The geomorphology of the land surrounding the Recherche Archipelago is dominated by isolated, often dome-shaped hills formed by Precambrian metamorphic rocks consisting largely of granite-gneiss (Myers, 1990). The coastline is characterised by arcuate sandy beaches located between the rocky headlands (Sanderson *et al*., 2000). These headlands, many of which are over 300 m high, are often multiple with small lunate bays and beaches between them. Exposed headlands, facing south and southwest, often have large cliffs or are fronted by steep slopes, which are swept by swell surge (Sanderson *et al.,* 2000). There are also numerous narrow limestone reefs paralleling the shore with the open rocky shores these habitats provide a variety of habitats for marine plants and animals. These rocky shores fall steeply in to the ocean till they reach the ocean floor at depths of 20-30m where the substratum can change abruptly to a sandy substratum

The islands of the Recherche Archipelago are scattered across the entire width of the continental shelf and in geomorphology resemble the granitic headlands of the mainland coast. However, on some islands the granite-gneiss is capped by limestone resulting in a flatter topography where sea-cliffs and shore platforms may be developed (e.g. Goose Island; Fairbridge & Serventy, 1954). The majority of the islands are inaccessible due to their steep dome-shaped sides, only two of the islands, Sandy Hook and Mondrain Islands, have beaches which permit landing from the sea (Fisheries WA, 1999a).

Relative to other areas identified in this review there has been sufficient research on the geology and geomorphology of this region. Fairbridge & Serventy (1954) were one of the first to describe this unique region, since then there have been numerous scientific papers and reports, including ArcInfo digital maps (see Appendix R1).

Catchment

The coastal plain catchment is up to 40 km wide in places and consists of numerous small ephemeral streams. In most instances however, the catchment has undergone significant change due to agricultural practices. These changes have put the adjacent streams, pools and inlets at risk to the adverse affects of salinity, sedimentation and eutrophication (Hodgkin & Clark, 1989). Overall the freshwater input into the marine environment is small and intermittent.

Climatic conditions

The Recherche Archipelago experiences a Mediterranean climate, with hot, dry summers and cool, wet winters. In summer temperatures range from 16–26 °C with maximums of 35°C in the January to February period, while winter temperatures, over June to August, average 8-

17°C, with minimums of 7°C (Fisheries WA, 1999). Annual rainfall averages 623 mm, the majority falling over the autumn/winter period (May–August), annual evaporation is greatest during the summer months and averaging about 1600 mm (Van Hazel *et al.,* 2001).
In summer the dominant wind direction is from the southeast. The afternoon sea breeze occurs from October to March and in January and February, over 25% of sea breezes exceed 30 km/h. During winter, southwest winds frequently prevail and northwest storm events occur. Periods of calm are few, and occur in autumn and winter (Fisheries WA, 1999).

Oceanography

Previous oceanographic surveys

While there is a small amount of information on the oceanography of this region it is yet to be studied in any great detail, either through field, analytical or numerical modeling methods. Incomplete bathymetry coverage for the Recherche Archipelago is available in ARCINFO GIS digital format as part of the coastal Resource Atlas produced by the WA Department of Transport, Coastal Management Branch. This coverage is not as accurate as the charts published by the Australian Hydrographic Service, R.A.N. However even on these charts many areas are shown as 'un-surveyed' or 'inadequately surveyed'
CSIRO have also collected a range of biological, hydrological and core sample data from this region on a series of voyages from 1951 to 1981 (Appendix V1).

Bathymetry

Within the Recherche region the continental shelf this shelf is as narrow as 50km in places (Li *et al.,* 1999) widening to as much as 300 km as it approaches the eastern Eucla region (James *et al.,* 1994). The shelf of this region has uneven topography and at the continental slope, drops to approximately 3600 m contrasting greatly with the gently sloping shelf of the main Bight region (Conolly & Von Der Borch, 1967). At the margin of the continental shelf there are numerous deep submarine canyons (Pearce, 2001), for example, Bremer, Stokes and Esperance canyons, the later of which has a vertical relief of approximately 1800 metres (Conolly & Von Der Borch, 1967). In our study area, within the Archipelago the depth of the seafloor averages 40□m, and most of the islands are within the 50m bathymetric contour. However some of the outer islands can rise from as deep as 80□m or more (Australian Hydrographic charts).

Currents, waves and seas

Within the Recherche Archipelago, little is known of currents with the exception of some preliminary modelling of waves and currents currently being undertaken by Dr Charitha Pattiaratchhi at the Centre for Water Research, University of Western Australia.
The southern continental shelf region is storm dominated with high (>2.5m) deep-water wave heights, and long period (> 12s) swell waves, with wavelength of 200m reported (James *et al.,* 2001). This region is characterised by strong thermal fronts as warmer tropical water meets the cooler Southern Ocean waters. The Leeuwin Current flows eastward along the outer continental shelf, with the strongest currents in the autumn/winter period just beyond the shelf break (Godfrey & Vaudrey, 1986). The Leeuwin current has a large influence on the circulation and therefore physical characteristics of the region. Through advection this current prevents water temperatures near the coast from falling below 13°C in winter and maintaining

summer temperatures around 22°C (Li *et al.,* 1999). The current is also reported to cause seasonal decreases in salinity during winter and to have an effect on chlorophyll and phytoplankton levels (Van Hazel *et al.,* 2001).
Tides in this region are semi-diurnal with a maximum spring tidal range of 1.1□m (Van Hazel *et al.,* 2001). Localised tidal currents may be experienced between islands or other constrictions, however tidal currents are likely to be insignificant compared with the wind generated currents. Sea surface currents are likely to be significantly higher than those experienced at the sea floor (Pearce, 2001).
For most of the year the Recherche Archipelago is affected by strong, relatively consistent swells from the southwest (Van Hazel *et al.,* 2001). These swells can be reinforced by wind generated waves, and produce a net eastward littoral drift along the south coast (Fisheries WA, 1999). The waves, swell and currents of this region have a significant influence on the coastal geomorphology. James *et al.,* (2001) reports that these influences can affect the sorting of sands by oscillatory motion at depths in excess of 100 m. In common with other oceanic waters of the south western Australia the waters off the Archipelago are believed to be nutrient poor.

Biological communities

Previous biological surveys

The study area is encompassed within the WA South Coast region of the Interim Marine and Coastal Regionalisation of Australia (IMCRA Version 3.1) extending from Israelite Bay in the east to Black Head in the west. IMCRA provides users with provincial-scale regionalisations for continental shelf waters, based on classifications of demersal and pelagic fish species diversity and richness.
In March 1994 biological ground truthing of the islands within the Recherche Archipelago commenced using methods of 'bounce' diving, vertical video observation, and grab sampling of material (Fisheries, 1999a). In 1998 further ground truthing occurred near Mondrain Island during a voyage of the STS Leeuwin, using drop down TV (Colman, 1997). Currently the ground truth data of a particular area is about 80% accurate.
A broad scale map and classification of the major benthic habitats of Australia's coastline, including the Recherche Archipelago study area, at a scale of 1:100000 was developed by Kirkman (1997). This classification included 180 ground truthing locations. The maps were prepared using the blue band or band 1 of the Landsat TM satellite (Fisheries, 1999a). Bottom types have also been identified by local fishermen (Appendices 3a-3d).

Benthic habitats

Everall (1999) conducted broad scale benthic habitat surveys using towed underwater video cameras. This study identified eight categories of sea bottom (below), however they note that the video tape record of the surveys contain much more information which could be analysed at a more detailed level.

- Dense seagrass
- Medium seagrass
- Sparse seagrass
- Patchy seagrass
- Bare sand

- Flat platform or low profile reef
- Heavy limestone reef
- Granite reef

In 1999 D.A. Lord & Associates identified three broad habitat categories within Esperance bay. Using bounce and drift dives they distinguished: bare sand, seagrass and wrack. Subsequently D.A. Lord & Associates in collaboration with Dr Gary Kendrick at UWA (2001) have conducted an historical mapping study of the benthic habitats in Esperance bay. Using aerial photography, from 1956 to 1995, and a image geo-referencing and rectification technique they identify significant changes in the benthic habitats, particularly seagrass coverage, within the bay.

Invertebrates

There have been relatively little published data on the occurrence, abundance and distribution of benthic invertebrates within the Recherche Archipelago region. However, based on published texts such as Edgar (1997), it is possible to suggest what species are likely to occur (Appendices I1 – I10). It is expected that the invertebrate communities within the Archipelago are abundant, diverse and exhibit a reasonable level of endemism, consistent with that displayed by the south coast marine fauna as a whole. Those invertebrates that have been examined include:

Echinoderms

To date Marsh (1991) is the only published reference on species of echinoderms of the south coast. The author describes the shallow-water echinoderms of the Albany region, South Western Australia. However there have been no intensive collections or taxonomic studies of echinoderms within the Recherche Archipelago, it is believed that the echinoderm assemblages are both diverse and abundant and highly endemic. Based upon the published texts and distribution data it is possible to suggest what species are likely to occur (Appendix I1).

Barnacles

The shallow-water barnacle (Cirripedia: Lepadomorpha, Balanomorpha) fauna of southwestern Australia has a large cosmopolitan component. Jones (1991) describes and provides a key for 31 species of shallow water barnacles (Cirripedia) that have been collected between Albany and the Houtman and Abrolhos Islands. This fauna has a relatively high Australian endemic element and differs markedly from that of northwestern areas (with Australasian, Indian Ocean/Malaysian or Indo-West Pacific affinities). The shallow-water barnacle species (both goose and acorn barnacles) are expected to occur, according to distribution (Appendix I2).

Decapods

Morgan & Jones (1991) record the distribution and habitat of 115 species of decapod crustaceans from the south coast Australia (between Cape Naturaliste and the South Australian border. Although work has been done the specific abundance and distribution of decapods, with the exception of the Southern Rock Lobster Fishery, decapod research within the study area is generally poor. However, using reference texts to determine relevant distribution, it is possible to suggest which species are likely to occur within the study area (Appendix I3).

Molluscs

The abundance and distribution of molluscs in the study area has yet to be fully established. A small survey was conducted in the Recherche Archipelago by Macpherson (1954) however this provided no quantitative data only providing a description of dead shells collected from beaches in the Archipelago. More research is needed for a greater understanding of species abundances and diversity. Wells & Mulvay (1995) describe the population biology and reproductive ecology of greenlip abalone (Haliotis laevigata) populations at Augusta Esperance and Hopetoun. Alan Longbottom has also compilled an extensive collection and database on molluscs from Esperance region. Based upon the above sources and the references of Macpherson (1954); Wells & Bryce (2000), and; Edgar (1997), the likely occurrence of species within the study area, according to distribution information, has been estimated. Estimates of species occurrence have been made for Chitons (Appendix I4), Prosobranchs (Appendix I5), Sea slugs (Appendix I6), Bivalves (Appendix I7) and Cephalopods (Appendix I8).

Cnidaria

While there have been no intensive collections or taxonomic studies of Cnidaria in the study area Veron & Marsh (1988) make a brief report on coral species that occur in the Recherche region and have a small paragraph discussing the faunal relationships of the south coast. James *et al.,* (1994) also identified four ahermatypic coral species (*Scolymia australis*, *monomyces radiatus*, *Flabellum pavoninum* and a *Charyophillia sp*.) from a single dredge between 180-250 m deep. However there are no published data on other Cnidaria from this region. Based upon the published texts and distribution data Appendix I9 identifies species likely to occur within the study area.

Other invertebrates

Detailed information on the invertebrate fauna from this region is sadly lacking. Britton *et al.* (1991) completed a study on the intertidal fauna of the rocky shores of southwestern Australia identifying patterns in species distribution. Other studies appear opportunistic, such as James *et al.,* (1994) who report a single dredge sample containing numerous sponge, bryozoan, polychaete and ahermatypic coral species. However there are still significant gaps in the published data for many invertebrate phyla from this region. Appendix I10 identifies species from the Porifera, Ctenophora and Chordata that may be expected to occur within the Recherche Archipelago region.

Seagrass and macroalgae

Seagrass

About 60 seagrass species are known worldwide, with one-third of these restricted to southern Australia. The exceptionally clear waters of the southern coast allow seagrasses to grow at depths of up to 30 m (Kirkman & Kuo, 1990) . In his classification of classification of the major benthic habitats of Australia's coastline, including the Recherche Archipelago study area, Kirkman (1997) describes the distribution of sparse to dense seagrass. D.A. Lord & Associates, in collaboration with researchers at UWA (2001), use 42 km of towed video footage to map in detail the distribution of seagrasses within Esperance bay. Other studies that have researched seagrass in this region include, Campey *et al.,* (2000) in their evaluation of the species boundaries among members of the *Posidonia ostenfeldii* complex. Waycott, (1998

& 2000) also sampled seagrasses from this region addressing the genetic variation of individuals within the *Posidonia australis* species.
However, for much of the Recherche Archipelago the exact distribution and abundance of seagrasses is unknown. For the south west coast on the whole there is a high level of endemism with nine out of 17 species being endemic (Kuo & McComb, 1989)(Appendix SG1).

Macroalgae

There have been no intensive collections or taxonomic studies of macroalgae in the study area, however it is believed that the macroalgal community is both diverse and abundant and exhibits a high degree of endemicity. In adjacent regions, such as the Fitzgerald biosphere, numerous macroalgal species have been found to be present (Appendix A1) .

Pelagic habitats

Cyanobacteria (non-bloom populations)

There is currently no published information on the distribution and abundance of cyanobacteria within the study site region.

Zooplankton

Relatively little work has been published on zooplankton in this region and a fully comprehensive study has yet to be done. However a study by Gaughan and Fletcher (1997) identified the effects that the Leeuwin Current had on the distribution of carnivorous macrozooplankton in the shelf waters off southern western Australia. They reported low species richness, high variability in abundance, seasonal patterns and a fauna dominated by chaetognaths and siphonophores. They also report a trend for decreasing species richness from west to east.

Planktonic foraminifera

With the exception of Li *et al.,* (1999) there is a paucity of planktonic research in the region. Their study on the foraminifera on the southern shelf of WA identified a total of 21 planktonic species (Appendix I11) and indicated clear planktonic provinces where subtropical species dominated in west and temperate species in the east. With the two provinces overlapping in the Recherche Archipelago between 122 and 124 °E.

Fish

In comparison with other locations around Australia there has been relatively little research into the distribution and abundances of fish species within the Recherche Archipelago region. Those studies that have quantitatively addressed fish diversity and abundance are limited to a survey of the surf zone fish assemblages (Ayvazian & Hyndes 1995) (review & fish species list in Appendix F1), and Gaughan *et al's.,* (2000) study on the mass mortality of the pilchard *Sardinops sagax*. There are also semi-quantitative visual surveys of nearshore reef fish assemblages by Hutchins (1994). The study identified 172 species (91% warm temperate, 7% subtropical) of fish with a distinct "offshore" versus "inshore" effect on diversity of tropical species, attributed to the Leeuwin Current (review & species list in Appendix F2). Other work in the area includes age structure and reproductive biology for pilchards (Gaughan *et al.*

2001) and a recent biodiversity study by Hutchins (2001). This study identified that 28% of the shallow water reef fish identified were endemic to the Recherche Archipelago.
Despite the few studies conducted in this region it is expected, based on known distribution data, that the elasmobranch and osteichthyes species listed in Appendices F3 and F4 are likely to occur within the study area.

Australian salmon & herring nursery

The region extending from east of Esperance through to the WA/SA border is an important WA nursery for Australian salmon (*Arripis truttacea*) and Australian herring (*Arripis georgiana*) (Fisheries WA, 1995). This has been confirmed with capture of:

a) Post-larval Australian salmon and herring in plankton trawls from the western Great Australian Bight, &;

b) Small >0 year old Australian salmon and herring at a number of shoreline locations throughout this region.

Leafy and weedy seadragons

Seadragons (Family Sygnathidae) and are only found in Australia's southern waters and both the leafy seadragon (*Pycodurus eques*) and the weedy seadragon (*Phyllopteryx taeniolatus*) occur within the study area. The area from Albany to Esperance appears to be important for both species of seadragon, with the majority of sightings coming from the reef and seagrass beds associated with the bays, sounds and headlands within this area. Eighteen percent of these sightings have come from the within the Recherche Archipelago (Dragon Search, 1998-2000).

Fishing

Recreational fishing

Since 1987 the number of recreational fishers in the Recherche Archipelago, Western Australia has more than doubled from 284,000 people to between approximately 500,000 and 600,000 people a year. The most targeted inshore species include Australian herring, whiting and Australian salmon (CALM, 1994). Offshore species include queen snapper, bright redfish, samsonfish (*Seriola hippos*), breaksea cod (*Epinephelus armatus*), blue groper and sharks. Netting is undertaken mostly in estuaries, such as Stokes Inlet, Torradup River and Jerdacuttup River, for species such as sea mullet, yelloweye mullet, Australian herring and black bream. In addition, rock lobster potting, squid jigging and diving for abalone occurs in the study area.

Commercial fishing & aquaculture

There are currently six commercial fisheries operating within the Recherche Archipelago region. The largest commercially targeted species are shark, pilchards, southern rock lobster and abalone. Other species caught include queen snapper, red snapper, blue groper and scallops. Commercial fishing within the study region comprises the following managed fisheries:

South coast purse seine fishery

This fishery involves the purse seining of small pelagic fish, primarily pilchards (*Sardinops neopilchardus*), within four prescribed zones along the southern coast and has taken place in the Esperance. Gaughan *et al.,* (2000) identified that the mass mortality events, due to the

herpesvirus, are already having effects on this fishery. Annual catches of pilchards from the region in 1999 were 730 t, considerably less than the expected catch of 4-5000t.

Southern demersal gill net and demersal longline fishery

The demersal gillnet and demersal longline fishery, primarily targets gummy (*Mustelus antarcticus*), whiskery (*Furgaleus macki*) and dusky or bronze whaler (*Carcharhinus obscurus*) sharks and demersal scalefish. Key species of scalefish include deepwater fishes such as leatherjackets (*Monocanthidae spp.*), hapuku (*Polyprion oxygeneios*), blue-eyed trevalla (*Hyperoglyphe antarctica*) and grey-banded rock cod (*Epinephelus septyemfasciatus*), together with species that can be taken closer inshore such as bright redfish (*Centroberyx gerradi*), queen snapper (*Nemadactylus valenciensi*) and blue groper (*Achoerodus gouldii*) (CALM, 1994).

South coast estuarine fishery

The South Coast commercial estuarine fishery operates in all of the South Coast estuaries from west of Albany to the Recherche Archipelago. Catches are dominated by black bream (*Acanthopagrus butcheri*) and to a lesser extent, yelloweye mullet (*Aldrichetta forsteri*) and sea mullet (*Mugil cephalus*). Small catches of blue manna crabs (*Portunus pelagicus*), cobbler (*Cnidoglanis macrocephalus*) and squid are taken in some estuaries.

Esperance rock lobster managed fishery

The Esperance Southern rock lobster fishery is located between 120°E (near Hopetoun) and 125°E (near Point Culver) and south to the limit of the Australian Fishing Zone (AFZ). The rock lobster season operates between 15 November and 30 June and each licence is entitled to 10 pots per metre of boat length, with a maximum entitlement of 90 pots.

South coast demersal trawl fishery

Currently managed under Western Australian State jurisdiction this fishery extends offshore to the 200m isobath between Cape Leeuwin and the Australian Bight. The target species are demersal finfish such as queen snapper, bright redfish, boarfish (*Pentacerotidae spp.*) and deepwater flathead (*Platycephalus conatus*). Scallops (*Pecten spp.*) are also seasonally open (April 1 to November 30) fished within the Archipelago.

Abalone fishery

Abalone is one of the most valuable nearshore resources harvested off the South Coast. Commercial abalone operations are managed in two zones, on either side of Shoal Cape (120°E) (CALM, 1994). The boundaries of the Zone 1 abalone fishery extend from the WA/SA border to Shoal Cape. Areas worked include Sandy Hook Island, Remark Island, Frederick Island, Long Island, the Mart Group and Middle Island. Currently only three species of abalone, Roe's (*Haliotis roei*), greenlip (*H. laevigata*) and brownlip (*H. conicopora*) are targeted.

Off shore tuna fishery

Currently managed by the Australian government, the southern bluefin tuna (*Thunnus maccoyii*) fishery operates from the major South Coast ports, including Esperance.

Aquaculture

Currently, there are no land or sea-based aquaculture activities operating within the study area. However, Fisheries Western Australia identified that the Recherche Archipelago has significant potential for supporting aquaculture enterprises (Fisheries WA, 2000). Areas identified by Fisheries WA as potentially suitable for both land-based and sea-based aquaculture and the relevant selection criteria are outlined in Appendices Aq1 & Aq2. Candidate species suitable for potential aquaculture ventures were also identified (Appendix AQ3).

Current gaps in knowledge

The Recherche Archipelago region represents a substantial gap in our knowledge of the western Australian coastline. This review has highlighted the limited amount of quantitative data currently available across all groups of organisms. Spatial data in the form of 1:500, 000 maps (Kirkman, 1997), and some towed video (Fisheries, 1999a; Gaughan, pers comm.) exists however this resource does not have broad scale coverage. Bathymetric data from this area is poor with approximately 33% of the Recherché Archipelago region having inadequate, or no bathymetric information.

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Wells F.E. & Mulvay P. (1995) Good and bad fishing for *Haliotis laevigata*: a comparison of population parameters. Marine and Freshwater Research, 46: 591-598.

APPENDIX R1 - Review of existing biological, oceanographic & geomorphological data from the Recherche Archipelago (as at April 2002).

Some general sources of information:

CALM (1994) A representative marine reserve system for Western Australia. Report of the marine parks and reserves selection working group

CALM (1998) South Coast terrestrial and marine reserve integration study. Project #713, National Reserve System Co-operative Program (Appendix II contains Part V Marine Reserves on the South Coast from CALM, 1994)

CSIRO Marine Data Centre, Hobart: www.marine.csiro.au/datacentre (for data request forms)
*Metadata sheets available via search on Marlin at: www.marine.csiro.au/marlin
*For Cruise reports contact: CSIRO Marine Library: library@hba.marine.csiro.au

Edgar, G.J. (1997) Australian Marine Life: the plants and animals of temperate waters. Reed Books, Hong Kong.

Fisheries WA (2000) Aquaculture plan for the Recherche Archipelago. Fisheries Management Paper No. 140

Fisheries WA, Everall Consulting Biologist and Fish Unlimited (1999) Draft aquaculture plan for the Recherche Archipelago, WA.

Fisheries WA & Everall Consulting Biologists (1999a) Draft aquaculture plan for the Recherche Archipelago, WA: Benthic habitat survey of the Remark, Mart, Mondrain, Tory and York Island groups in the Recherche Archipelago.

Lee, S. & Bancroft, K.P. (2001) Review of the existing ecological information for the proposed Recherche Archipelago marine conservation reserve. Literature review. MRI/WSA, EUC/SIN, RAR-51/2001 (Marine Conservation Branch, CALM).

South Coast Management Group (2001) Southern Shores 2001-2021: A strategy to guide coastal and marine planning and management in the South Coast Region of Western Australia.

Stoddart, J.A., Wajon, J.E., Simpson, C.J., & Royce, P.M. (1991) A preliminary assessment of the marine impacts of the wreck of the *Sanko Harvest* at Esperance, Western Australia.

Van Hazel, J.H. (2001) The climate and physical oceanography of the Recherche Archipelago and adjacent waters. Unpublished thesis.

Van Hazel, J.H., Pattiaratchi, C., & D'Adamo, N. (2001) Review of the climate and physical oceanography of the Recherche Archipelago and adjacent waters

Wells, F.E., Walker, D.I., Kirkman, H. & Lethbridge, R. (eds). The Marine Flora and Fauna of Albany, Western Australia, volumes 1 and 2.

CATEGORY

3. Sea floor

LAYER NAME

3.1. Bathymetry

SUBJECT

Bathymetry

PRIMARY SOURCE

AGSO 30 Arc second gridded bathymetry (Digital - ASCII)
Navy (Australian Hydrographic Office)

SECONDARY SOURCE

CALM, WALIS

Australian Hydrographic Service, Nautical Charts: (Digital Raster or hardcopy)
Aus119 Approaches to Esperance
Aus119 Esperance
Aus4726 Cape Leeuwin to Esperance
Aus4727 Esperance to Whitby Isles

CONTACT

Mark Bolger, mark.bolger@defence.gov.au, Australian Hydrographic Office

COMMENTS

have emailed Mark Bolger with a request for bathymetric data, waiting for reply

CATEGORY

3. Sea floor

LAYER NAME

3.2. bottom sediment distribution

SUBJECT

Bottom sediment distribution

PRIMARY SOURCE

Cann, J.H., & Clarke, J.D.A. (1993) The significance of *Marginopora vertebralis* (Foraminifera) in surficial sediments at Esperance, Western Australia, and in last interglacial sediments in northern Spencer Gulf, South Australia. Marine Geology, 111: 171-187.

Conolly, J.R. & Von Der Borch, C.C. (1967) Sedimentation and physiography of the sea floor south of Australia. Sedimentary Geology. 1: 181-220.

Cooney, P.M. (1974) Geology of the Recherche Archipelago based on a seismic survey WA-47P for Continental Oil Co. (unpublished report by WA Geol. Surv.)

James, N.P., Bone, Y., Collins, L.B. & Kyser, T.K. (2001) Surficial sediments of the Great Australian Bight: facies dynamics and oceanography on a vast cool-water carbonate shelf. Journal of Sedimentary Research 71:549-567

Li, Q., James, N.P., Bone, Y. & McGowran, B. (1999) Paleoceanographic significance of recent foraminiferal biofacies on the southern shelf of Western Australia: a preliminary study. Palaeogeography, Palaeoclimatology, Palaeoecology. 147: 101-120

SECONDARY SOURCE

AuSEABED, www.es.usyd.edu.au/geology/centres/osi/auseabed/au7_web2.html

Stagg, H.M.J. *et al.,* (1990) Basins of the Great Australian Bight Region: geology and Petroleum potential (Recherche sub-basin) BMR & SADME:

CONTACT

Lindsay Collins, Curtin University, School of Applied Geology, Head of Applied Geology
head@lithos.curtin.edu.au

COMMENTS

Dept of Mineral and Petroleum Resources is sending three reports including above mentioned 1974 unpublished report
Cann, J.H., & Clarke, J.D.A. (1993) - Determined relative abundance of selected species of foraminifera in the sediments of samples taken within Esperance Bay. No quantitative data.

CATEGORY

4. Geomorphology

LAYER NAME

4.1. Geomorphology

SUBJECT

Geomorphology

PRIMARY SOURCE

Fairbridge, R.W., & Serventy, V.N. (1954) 1b. Physiography. *In,* The Archipelago of the Recherche: 9-28.

Hodgkin, E.P., & Clark, R. (1987) Estuaries and coastal lagoons of South Western Australia: Wellstead Estuary. Environmental Protection Authority, Estuarine Studies Series, 1.

Hodgkin, E.P., & Clark, R. (1989) Estuaries and coastal lagoons of South Western Australia: Estuaries of the shire of Esperance, Stokes Inlet, Oldfield Estuary and ten others. Environmental Protection Authority, Estuarine Studies Series, 5.

Myers, J.S. (1990). "Western Gneiss Terrane" *In* "Geology and Mineral Resources of Western Australia", Geological Survey, Western Australian Memoirs, **3**:13-32.

Sanderson, P.G., Eliot, I., Hegge, B., & Maxwell, S. (2000) Regional variation of coastal morphology in southwestern Australia: a synthesis. Geomorphology, 34: 73-88.

Von Der Borch, C.C. (1968) Southern Australian submarine canyons: their distribution and ages. Marine Geology, 6: 265-266.

Also geology:

Esperance Digital Geology 1:250 000. ArcInfo (hardcopy map can also be purchased) from NGIS Australia (ngis@ngis.com.au or ph: 9277 9600)

Hawkins, L.V., Hennion, J.F., Nafe, J.E., & Doyle, H.A. (1965) Marine seismic studies on the continental margin to the south of Australia. Deep-Sea Research, 12:479-495.

James, N.P., Boreen, T.D., Bone, Y., & Feary, D.A. (1994) Holocene carbonate sedimentation on the west Eucla Shelf, Great Australian Bight: a shaved shelf. Sedimentary Geology, 90: 161-177.

Morgan, K.H., Horwitz, R.C., & Sanders, C.C. (1967) Structural layering of the rocks of the Archipelago of the Recherche. Report of the Dept. Mines. W.A.

Revill, K., Roach, I., & Stagg, H.M.J. (1987) Rig seismic research cruises 10 & 11, Southern margin of Australia. Bureau of Mineral Resources, Geol. & Geophysics.

Twidale, C.R. and Bourne, J.A. (1998) Origin and age of Bornhardts, southwest Western Australia. Australian Journal of Earth Sciences, 45:903-914

SECONDARY SOURCE

CALM (1994) A representative marine reserve system for Western Australia. Report of the marine parks and reserves selection working group

Fisheries WA & Everall Consulting Biologists (1999) Draft aquaculture plan for the Recherche Archipelago, WA: Benthic habitat survey of the Remark, Mart, Mondrain, Tory and York Island groups in the Recherche Archipelago.

Fisheries WA, Everall Consulting Biologist and Fish Unlimited (1999) Draft aquaculture plan for the Recherche Archipelago, WA.

Lee, S. & Bancroft, K.P. (2001) Review of the existing ecological information for the proposed Recherche Archipelago marine conservation reserve. Literature review. MRI/WSA, EUC/SIN, RAR-51/2001 (Marine Conservation Branch, CALM).

COMMENTS

Lee & Bancroft cite Myers (1990) but this is geology rather than geomorphology

Sanderson *et al*., (2000) when discussing the coastline refers to Woods, P.J., Webb, M.J., & Elliot, I.G. (1985) Western Australia. In: Bird, E.C.F., Schwartz, M.L. (Eds.), The world's coastline. Van Nostrand-Reinhold, New York :929-947. (need copy)

CATEGORY

5. Oceanography

LAYER NAME

5.1. Currents

SUBJECT

Leeuwin current
summer counter current
island eddies
summer upwelling

PRIMARY SOURCE

Church, J.A., Cresswell, G.R., & Godfrey, J.S. (1989) The Leeuwin Current. Papers from the workshop on Poleward flowing undercurrents on Eastern boundaries.

Cresswell, G.R., & Vaudrey, D.J. (1978?) Satellite-tracked bouy data report 1: Western Australian releases 1975 & 1976.

Cresswell, G.R. (1991) The Leeuwin Current - observations and recent models. Journal of the Royal Society of Western Australia, 74: 1-14.

CSIRO (1962) Aust. Oceanogr. Cruise, Rep. No. 16

CSIRO (1988) Current-meter data from the Leeuwin Current interdisciplinary experiment. Rep. No. 198.

CSIRO Franklin voyage 94/07 data, CSIRO (but data is outside state territorial waters) - surface currents and depth profiles (see figure 4.7 of van Hazel 2001 for location of data stations near the Recherche)

Godfrey, J.S. & Vaudrey, D.J. & Hahn, S.D. (1986). Observations of the Shelf-edge current South of Australia, Winter 1982" J. Phys. Oceanog. 16: 668-679.

Herzfeld, M. (1997) The annual cycle of sea surface temperature in the Great Australian Bight. Prog. Oceanog, **39**: 1-27.

Legeckis, R., & Cresswell, G. (1981) Satellite observations of sea-surface temperature fronts off the coast of western and southern Australia. Deep-Sea Research, 28: 297-306.

Pattiaratchi (1998). "Assessment and modelling of oceanographic conditions at four potential sites for Tuna fattening in Esperance" Centre for Water Research (UWA). Current circulation patterns in Esperance Bay predicted from wave modelling, fig 4.13-24.

Pearce, A.F. (2001) Ocean Temperature variability off Esperance, Western Australia. Report prepared for CSIRO Fisheries WA. (unpublished report).

Smith, R.L., Huyer, A., Godfrey, J.S., & Church, J.A. (1991) The Leeuwin current off Western Australia, 1986-1987. Journal of Physical Oceanography, 21: 323-345.

- only has data for North West Cape (22°S) to the Albany region (35°S).
-

Van Hazel, J.H., Pattiaratchi, C., & D'Adamo, N. (2001) Review of the climate and physical oceanography of the Recherche Archipelago and adjacent waters.

- Section 4.3 modelling of currents from barotropic forcing

SECONDARY SOURCE

Crossland, C.J. & Wells, F.E. (1985) A selected bibliography of marine and estuarine studies (other than physical oceanography) in Western Australia. CSIRO Report 160.

Van Hazel, J.H., Pattiaratchi, C., & D'Adamo, N. (2001) Review of the climate and physical oceanography of the Recherche Archipelago and adjacent waters

- Section 5.4, figures 5.4, 5.4, 5.8, 5.9. Poor quality satellite imagery, refers to Pearce & Pattiaratchi (1999).

Van Hazel, J.H., Pattiaratchi, C., & D'Adamo, N. (2001) Review of the climate and physical oceanography of the Recherche Archipelago and adjacent waters.

- Section 4.1.3, figures 4.5, 4.6, appendices C and D, same as above. Section 4.1.4, speculation on island eddies. Section 4.2.1, figures 4.8-12, analysis of data from Franklin voyage 94/07. Section 4.4. prediction of summer upwelling patterns.

Pearce and Pattiaratchi (1997) "Applications of satellite remote sensing to the marine environment in WA", J. Royal Soc. WA 80: 1-14

Pearce and Pattiaratchi (1999) "The Capes Current: a summer counter current flowing past Cape Leeuwin and Cape Naturaliste", WA. Continental Shelf Research, 19, 401-420.

Other possible sources cited in Van Hazel thesis:
Pattiaratchi, C. & Buchan, S. (1991) Implications of long-term climate change for the Leeuwin current. J. Roy. Soc. WA 74.

Herzfeld, M & Tomczak, M (1997) Numerical modelling of sea surface temperature and circulation in the Great Australian Bight. Progress in Oceanography, 39:29-78

Cresswell, G.R. and Peterson, J.L. (1993) The Leeuwin current south of western Australia. Aust. J. of Marine and Freshwater Res. 44:285-303

Pearce, A.F. and Walker, D.I. (eds) The Leeuwin current. Royal Society of Western Australia, Journal, 74

Lee & Bancroft. refers to Fisheries WA (1999) and Pearce & Pattiaratchi (1997); also refers to modelling of currents done by Centre for Water Research (UWA) (reported in Fisheries WA, State of the Fisheries report 1998/1999), is this van Hazel's work?

Fisheries WA (1998) A proposal for the establishment of Southern Bluefin Tuna farming at three sites in Esperance Bay by the Pearling and Aquaculture Program. Refers to Pattiaratchi (1998).

CONTACT

Charitha Pattiaratchi, Centre for Water Research, UWA)
Alan Pearce (CSIRO Marine, Watermans)

CATEGORY

5. Oceanography

LAYER NAME

5.2. Water temperature

SUBJECT

Water temperature

PRIMARY SOURCE

A.F. Pearce (unpublished report) Ocean Temperature variability off Esperance, Western Australia. Report prepared for CSIRO Fisheries WA

Pearce's temperature data comes from 4 sources:

1. Reynold's SST's derived from satellite data.

   Reynolds, R.W. & Smith, T.M. (1994) Improved global sea surface temperature analyses using optimal interpolation, Journal of Climate 7: 929-948.
2. National Tidal Facility Seaframe station on wharf (water T, sea T, wind, sea-level) maintained by Flinders Uni (Flinders Institute for Atmospheric and Marine Sciences, contact: Paul Davill and Allan Suskin)
3. Fisheries WA temperature loggers on seabed near wharf (contact Stuart Blight and Rod Lenanton) - stopped operating 1995
4. satellite thermal images (from NOAA satellite 2 km resolution, afternoon); satellite images originally in 1 km resolution (contact Peter Saunders at DOLA)

CSIRO Marine Voyages (appendix V1)

LANDSAT satellite images may be higher resolution than NOAA, and go back to 1970's; but would have to pay for these.

IRI/LDEO Climate Data Library web site: ingrid.ldgo.columbia.edu/
monthly estimates of sst blended from ship, buoy and bias-corrected satellite data (Reynolds and Smith, 1994), 1 degree grid.

Esperance Coastal Data Station 1979-1981 (Temperature, salinity, nutrients): contact CSIRO Marine Data Centre, Hobart

Fisheries WA (2000) cites pers. comm. from L Hudson suggesting that local dive shop has records of water temperature.

SECONDARY SOURCE

van Hazel (2001) section 4.1.1 (summary from data at IRI/LDEO website) and Appendix B (satellite imagery showing sea-surface temperature - source not indicated), figure 4.1 graph showing temperature variation. Section 4.2.2, figures 4.13-19 on Franklin voyage CTD data.

van Hazel et al. (2001), section 5.1, figure 5.1, same as above.

CONTACT

Tony Reese at Data Centre CSIRO Marine
Charitha Pattiaratchi, Centre for Water Research, UWA)
Alan Pearce (CSIRO Marine, Watermans)

COMMENTS

Alan Pearce is happy to assist if you want more temperature data from satellite imagery, please talk to him. Alan Pearce also maintains a temperature logger on Woody Island (since ~April 2001)

CATEGORY

5. Oceanography

LAYER NAME

5.3. Water salinity

SUBJECT

Water salinity

PRIMARY SOURCE

IRI/LDEO Climate Data Library web site: ingrid.ldgo.columbia.edu/

CSIRO Marine Voyages (see summary at beginning of document)

Esperance Coastal Data Station 1979-1981 (Temperature, salinity, nutrients): contact CSIRO Marine Data Centre, Hobart

SECONDARY SOURCE

van Hazel (2001) summarises salinity (data from IRI/LDEO web site?) section 4.1 and figure 4.2. Section 4.2.2, figures 4.15-19 on Franklin voyage CTD data.

van Hazel et al. (2001) section 5.1 and figure5.2, as above.

CONTACT

Tony Reese at Data Centre CSIRO Marine
Charitha Pattiaratchi, Centre for Water Research, UWA)
Alan Pearce (CSIRO Marine, Watermans)

CATEGORY

5. Oceanography

LAYER NAME

5.4. Water quality

SUBJECT

chlorophyll

PRIMARY SOURCE

Satellite data used by van Hazel:
(1) SeaWiFS (Sea-viewing Wide Field of view Sensor)
(2) CZCS (Coastal Zone Colour Scanner)

Kinhill Engineers (1991). "Report on visit to the areas of the Sanko Harvest grounding, Esperance. February 1991
(Table 4 for chlorophyll levels)

IRI/LDEO Climate Data Library web site: ingrid.ldgo.columbia.edu/

CSIRO Marine Voyages (see summary at beginning of document)

SECONDARY SOURCE

van Hazel et al. (2001) section 5.2, figures 5.4 (SeaWiFS- satellite images) 5.5 (CZCS satellite images), 5.6, 5.7 (seasonal variation graphs)

van Hazel (2001) section 4.1.2, appendices C & D, and figures 4.3 & 4.4, as above, but with more interpretation of images

CONTACT

Tony Reese at Data Centre CSIRO Marine
Charitha Pattiaratchi, Centre for Water Research, UWA)
Alan Pearce (CSIRO Marine, Watermans)

CATEGORY

5. Oceanography

LAYER NAME

5.4. Water quality

SUBJECT

nutrients

PRIMARY SOURCE

Kinhill Engineers (1991). "Report on visit to the areas of the Sanko Harvest grounding, Esperance. February 1991
(Table 1-3 for nutrients)

CSIRO Marine Voyages (see summary at beginning of document)

Esperance Coastal Data Station 1979-1981 (Temperature, salinity, nutrients): contact CSIRO Marine Data Centre, Hobart

IRI/LDEO Climate Data Library web site: ingrid.ldgo.columbia.edu/

SECONDARY SOURCE

van Hazel et al. (2001) section 5.3
van Hazel (2001) section 4.2.3, figures 4.20-21, nitrate and phosphorous levels from Franklin voyage 94/07, but data is outside state territorial waters

CONTACT

Tony Reese at Data Centre CSIRO Marine
Charitha Pattiaratchi, Centre for Water Research, UWA)
Alan Pearce (CSIRO Marine, Watermans)

CATEGORY

5. Oceanography

LAYER NAME

5.6. Wave height, period and direction

SUBJECT

Wave height, period and direction

PRIMARY SOURCE

Russell, K.L. (1984). Analysis of PWD Esperance location 16 wave data December 1982-1983. RK Steedman & Assoc's Report 242.

Pattiaratchi (1998). "Assessment and modelling of oceanographic conditions at four potential sites for Tuna fattening in Esperance" Centre for Water Research (UWA). 1 year of wave height data from Magistrate rock, figures 4.1-6; predicted wave heights for tuna sites, figures 4.8-11. Data from Russell (1984).

SECONDARY SOURCE

Van Hazel, J.H., Pattiaratchi, C., & D'Adamo, N. (2001) Review of the climate and physical oceanography of the Recherche Archipelago and adjacent waters.

- Section 2.2.1, figures 2.9-12 (surface gravity waves), refers to Pattiaratchi (1998). Section 2.2.4, figures 2.14-15 (continental shelf waves and storm surge), refers to Provis & Radok.

van Hazel et al. (2001). Section 4.1 (gravity waves, as above), section 4.4 (continental shelf waves and storm surge, as above)

van Hazel has a lot of data on waves but it is not clear where all the data came from (possibly from Russell 1984?)

CONTACT

Charitha Pattiaratchi, Centre for Water Research, UWA)

COMMENTS

Ask Charitha Pattiaratchi about Provis & Radok (1979) reference
Pattiaratchi (1998) 1 year of wave height data from Magistrate rock, figures 4.1-6; predicted wave heights for tuna sites, figures 4.8-11. Data from Russell (1984).

CATEGORY

6. Biology Marine

LAYER NAME

6.1. Benthic flora

SUBJECT

Benthic flora
Benthic habitat mapping

PRIMARY SOURCE

Coastal Resource Atlas, WA Dept of Transport, Coastal Management branch, data as ArcInfo GIS. (ground-truthing indicates inaccurate at local scale), probably also available from CALM Fremantle.

CALM (1998). South coast terrestrial and marine reserve integration study. Final Report: MRIP/SC - 10/1997. Marine Conservation Branch, CALM, Fremantle. Appendix IV - Kirkman, H. (1997) Benthic habitat mapping (describes how data was collected and interpreted: i.e. Landsat TM satellite imagery for interpretation and ground truthing via bounce dives).

*Also Excel spreadsheet is available from CALM of results of bounce dives.
*Although some reports claim that drop-down TV was used near Mondrain Island (in the Recherche) on the Leeuwin voyage (as proposed in Colman, 1997), Colman has informed me that that their survey was restricted to the Fitzgerald Biosphere as reported in CALM (1998)

D.A. Lord & Associates (1999) Esperance Harbour Redevelopment: Marine Environmental Studies. Report prepared for Environmental risk Solutions, Report No. 99/106/1. December 1999. (Environmental Risk Solutions (2000) Esperance Port Upgrade Facilities - Public Environmental Review. Prepared for the Esperance Port Authority, January 2000) - bounce and drift dives

D.A. Lord & Associates (2001) Interim report on historical benthic habitat mapping in Esperance Bay. Prepared for Esperance Port Authority. Report No. 00/172/1. - historical mapping used aerial photo interpretation; results of towed underwater video will be reported in a subsequent report (report lists sources of aerial photographs, their coverage and their quality)

D.A. Lord & Associates (2001) Esperance Bay: Interim report on seagrass monitoring offshore of breakwater. Prepared for Esperance Port Authority. Report No. 00/172/2.

D.A. Lord & Associates (2001) Notification of maintenance dredging at Bandy Creek Harbour. prepared for Department of Transport (lists seagrass species observed during dive surveys in the vicinity of the Port of Esperance; and describes grain sizes for sediment to be dredged)

Fisheries WA & Everall Consulting Biologists (1999a) Draft Aquaculture Plan for the Recherche Archipelago, WA: Benthic habitat survey of the Remark, Mart, Mondrain, Tory and York Island groups in the Recherche Archipelago. (reports the taking of underwater video transects, the existence of Excel spreadsheets of field survey results and the conversion of data to ArcView GIS: Chris Dibden is trying to track this information down for us)

Murdoch University (1996) Southern Western Australian Seagrass Study. Final report to Australian Heritage Commission.

Wells (1997) site assessment for Fisheries WA (1988, see below)

SECONDARY SOURCE

Habitat mapping

Colman J.G.(1997) Biological verification of the major benthic habitats of the south coast (Mondrain Island - Albany): 10-21 February 1997, Field Program report: MRIP/SC - 2/97. Marine Conservation Branch, CALM, Fremantle.

CALM (1998). South coast terrestrial and marine reserve integration study. Final Report: MRIP/SC - 10/1997. Marine Conservation Branch, CALM, Fremantle. Sections 1.4 & 1.5.

Fisheries WA (1998) A proposal for the establishment of Southern Bluefin Tuna farming at three sites in Esperance Bay by the Pearling and Aquaculture Program. Refers to site assessment by Wells (1997) and ecological literature review by Bowman Bishaw Gorham (environmental
consultants)

Seagrass

Campey, M. L., Waycott, M. & Kendrick, G.A. (2000) Re-evaluating species boundaries among members of the *Posidonia ostenfeldii* species complex (Posidoniaceae) – morphological and genetic variation.

Kuo J. & Kirkman H. (1995). *Halophila decipiens* Ostenfeld in estuaries of south western Australia. Aquatic Botany, 51: 335-340.

Kirkman, H. & Kuo, J. (1990) Pattern and process in southern Western Australian seagrasses. Aquatic Botany, 37: 367-382.

Kuo J. & McComb A.J. (1989) Seagrass taxonomy, structure and development. In Biology of Seagrasses: A Treatise on the Biology of Seagrasses with Special Reference to the Australian region. Larkum, A.W.D., McComb, A.J. & Sheperd, S.A. (eds) pp6-73. Elsevier, Amsterdam.

Walker, D.I. (1991) The effect of sea temperature on seagrasses and algae on the Western Australian coastline. J. Roy. Soc. WA. 74: 71-77.

Waycott, M. (1998) Genetic variation, its assessment and implications to the conservation of seagrasses. Molecular Ecology, 7: 793-800.

Waycott, M. (2000) Genetic factors in the conservation of seagrasses. Pacific Conservation Biology, 5: 269-276.

Macroalgae

Womersley, H.B.S. (1984 & 1987) The Marine Benthic Flora of Southern Australia. Part I & II, Government Printer, Adelaide

Womersley, H.B.S. (1990). Biogeography of Australasian marine macroalgae. In: M.N. Clayton & R.J. King (eds), Biology of Marine Plants, pp367-381. Longman Cheshire, Melbourne.

Womersley, H.B.S. (1994) The marine benthic flora of southern australia. Part IIIA. Australian Biological Resources Study, Canberra.

Womersley (1984) indicates Prof A McComb at UWA is the expert in physiology of benthic flora, and Mr G. Smith at Murdoch Uni is a taxonomist

have done a search for DEP reports on web (as direct enquiries of DEP personnel revealed no knowledge of any reports), see list printed out of (1) DEP bulletins for Esperance Port Authority and (2) two Environmental Impact Assessments (from search of WALIS)

CONTACT

Chris Dibden at Fisheries WA, ph: 9482 7367, cdibden@fish.wa.gov.au
Kevin Bancroft at CALM Fremantle, ph: 9432 5102, kevinb@calm.wa.gov.au
Bruce Hegge DAL PH: 9389 9669 bhegge@dalord.com.au

COMMENTS

Vicki Gouteff, Librarian at WAMRL: is tracking down reports for us and will mail them
Bruce Hegge says that (1) Geraldton Port Authority is doing a survey on Introduced Marine Pests for Esperance Port soon and (2) aerial photography of Esperance is due soon.
Have requested data from AIMS Data Centre via e-mail but received no reply (contact Scott Bainbridge: s.bainbridge@aims.gov.au ph (07) 4753 4377

CATEGORY

6. Biology Marine

LAYER NAME

6.2. Infauna (sea-floor)

PRIMARY SOURCE

Di Jones (WA Museum) suggests looking for papers by Chris Erseus and Ray Gibson on worms and Pat Hutchings (Australian Museum, Sydney) on marine polychaetes (check Albany workshop papers)

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

decapod crustaceans

PRIMARY SOURCE

Morgan G.J. and Jones, D.S. (1991). Checklist of the marine decapod Crustacea of southern Western Australia. *In* F.E. Wells, D.I. Walker, H. Kirkman & R. Lethbridge (Eds). *Proceedings of the Third International Marine Biological Workshop: The Marine Flora and Fauna of Albany, Western Australia*, Volume **II**: 483-497. Western Australian Museum, Perth.

*Some of the species described are from the Recherche area. Paper also discusses the faunal relationships of the marine decapods of the SW and western coasts.

Gibson, R. & Jones, D.S. (1990). A new species of *Carcinonemertes* (Nemertea: Enopla: Carcinonemertidae) from the egg masses of *Naxia aurita* (Latreille) (Decapoda: Brachyura: Majidae) collected in the Albany region of Western Australia. *In* F.E. Wells, D.I. Walker, H. Kirkman & R. Lethbridge (Eds). *Proceedings of the Third International Marine Biological Workshop: The Marine Flora and Fauna of Albany, Western Australia,* 1988. Volume **1**: 333-437. Western Australian Museum, Perth.

*Species described also from the Recherche area.

SECONDARY SOURCE

Edgar, G.J. (1997) Australian Marine Life: the plants and animals of temperate waters. Reed Books, Hong Kong.

Fisheries Department (1986) Fisheries management paper No. 4 "The Esperance rock lobster working group" WA

Jones, D.S. & Morgan G.J. (1994). *A field guide to the crustaceans of Australian waters*. Reed/Western Australian Museum. 216 pp. (new edition due out in next few months).

Lee & Bancroft (2001), section 4.5.2; appendix 17 lists species likely to occur according to Morgan & Jones (1991), Edgar (1997); section 7.4 (rock lobster fishery)

Melville-Smith, R (in press) extract from State of the fisheries report: South Coast Rock Lobster Fishery Status Report (e-mailed)

Sheperd, S.A. & Thomas, I.M. (1982) Marine Invertebrates of southern Australia. Part I. Government Printer, Adelaide.

Sheperd, S.A. & Thomas, I.M. (1989) Marine Invertebrates of southern Australia. Part II. Government Printer, Adelaide.

CONTACT

Di Jones, WA Museum
Roy Melville-Smith, Fisheries WAMRL, Rock Lobster, rmsmith@fish.wa.gov.au PH: 9246 8406

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

Cirripedia (shallow water barnacles)

PRIMARY SOURCE

Jones, D.S. (1990d). The shallow-water barnacles of southern Western Australia. *In* F.E. Wells, D.I. Walker, H. Kirkman and R. Lethbridge (Eds). *Proceedings of the Third International Marine Biological Workshop: The Marine Flora and Fauna of Albany, Western Australia, 1988*. Volume **1**: 333-437. Western Australian Museum, Perth.

*Some of the species described are from the Recherche area. Paper also discusses the faunal relationships of the barnacles of the SW and western coasts.

Jones, D.S., Anderson, J.T. & Anderson, D.T. (1990). A checklist of the Australian Cirripedia (Thoracica, Acrothoracica). *Technical Reports of the Australian Museum*, No.**3**: 1-38.

*Some of the species described are from the Recherche area. Paper also discusses the faunal composition of the barnacles of the south coast in relation to other areas of Australia.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.5.2; appendix 16 lists species likely to occur according to Jones (1991), Edgar (1997)

CONTACT

Di Jones (WA Museum) PH 9427 2700

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

greenlip abalone (*Haliotis laevigata*)
Roe's abalone (*Haliotis roei*)
brownlip abalone (*Haliotis conicopora*)

PRIMARY SOURCE

Wells F.E. & Mulvay P. (1995) Good and bad fishing for *Haliotis laevigata*: a comparison of population parameters. Marine and Freshwater Research, 46: 591-598.

- Sampled abalone (*Haliotis laevigata)*, from sites at Esperance & Cape Arid. Produced size frequency statistics but not density data. Describes the population biology and reproductive ecology of populations at Augusta Esperance and Hopetoun.

SECONDARY SOURCE

Lee & Bancroft (2001) section 4.5, 7.6.

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

molluscs

PRIMARY SOURCE

Alan Longbottom has a collection and database on molluscs from Esperance region

Harris, D.C., Joll, L.M., & Watson, R.A. (1999) The Western Australian scallop industry. Fisheries Research Report No. 114.

Macpherson J.H. (1954). The Archipelago of the Recherche, Part 7, Molluscs. Report of the Australian Geographical Society, 1: 55-63.

* No Quantitative data – description of dead shells collected from beaches in the Archipelago

Wells, F.E. (1980). The distribution of shallow-water marine prosobranch gastropod molluscs along the coastline of Western Australia. *Veliger* **22** (3): 232-247.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.5.3; appendix 18, 19, 20, 21, 22 lists species of molluscs likely to occur in region (i.e. chitons, prosobranchs, seas slugs, bivalves and cephalopods, respectively)

Wells, F.E. (1984). *A guide to the common molluscs of south-western Australian estuaries*. Western Australian Museum, Perth. 112 pp. (Photography by C.W. Bryce)

Wells, F.E. & Bryce, C.W. (2000). *Seaslugs of Western Australia*. Western Australian Museum, Perth. 208 pp.

Wells, F.E. & Bryce, C.W. (2000). *Seashells of Western Australia*. Revised edition. Western Australian Museum, Perth. 207 pp.

CONTACT

Alan LongBottom, Grasspatch, Esperance (Associate of the WA Museum) PH: 0427 757 030

Shirley Slack-Smith , WA Museum PH 9427 2700 (has a collection of molluscs but not in database, would be slow process to sort through collection)

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

echinoderms

PRIMARY SOURCE

Marsh L.M. (1991). Shallow water echinoderms of the Albany region, south-western Australia. In: The Marine Flora and Fauna of Albany, Western Australia, Volume II. Western Australian Museum: 439-482.

*This is the only published information on species of echinoderms of the south coast.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.5.1; appendix 15 lists species likely to occur according to Marsh (1991)

DATA FORMAT

CONTACT

Loisette Marsh (WA Museum)

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

Cnidaria

PRIMARY SOURCE

James, N.P., Boreen, T.D., Bone, Y., & Feary, D.A. (1994) Holocene carbonate sedimentation on the west Eucla Shelf, Great Australian Bight: a shaved shelf. Sedimentary Geology, 90: 161-177.

- single dredge between 180-250 m deep – identified four ahermatypic coral species including: *Scolymia australis*, *monomyces radiatus*, *Flabellum pavoninum* and a *Charyophillia sp*.

Veron, J.E.N. & Marsh, L.M. (1988). Hermatypic Corals of Western Australia. Records and annotated species list. *Records of the Western Australian Museum*, Supplement **29.**

*Column on coral species that occur in the Recherche and a paragraph discussing the faunal relationships of the south coast.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.5.4; appendix 23 lists species likely to occur according to Vernon & Marsh (1988), Edgar (1997)

CATEGORY

6. Biology Marine

LAYER NAME

6.4 Epifauna (top layers)

SUBJECT

other invertebrates

PRIMARY SOURCE

Britton *et al.* (1991) identified relationships between topography, substratum and surface temperature in determining the spatial distribution of intertidal fauna of the rocky shores of southwestern Australia.

Fromont, J.(1998). Revision of the marine sponge genus *Caulospongia* Saville Kent, 1871 (Demospongiae: Hadromerida). Part 1. Morphological and skeletal characters. *Records of the Western Australian Museum*, **19**: 65-89.

*Some of the species are described from the South coast, and were collected in the Recherche area.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.5.5; appendix 24 lists invertebrates likely to occur in the region according to Edgar (1997)

Morgan, G.J. & Wells, F.E. (1991). Zoogeographic provinces of the Humboldt, Benguela and Leeuwin Current systems. *Journal of the Royal Society of Western Australia* 74: 59-69.

CONTACT

Jane Fromont WA Museum Ph: 9427 2745 (provided ist on publications by WAM for the Recherche area).

CATEGORY

6. Biology Marine

LAYER NAME

6.5. Fish

SUBJECT

Fish

PRIMARY SOURCE

Ayvazian, S.G. & Hyndes, G.A. (1995). Surf-zone fish assemblages in the south-western Australia: do adjacent nearshore habitats and the warm Leeuwin current influence the characteristics of the fish fauna? Marine Biology. 122: 527-536

*Lists fish caught by seine net at Esperance (see Appendix F1)

* Suzy Ayvazian has an Access DB with data but is unpublished yet

Dragon Search (for sightings of leafy and weedy seadragons)

Fisheries WA (1987) A development plan for the south coast inshore trawl fishery. Fisheries Management paper No. 13.

Fisheries WA & Everall Consulting Biologists (1999) Draft aquaculture plan for the Recherche Archipelago, WA: Draft user profile of the Recherche Archipelago and the adjacent coast.

Fisheries WA & Everall Consulting Biologists (1999) Draft aquaculture plan for the Recherche Archipelago, WA: Report on community consultations.

Gaughan, D.J. and Fletcher, W.J. (1997). Effects of the Leeuwin current on the distribution of carnivorous macro-zooplankton in the shelf waters off southern Western Australia. Estuarine, Coastal and Shelf Science 45: 89-97

Gaughan, D.J., Mitchell, R.W., & Blight, S.J. (2000) Impact of mortality, possibly due to herpesvirus, on pilchard *Sardinops sagax* stocks along the south coast of Western Australia in 1998-1999. Mar. Freshwater Research, 51: 601-612.

Gaughan, D.J., Baudains, G.A., Mitchell, R.W.D., & Leary, T.I. (2001) Pilchard (*Sardinops sagax*) nursey areas and recruitment process assessment between different regions in southern Western Australia. Fisheries Research Report No. 131.

Gaughan, D.J., White, K.V. and Fletcher, W.J. (2001). The links between functionally distinct adult assemblages of *Sardinops sagax*: larval advection across management boundaries. ICES Journal of Marine Science, 58: 597-606.

*No quantitative data. Aging of sardine (*Sardinopsis sagax)* larvae using otolith techniques suggest that larvae from Western Australian populations can be passively transported close to the central coast of Southern Australia by the Leeuwin Current.

Possible implications for management of fisheries. Westward migration of juveniles required to maintain functionally distinct adult assemblages (FDAAs) at Albany, Bremer Bay and Esperance.

Hancock, D.A. (1980) Fisheries management – Esperance. Fisheries Research Seminar.

Hutchins (1994). "A survey of the nearshore fish fauna of Western Australia's west and southwest coasts - The Leeuwin province". Records of the Western Australian Museum. Supplement # 46

Hutchins, J.B. (2001) Biodiversity of shallow reef fish assemblages in Western Australia using a rapid censusing technique. Records of the Western Australian Museum, 20: 247-270.

*Same data set from Hutchins (1994) for the Recherche area. Surveyed sites expanded northwards to Kimberly and including offshore atolls. Analysis targeted 18 families. Identified Four assemblages: Southwest (Recherche to Pt Denniston and Kalbarri); northwest (Abrolhos and Shark Bay to Dampier); offshore atolls; and Kimberley.

Non-quantitative data: Densities classed as rare, occasional, frequent or abundant) Sites in the southwest region are inhabited by fauna with a relatively high proportion of endemic species. (28% for the Recherche).

*Hutchins, will be presenting more data on fishes around Recherche at 2003 Workshop in Esperance (this data not available until then)

Hyndes, G.A., & Potter, I.C. (1997) Age, growth and reproduction of *Sillago schomburgkii* in south-western Australia, nearshore waters and comparisons of life history styles of a suite of *Sillago* species. Experimental Biology of Fishes, 49: 435-447.

Hyndes, G.A., Platell, M.E., & Potter, I.C. (1998) Age composition, growth, reproductive biology, and recruitment of King George Whiting, *Sillaginodes punctata*, in coastal waters of southwestern Australia. Fishery Bulletin, 96: 258-270.

Hyndes, G.A., Platell, M.E., Potter, I.C., & Lenanton, C.J. (1999) Does the composition of the demersal fish assemblages in temperate coastal waters change with depth and undergo consistent seasonal changes? Marine Biology, 134: 335-352.

*No quantitative data for the Esperance area. Lower west coast of WA (Perth to Cape Naturaliste) 200km range. 9 sites in water depths 5-15m or 20-35m within 20km from shore.

Sampled with otter trawl net- Composition of fish fauna influenced by distance from shore as well as by water depth. Most sites underwent consistent, cyclic seasonal changes attributed to patterns of migration including: Movements of certain species from nursery grounds to deeper waters; Migrations into and off sandy areas of inner continental shelf; migrations to spawning areas; and movements to areas where detached macrophytes accumulate in winter.

Potter, I.C., & Hyndes, G.A. (1999) Characteristics of the ichthyofaunas of southwestern Australian estuaries, including comparisons with holarctic estuaries and estuaries elsewhere in temperate Australia: A review. Australian Journal of Ecology, 24: 395-421.

*Recreational fishing catch and effort data: Neil Sumner at WAMRL has applied for FRDC funding to do survey in 2002 (will start July if successful)

Walker, M.H., Blight, S.J., & Clarke, D.P. (1989) A description of the British united Trawlers/Southern Ocean Trawlers operation in the Great Australian Bight during the period 19.11.77 to 28.5.79. Fisheries Research Report No. 85.

Walker, M.H., & Clarke, D.P. (1989) The demersal trawl resources of the Great Australian Bight as indicated by the fishing operations of the stern trawlers Orthello, Orsino and Cassio in the period 19.11.77 to 28.5.79. Fisheries Research Report No. 86.

SECONDARY SOURCE

Lee & Bancroft (2001), section 4.4, section 6 (recreational fishing), section 7 (commercial fishing)

Hutchins B. & Swainston R. (1986). Sea fishes of southern Australia. Swainston Publishing, Perth.

Hutchins B. & Thompson M. (1983). The Marine and Estuarine Fishes of South-western Australia, a Field guide for divers and anglers. Western Australian Museum.

Gomon M.F., Glover, J.C.M. & Kuiter, R.H. (1994). The fishes of Australia's south coast. State Printer, Adelaide.

Last, P.R. & Stevens, J. (1994) The Sharks and Rays of Australia. CSIRO, Melbourne.

<u>for herring and salmon:</u>
Fisheries WA (1995) . "Draft report of the south coast estuarine fishery working group"

<u>for shark:</u>
Fisheries Department (1986). "Fisheries management paper No. 1: The report of the southern WA shark working group"

<u>for fishing: recreational and commercial:</u>
CALM (1994). "A representative marine reserve system for WA"

<u>for recreational fishing:</u>
Fisheries WA (1998/1999). State of the fisheries report 1998/1999
Fisheries WA (1999/2000). State of the fisheries report 1999/2000

CONTACT

Neil Sumner, WAMRL, Ph: 9246 8438
Barry Hutchins, WA Museum PH 9427 2700 (will only supply published data)

Comment from Barry Hutchins re: Fishes

Re the Recherche, I have published a fish list for the area (Hutchins, 1994, Rec. West. Aust. Mus. Suppl. 46: 1-66).
The fish fauna is also referred to in another paper of mine in press (Rec. West. Aust. Mus.) which is due out shortly - Biodiversity of shallow reef fish assemblages in Western Australia using a rapid censusing technique.
Finally I am preparing an annotated checklist of the fishes of the Archipelago but I have not decided where or when it will be published.

CATEGORY

6. Biology Marine

LAYER NAME

6.6. Marine Pests

SUBJECT

Sabella spallanzanii (fanworm)

PRIMARY SOURCE

Esperance Port Authority

SECONDARY SOURCE

Lee and Bancroft (2001) cite G. Clapin pers. com.

CATEGORY

6. Biology Marine

LAYER NAME

6.7. Marine mammals

SUBJECT

Cetaceans
Pinnipeds:
NZ Fur Seal (Arctocephalus forsteri)
Australian Sea Lion (Neophoca cinerea)

PRIMARY SOURCE

See extensive references list from Oswald: Appendix III in CALM (1998)

SECONDARY SOURCE

CALM (1998). South coast terrestrial and marine reserve integration study. Final Report: MRIP/SC - 10/1997. Marine Conservation Branch, CALM, Fremantle. Last paragraph, section 1.4, pg 8. Figures 7 & 8 for distribution sites around Recherche. Also: Appendix III: Oswald, H. (1997) A review of Marine Mammals

APPENDICES I1 – I11 Invertebrates

APPENDIX I1: Shallow-water echinoderm species expected, according to distribution information, to occur within the study area (from Marsh, 1991).

Crinoidea Feather Stars

COMASTERIDAE

Cenolia trichoptera

Cenolia tasmaniae

Oxycomanthus muelleri

Comatulella brachiolata

APOROMETRIDAE

Aporometra occidentalis

PTILOMETRIDAE

Ptilometra macronema

ANTEDONIDAE

Antedon incommoda

Echinoidea (Sea urchins)

CIDARIDAE

Phyllacanthus irregularis

Goniocidaris tubaria

DIADEMATIDAE

Centrostephanus tenuispinus

TEMNOPLEURIDAE

Temnopleurus michaelseni

Amblypneustes pallidus

Holopneustes porosissimus

ECHINOMETRIDAE

Heliocidaris erythrogramma

FIBULARIIDAE

Fibularia oblonga

LAGANIDAE

Peronella lesueuri

SCHIZASTERIDAE

Echinocardium cordatum

Holothurioidea (Sea cucumbers)

CUCUMARIIDAE

Pentacta anceps

Ocnus calcareus

Neoamphicyclus lividus

Lipotrapeza vestiens

HOLOTHURIIDAE

Holothuria hartmeyeri

STICHOPODIDAE

Stichopus ludwigi

Stichopus mollis

APODIDAE

Leptosynapta dolabrifera

Asteroidea (Starfish)

LUIDIIDAE

Luidia australiae

ASTROPECTINIDAE

Astropecten preissi

Bollonaster pectinatus

GONIASTERIDAE

Tosia australis

Pentagonaster duebeni

OREASTERIDAE

Anthaster valvulatus

Nectria multispina

Nectria saoria

Nectria wilsoni

Nectria macrobrachia

ASTEROPSEIDAE

Petricia vernicina

OPHIDIASTERIDAE

Austrofromia polypora

ASTERINIDAE

Patiriella calcar

Patririella gunnii

Patririella brevispina

Paranepanthia grandis

Nepanthia troughtoni

ECHINASTERIDAE

Echinaster arcystatus

Echinaster glomeratus

Echinaster varicolor

Plectaster decanus

ASTERIIDAE

Allostichaster polyplax

Coscinasterias calamaria

Coscinasterias muricata

Uniophora dyscrita

Ophioroidea (Brittle stars)

OPHIOMYXIDAE

Ophiomyxa australis

GORGONOCEPHALIDAE

Conocladus australis

Astroboa ernae

EURYALIDAE

Euryale aspera

OPHIACANTHIDAE

Ophiacantha alternata

Ophiactis tricolor

Ophiactis resiliens

AMPHIURIDAE

Amphipholis squamata

Amphiura constricta

Amphiura multiremula

OPHIOTRICHIDAE

Ophiothrix caespitosa

Ophiothrix spongicola

Macrophiothrix michaelseni

OPHIOCOMIDAE

Clarkcoma canaliculata

Clarkcoma pulchra

OPHIONEREIDAE

Ophionereis schayeri

Ophionereis semoni

OPHIODERMATIDAE

Ophiarachnella ramsayi

Ophiopeza cylindrical

Ophiopsammus assimilis

Ophioconis opacum

APPENDIX I2: Shallow-water barnacle species that are expected, according to distribution information, to occur within the study area (after Edgar, 1997; & Jones, 1991).

SCALPELLIDAE

Smilium peronii

IBLIDAE

Ibla quadrivalvis

LEPADIDAE

Lepas anserifera

Lepas pectinata

Lepas australis

POECILASMATIDAE

Trilasmis kaempferi

TETRACLITIDAE

Epopella simplex

Tetraclitella purpurascens

ARCHAEOBALANIDAE

Eliminus modestus

Eliminus covertus

BALANIDAE

Balanus variegatus

Austromegabalanus nigrescens

APPENDIX I3: Marine decapod (crustacean) species that are expected, according to distribution information, to occur within the study area (after Edgar, 1997; & Morgan & Jones 1991).

PENAEIDAE (Prawns, shrimps)

Metapenaeopsis lindae

ALPHEIDAE (Pistol shrimps)

Alpheus edwardsii

Alpheus euphrosyne richardsoni

Alpheus novaezealandiae

Alpheus parasocialis

Alpheus strenuus cremnus

Alpheus villosus

Athanas granti

Synalpheus neomeris

Synalpheus streptodactylus

Synalpheus tumidomanus

PANDALIDAE (Pandalid shrimps)

Chlorotocella leptorhynchus

RHYNCHOCINETIDAE (Hinge-back shrimps)

Rhynchocinetes australis

HIPPOLYTIDAE (Hippolytid shrimps)

Hippolyte australiensis

PALAEMONIDAE (Palaemonid shrimps)

Macrobrachium intermedium

Palaemontes australis

NEPHROPIDAE

Metanephrops andamanicus

Metanephrops boschmai

AXIIDAE

Axius waroona

PALINURIDAE (Rock lobster)

Jasus edwardsii (Southern rock lobster)

SCYLLARIDAE (Shovel-nosed lobsters)

Ibacus alticrenatus (Wollongong bug)

Ibacus peronii (Balmain bug)

DIOGENIDAE (Diogenid hermit crabs)

Dardanus arrosor

Paguristes frontalis

Paguristes sulcatus

Paguristes tuberculatus

Cancellus typus

Trizopagurus strigimanus

UPOGEBIIDAE

Upogebia bowerbankii

Upogebia tractabilis

CALLIANASSIDAE (Ghost shrimps)

Callianassa aequimana

Callianassa ceramica

PAGURIDAE (Pagurid hermit crabs)

Pagurixus handrecki

Pagurus sinuatus

LOMISIDAE (Hairy stone crabs)

Lomis hirta

PORCELLANIDAE (Porcelain crabs)

Petrocheles australiensis

Pisidia dispar

Polyonyx transversus

Porcellana gravelei

GALATHEIDAE (Squat lobsters)

Galathea australiensis

Galathea magnifica

Phylladiorhynchus pusillus

HIPPIDAE

Hippa australis

DROMIIDAE (Sponge crabs)

Cryptodromia octodentata

Dromidia australis

Dromidiopsis excavata

Petalomera lamellata

Petalomera lateralis

LEUCOSIIDAE (Pebble crabs)

Ebalia tuberculosa

Ebalia intermedia

Ebalia dentifrons

Philyra laevis

Merocryptus lambriformis

Myra mammillaris

HYMENOSOMATIDAE

Amarinus laevis

Elamena abrolhensis

Halicarcinus ovatus

Halicarcinus rostratus

Trigonoplax longirostris

PINNOTHERIDAE (Pea crabs)

Pinnotheres hickmani

OCYPODIDAE (Stalk-eyed crabs)

Macrophtalmus punctulatus

GRAPSIDAE (Shore crabs)

Cyclograpsus audouinii

Leptograpsodes octodentatus

Leptograpsus variegatus (Swift-footed crab)

Plagusia chabrus (Red bait crab)

CORYSTIDAE

Gomeza bicornis

PORTUNIDAE (Swimming crabs)

Nectocarcinus integrifrons (Red swimmer crab)

Nectocarcinus tuberculosus (Red swimmer crab)

Ovalipes australiensis (Surf crab)

Portunus pelagicus (Blue manna crab)

Portunus sanguinolentus

Macropipus corrugatus

Megametope carinatus

Pseudocarcinus gigas (Giant crab)

XANTHIDAE (Stone crabs)

Actaea peronii occidentalis

MENIPPIDAE

Hypothalassia armata

Ozius truncatus

PILUMNIDAE (Hairy shore crabs)

Actumnus setifer

Pilumnus acer

Pilumnus etheridgei

Pilumnus tomentosus

Pilumnopeus serratifrons

GONEPLACIDAE (Goneplacid crabs)

Georgeoplax glabra

Litocheira bispinosa

MAJIDAE (Spider crabs)

Antilibinia lappacea

Achaeopsis ramusculus

Cyrtomaia maccullochi

Ephippias endeavouri

Huenia australis

Huenia halei

Leptomithrax gaimardii

Leptomithrax sternocostulatus

Naxia aurita

Naxia spinosa

Paramithrax barbicornis

Paratymolus latipes

Pippacirama tuberculosa

Platymaia wyvillethomsoni

Rochinia mosaica

Schizophrys rufescens

Platymaia wyvillethomsoni

Schizophrys rufescens

Rochinia mosaica

APPENDIX I4: Polyplacophora (chiton) species that are expected, according to distribution information, to occur within the study area (WA Museum, pers. comm.).

ISCHNOCHITONIDAE

Ischnochiton torri

Ischnochiton contractus

Ischnochiton lineolatus

Ischnochiton verconis

Stenochiton longicymba

Ischnochiton cariosus

LORICIDAE

Lorica paucipustulosa

ACANTHOCHITONIDAE

Acanthochitona bednalli

Acanthochitona sueurii

CHITONIDAE Chitons

Clavariona hirtosa

Chiton torrianus

Onithochiton occidentalis

CRYPTOPLACIDAE

Cyptoplax striata

APPENDIX I5: Prosobranch species that are expected, according to distribution information, to occur within the study area (WA Museum, pers. comm.).

PATELLIDAE (Patellid Limpets)

Patella chapmani

Patella laticostata

Patella peronii

ACMAEIDAE (Acmaeid Limpets)

Asteracmea axiaerata

Asteracmea crebristriata

Asteracmea roseoradiata

Asteracmea stowae

Asteracmea illibrata

Collisella onychitis

Collisella septiformis

Naccula compressa

Naccula punctata

Notoacmea conoidea

Notoacmea flammea

Patelloida alticostata

Patelloida insignis

Patelloida mufria

Patelloida nigrosulcata

Patelloida profunda

NERITIDAE (Nerites)

Nerita altramentosa

PHENACOLEPADIDAE (Sugar Limpets)

Phenacolepas calva

SCISSURELLIDAE (Little Slit Shells)

Incisura vincentiana

Sinezona atkinsoni

Sinezona beddomei

HALIOTIDAE (Abalone)

Haliotis conicopora

Haliotis cyclobates

Haliotis elegans

Haliotis laevigata

Haliotis roei

Haliotis scalaris

Haliotis semiplicata

FISSURELLIDAE (Keyhole & Slit Limpets)

Diodora lincolnensis

Amblychilepas javanicensis

Amblychilepas nigrita

Amblychilepas oblonga

Cosmetalepas concatenatus

Macroschisma bakiei

Macroschisma producta

Emarginula candida

Emarginula dilecta

Emarginula patula

Emarginula subtilitexta

Emarginula devota

Hemitoma subemarginata

Montfortula rugosa

Scutus antipodes

Tugali cicatricosa

TURBINIDAE (Turban Shells)

Argalista corallina

Austroliotia australis

Austroliotia densilineata

Austroliotia pulcherrima

Munditia mayana

Munditia subquadrata

Phasianella australis

Phasianella solida

Phasianella variegata

Phasianella ventricosa

Tricolia gabiniana

Tricolia rosea

Tricolia tomlini

Turbo jourdani

Turbo torquatus

Turbo undulatus

Turbo gruneri

Turbo pulcher

Australium aureum

Australium squamiferum

Australium tentorium

CAMPANILIDAE (Lighthouse Shells)

Campanile symbolicum

BATILLARIIDAE (Southern Mud Creepers)

Batillariella estuarina

Velacumantus australis

Zeacumantus diemenesis

CERITHIIDAE (Creepers)

Bittium granarium

Bittium icarus

DIALIDAE (Dialids)

Diala monile

DIASTOMATIDAE (Diastomas)

Diastoma melanioides

LITIOPIDAE (Litiopids)

Alba translucida

PLESIOTROCHIDAE

Plesiotrochus crinitus

Plesiotrochus monachus

TROCHIDAE (Top Shells)

Calliostoma comptum

Calliostoma hedleyi

Calliostoma legrandi

Calliostoma zietzi

Calliostoma armillatum

Calliostoma rubiginosum

Calliostoma spinulosum

Calliostoma incertum

Astele ciliare

Astele subcarinatum

Astele multigranum

Euchelus ampullus

Euchelus profundior

Granata imbricata

Herpetopoma annectans

Herpetopoma aspersa

Herpetopoma fenestrata

Herpetopoma pumilio

Herpetopoma scabriusculus

Botelloides bassianus

Spectamen marsus

Austrocochlea concamerata

Austrocochlea constricta

Austrocochlea crinita

Austrocochlea rudis

Cantharidella beachportensis

Cantharidus pulcherrimus

Fossarina legrandi

Nanuka flindersi

Notogibbula lehmanni

Notogibbula pulcherrimus

Jujubinus lepidus

Phasianotrochus apicinus

Phasianotrochus bellulus

Phasianotrochus eximius

Phasianotrochus irisodontes

Thalotia conica

Thalotia chlorostoma

Clanculus consobrinus

Clanculus denticulatus

Clanculus dunkeri

Clanculus euchelioides

Clanculus flagellatus

Clanculus leucomphalus

Clanculus limbatus

Clanculus maxillatus

Clanculus ochroleucus

Clanculus personatus

Clanculus philippi

Clanculus plebejus

Clanculus ringens

Clanculus undatus

Clanculus weedingi

Leiopyrga octona

Ethminolia vitiliginea

TURRITELLIDAE (Screw Shells)

Archimediella occidua

Colospira accisa

Colospira smithiana

Colospira bundilla

Colospira mediolevis

Colospira wollumbi

Gazameda iredalei

Gazameda tasmanica

LITTORINIDAE (Periwinkles)

Bembicium auratum

Bembicium vittatum

Laevilittorina johnstoni

HIPPONICIDAE (Horse hoof Limpets)

Antisabia foliacea

Hipponix australis

CALYPTRAEIDAE (Slipper Shells)

Cheilea occidua

Zeacrypta immersa

CAPULIDAE (Cap Limpets & Trichotropes)

Capulus violaceus

XENOPHORIDAE (Carrier Shells)

Xenophora flindersi

CYPRAEIDAE (Cowries)

Cypraea reevei

Cypraea fallax

Cypraea comptoni

Cypraea piperita

Cypraea pulicaria

Cypraea armeniaca

Cypraea friendii vercoi

Cypraea marginata

Cypraea rosselli

NATICIDAE (Sand & Moon Snails)

Natica sertata

Natica sagittata

Natica subcostata

Natica zonalis

Natica zonulata

Friginatica beddomei

Polinices conicus

Sinum zonale

Eunaticina albosutura

Eunaticina umbilicata

BURSIDAE (Frog Shells)

Bursa humilis

CASSIDAE (Helmet Shells)

Cassis fimbriata

Semicassis labiata

Semicassis paucirugis

Semicassis pyrum

Semicassis royanum

Semicassis adcocki

Semicassis semigranosum

Semicassis sinuosum

FICIDAE (Fig Shells)

Ficus eospila

Thalassocyon bonus

RANELLIDAE (Tritons & Trumpets)

Ranella australasia

Cabestana tabulata

Charonia lampas

Cymatium parthenopeum

Sassia subdistorta

TONNIDAE (Tun Shells)

Tonna variegata

CERITHIOPSIDAE (Cerithiopsids)

Ataxocerithium beasleyi

Ataxocerithium serotinum

Zaclys styliferus

Specula regina

Seila crocea

Euseila pileata

TRIPHORIDAE (Triphoras)

Isotriphora nivea

Eutriphora cana

Teretriphora spica

Latitriphora latilirata

Nototriphora vestita

Hedleytriphora elata

Hedleytriphora fasciata

Aclophoropsis festiva

Obesula mamillata

Monophorus angasi

Inella intercalaris

EPITONIIDAE (Wentletraps)

Epitonium helicornum

Epitonium jukesianum

Epitonium tacitum

Opalia granosa

Opalia australis

JANTHINIDAE (Violet Sea Snails)

Janthina exigua

Janthina janthina

Janthina pallida

MURICIDAE (Murex Shells & Relatives)

Maculotriton bicolor

Fusus bednalli

Pterynotus angasi

Coralliophila mira

Coralliophila wilsoni

Bedeva hanleyi

Bedeva paivae

Dermomurex angustus

Pterynotus triformis

Pterynotus undosus

Murexiella brazieri

Muricopsis diamanthina

Muricopsis planilirata

Lepsiella flindersi

Lepsiella reticulata

Lepsiella vinosa

Thais orbita

Prototyphis angasi

Tripterotyphis robustus

Typhis philippensis

TURBINELLIDAE (Vase & Pagoda Shells & Relatives)

Vasum flindersi

COLUMBELLIDAE (Dove Shells)

Anachis beachportensis

Anachis cominelliformis

Mitrella acuminata

Mitrella austrina

Mitrella semiconvexa

Pseudamycla dermestoidea

Pyrene bidentata

BUCCINIDAE (Buccinid Whelks)

Buccinulum bednalli

Cominella eburnea

Cominella lineolata

Cominella torri

Cominella tasmanica

Cominella lineolata

Kapala kengrahami

Fusinus australis

Fusinus tessellatus

Fusinus undulatus

Latirus pulleinei

Pleuroploca australasia

Cyllene sulcata

Nassarius ephamillus

Nassarius pauperatus

Nassarius burchardi

Nassarius pyrrhus

Fusus bednalli

Fusus reticulatus

VOLUTIDAE (Volutes)

Amoria exoptanda

Amoria grayi

Lyria mitraeformis

Cymbiola irvinae

Ericusa fulgetra

Ericusa papillosa

Livonia nodiplicata

Livonia roadnightae

Notopeplum translucidum

OLIVIDAE (Olives, Olivellas & Ancillids)

Alcospira edithae

Alcospira marginata

Alcospira oblonga

Amalda coccinata

Exiquaspira ornata

Gracilispira albanyensis

Gracilispira lineata

Gracilispira monolifera

Belloliva triticea

Oliva australis

HARPIDAE (Harp Shells)

Austroharpa loisae

MARGINELLIDAE

Alaginella borda

Dentimargo allporti

Dentimargo jaffa

Dentimargo kemblensis

Dentimargo lodderae

Dentimargo mayii

Gibberula diplostreptus

Gibberula subbulbosa

Mesoginella turbinata

Ovaginella tenisoni

Persicula albomaculata

Persicula deburghi

Volvarina occidua

MITRIDAE (Mitres)

Mitra carbonaria

Mitra glabra

Cancilla citharoidea

Cancilla strangei

VOLUTOMITRIDAE (Volutomitrids)

Peculator bacatus

Peculator porphyria

COSTELLARIIDAE (Costellate Mitres)

Austromitra analogica

Vexillum acromiale

Vexillum apicitinctum

Vexillum lincolnense

Vexillum corallinum

Vexillum marrowi

CANCELLARIIDAE (Nutmegs)

Cancellaria spirata

Cencellaria undulata

Inglisella fischeri

TURRIDAE (Turrids)

Crassispira harpularia

Daphnella botanica

CONIDAE (Cone Shells)

Conus anemone

Conus clarus

Conus gabelishi

Conus klemae

Conus rutilus

TERREBRIDAE (Pencil Shells)

Terebra albida

OVULIDAE (Egg & Spindle Cowries)

Phenacovolva philippinarum

TRIVIINAE (Bean Cowries)

Trivia merces

APPENDIX I6: Opisthobranch (sea-slug) species that are expected, according to distribution information, to occur within the study area (after Wells & Bryce, 1993).

CEPHALASPIDAE (Bubble Shells)

BULLIDAE

Bulla quoyii

AGLAJIDAE (Tailed Slugs)

Philinopsis troubridgensis

Anaspidea

AKERIDAE

Akera soluta

APLYSIIDAE (Sea hares)

Aplysia gigantea

Notaspidea (Side-gilled sea slugs)

TYLODINIDAE

Tylodina corticalis

UMBRACULIDAE

Umbraculum sinicum

PLUEROBRANCHIDAE

Pluerobranchus peroni

Berthellina citrina

Sarcoglossa (Sarcoglossans)

JULIIDAE (Bivalved gastropods)

Ascobulla fischeri

Volvatella ventricosa

OXYNOIDAE

Oxynoe viridis

ELYSIIDAE (Elysiids)

Elysia australis

Elysiella pusilla

Elysia filicauda

Pattyclaya brycei

Nudibranchia (Nudibranchs)

POLYCERIDAE (Polycerids)

Polycera hedgpethi

Thecacera pacifica

DORIDIDAE

Aphelodoris cf. lawsae

Sclerodoris spp.

Discodoris cf. crawfordi

Neodoris chrysoderma

Hoplodoris nodulosa

Doris cf. cameroni

Halgerda graphica

Rostanga calumus

CHROMODORIDIDAE

Hypselodoris infucata

Chromodoris epicuria

Chromodoris westraliensis

Chromodoris alternata

Mexichromis macropus

Ceratosoma amoena

Ceratosoma brevicaudatum

Cadlina nigrobranchiata

Glossodoris undaurum

Orodoris miamirana

Verconia verconis

DENDRODORIDIDAE

Dendrodoris aurea

Dendrodoris albopurpurea

Dendrodoris carneola

Dendrodoris nigra

Dendrodoris albobrunnea

Dendrodoris denisoni

AEOLIDIIDAE

Spurilla australis

Spurilla major

GLAUCIDAE

Austraeolis ornata

Phyllodesmium spp.

MADRELLIDAE

Madrella sanguinea

TRITONIIDAE (Tritoniids)

Marionia spp.

HANCOCKIIDAE

Hancockia burni

SCYLLAEIDAE

Scyllaea pelagica

TETHYIDAE

Melibe australis

APPENDIX I7: Bivalve species that are expected, according to distribution information, to occur within the study area (after WA Museum, pers. comm.; & Macpherson, 1954).

ARCIDAE (Arks)

Arca squamosa

NUCULANIDAE (Beaked Nut shells)

Nuculana crassa

GLYCYMERIDAE (Dog Cockles)

Glycymeris striatularis

Glycymeris radians

MALLEIDAE (Hammer Oysters)

Vulsella spongiarium

Malleus meridianus

PECTINIDAE (Scallops & Fan Shells)

Chlamys aktinos

Pecten fumatus

Chlamys asperrimus

SPONDYLIDAE (Thorny Oysters)

Spondylus tenellus

LIMIDAE (File Shells)

Lima lima

Limatula strangei

Austrolima nimbifera

MYTILIDAE (Mussels)

Brachidontes ustulatus

Brachidontes erosus

Brachidontes rostratus

Xenostrobus pulex

Xenostrobus inconstans

Mytilus edulis

Modiolus cottoni

Modiolus albicostus

Amygdalum beddomei

Musculus cummingianus

PTERIIDAE (Pearl Oysters)

Electroma georgiana

ANOMIIDAE (Jingle Shells, Windowpane Shells)

Anomia trigonopsis

OSTREIDAE (Oysters)

Saccostrea cucullata

Ostrea angasi

PINNIDAE (Pen Shells)

Pinna bicolor

CARDITIDAE (Cardita Clams)

Cardita crassicosta

Venericardia rosulenta

Venericardia sowerbyi

CRASSATELLIDAE (Crassatellas)

Eucrassatella donacina

CHAMIDAE

Chama ruderalis

LUCINIDAE

Anodontia perplexa

Divalucina cumingi

Codokia lacteola

ERYCINIDAE

Scintilla spp.

Lasaea australis

Ephippodonta lunata

Mylitta deshayesii

CARDIIDAE (Cockles)

Acrosterigma reeveanum

Fulvia tenuicostata

Cardium cygnorum

Cardium flavum

Cardium racketti

MESODESMATIDAE (Wedge Shells)

Paphies elongata

Paphies cuneata

Anapella cycladea

SOLENIDAE (Razor Shells)

Solen vaginoides

VENERIDAE (Venus shells)

Tawera lagopus

Eumarcia fumigata

Venerupis exotica

Venerupis galactites

Katelysia rhytiphora

Katelysia scalarina

Katelysia peronii

Bassina disjecta

CLEIDOTHAERIDAE

Cleidothaerus albidus

TELLINIDAE (Tellins)

Tellina deltoidalis

Tellina marginaritina

Tellina albinella

Pseudarcopagia piratica

DONACIDAE (Pipis)

Donax deltoides

PSAMMOBIIDAE (Sunset Shells)

Gari livida

Sanguinolaria biradiata

MACTRIDAE (Trough Shells)

Spisula trigonella

Mactra pura

Mactra rufescens

Lutraria rhynchaena

AMPHIDESMATIDAE

Amphidesma angustata

ALOIDIDAE

Aloidis iredalei

HIATELLIDAE

Hiatella australis

PHOLADIDAE (Angel wings)

Barnea australasiae

APPENDIX I8: Cephalopod species that are expected, according to distribution information, to occur within the study area (after Edgar, 1997; & WA Museum, pers. comm.).

LOLIGINIDAE (Squid)

Sepioteuthis australis

IDIOSEPIIDAE (Pygmy Squid)

Idiosepius notoides

SEPIOLIDAE (Dumpling Squids)

Sepioloidea lineolata

Euprymna tasmanica

SEPIIDAE (Cuttlefish)

Sepia apama

OCTOPODIDAE (Octopus)

Hapalochlaena maculosa

Octopus spp.

ARGONAUTIDAE (Argonauts)

Argonauta nodosa

APPENDIX I9: Cnidaria species that are expected, according to distribution information, to occur within the study area (after Edgar, 1997; & Veron & Marsh 1988).

Hydroida (Hydroids)

Gymnangium superbum

Stereotheca elongata

Halocordyle disticha

Solanderia fusca

Turritopsis nutricula

Velella velella

Siphonophora (Siphonophores)

Physalia physalis (Bluebottle)

Actiniaria (Anemones)

Actinia tenebrosa

Oulactis macmurrichi

Aulactinia veratra

Phylyctenactis

Actinothoe glandulosa

Zoanthidea (Zoanthids)

Zoanthus praelongus

Epizoanthus sabulosus

Scleractinia (Stony corals)

Plesiastrea versipora

Coscinaraea marshae

Coscinaraea mcneilli

Culicia tenella

Scolymia australis

Turbinaria mesenterina

Turbinaria reniforms

Turbinaria frondens

Symphyllia wilsoni

Favites spp.

Ceriantharia (Tube anemones)

Pachycerianthus spp. (Purple-tipped)

Antipatharia (Black corals)

Antipathes spp.

Alcyonacea (Soft corals)

Carijoa spp.

Mopsella zimmeri

Mopsella klunzingeri

Semaeostomeae (Jellyfish)

Cyanea capillata (Lion's mane jellyfish)

Pelagia noctiluca

Aurelia aurita

Cubomedusae (Box jellyfish)

Carybdea rastoni

APPENDIX I10: Other invertebrate species that are expected, according to distribution information, to occur within the study area (after Edgar, 1997).

PORIFERA

Leucosolenia spp.

Tethya ingallis

Chondrilla australiensis

Echinoclathria laminaefavosa

CTENOPHORA

Beroe cucumis

CHORDATA

Ascidiacea (Ascidians)

ASCIDIIDAE

Ascidia sydneiensis

Phallusia obesa

STYELIDAE

Cnemidocarpa radicosa

Polycarpa viridis

Botrylloides magnicoecum

Botrylloides leachi

Botrylloides perspicuum

PYURIDAE

Herdmania momus

Pyura australis

Pyura gibbosa

Pyura spinifera

Pyura stolonifera

CLAVELINIDAE

Clavelina ostrearum

Clavelina cylindrica

Clavelina pseudobaudinensis

Clavelina molluccensis

PYCNOCLAVELLIDAE

Pycnoclavella aurantia

Pycnoclavella diminuta

HOLOZOIDAE

Sigillina australis

Sycozoa cerebriformis

Sycozoa pulchra

Sycozoa pedunculata

POLYCITORIDAE

Polycitor giganteus

Cystodytes dellachiajei

POLYCLINIDAE

Aplidium clivosum

DIDEMNIDAE

Didemnum mosleyi

Didemnum spongioides

Thaliacea (Salps)

Pyrosoma atlanticum

Pegea confoederata

BRACHIOPODA

Magellania flavescens

PHORONIDA

Phoronis australis

BRYOZOA

Lichenopora echinata

Membranipora membranacea

Bugula dentata

Adeona grisea

Triphyllozoon moniliferum

APPENDIX I11: Planktonic foraminifera species identified along the southern shelf of Western Australia (from Li *et al.,* 1999).

(NB. * denotes temperate species dominant within study region)

*Globigerina bulloides**

*Globigerina falconensis**

Globigerinella cf. *calida*

Globigerinella siphonifera

*Globigerinita glutinata**

*Globigerinooides rubber**

Globigerinooides trilous

Globigerinooides conglobatus

*Globorotalia inflata**

Globorotalia menardii

Globorotalia truncatulinoides

Globorotalia crassaformis

Globorotalia hirsute

*Globorotalia Scitula**

*Globoturboratalita rubescens**

*Neogloboquadrina dutertrei**

Neogloboquadrina pachyderma

*Orbulina universa**

Pulleniatina obliquiloculata

*Tenuitella sp.**

*Turborotalita quinqueloba**

APPENDICES F1-F4 Fish species

APPENDIX F1 – Ayvazian & Hyndes (1995) Surf-zone fish study

Ayvazian, S.G. & Hyndes, G.A. (1995) Surf-zone fish assemblages in south –western Australia: do adjacent nearshore habitats and the warm Leeuwin Current influence the characteristics of the fish fauna? *Marine Biology* 122: 527-536.

Surf-zone fish assemblages in South Western Australia.

Surveyed from 1991-1992. Sites from Geraldton to Recherche Archipelago
Sampled using seine net: max depth 1.5m, area 274m^2, triplicate samples.
Greater species numbers (20-66) found on west coast site than south coast sites (11 to 16 species). Identifies a smaller contribution of transient species on the south coast (absence of tropical species). Attributed to 2 factors: adjacent nearshore habitats (eg limestone reefs and seagrass beds) producing more sheltered and temporally stable surf zones, and more microhabitats; and the reduced influence of the Leeuwin Current on the south coast. South coast assemblages had decreased proportion of benthic invertevores, and increased proportion of zooplantivores. (reflecting increased exposure of surf zones)

<u>Recherche Archipelago</u>
Site located here grouped by multivariate analysis with site near Albany(?). Species found:

Spratelloides robustus (high density >100/m2)
Aldrichetta forsteri (low density 1-9/m2)
Sillago bassensis
Lesuerina sp.
Mugil cephalus
Lepatherina presbyteroides
Platycephelus speculator
Cnidoglanis macrocephalus
Cristiceps australis
Ammotretis elongates
Haletta semifasciata
Arripis georgianus
Iso rhothophilus
Allanetta mugiloides

APPENDIX F2 – Hutchins (1994) Near-shore reef fish study

Hutchins, B. (1994) A Survey of the Nearshore Reef Fish Fauna of Western Australia's West and South Coasts. *Records of the Australian Museum* Supplement No. 46: 66pp.

Survey from 1976-1993 along west and south coasts of Western Australia. Used visual survey technique. Quantitative data not included in report. Examined distributions of tropical, sub tropical and warm temperate species. Found "offshore" versus "inshore" effect on diversity of tropical species, attributed to the Leeuwin Current.

Recherche Archipelago

172 species found: 91% warm temperate, 7% subtropical.
Survey sites: Sandy Hook, Long, Frederick, Gull, Rob, Mondrain Islands. Lucky Bay (mainland reefs). Israelite Bay reefs, Six Mile Island, Dempster Point, Point Malcom, No differences found between Lucky Bay (mainland) and offshore Islands. Israelite Bay lacked many of species of western area of Archipelago (reefs shallow <10m and lacking habitat diversity.

<u>10 most abundant species:</u>

Chromis klunzingeri
Trachinops noalungae
Pempheris klunzingeri
Austrolabrus maculates
Scorpis aequipinnis
Ophthalmolepis lnieolatus
Siphonognathus beddomei
Notolabrus parilus
Pseudolabrus biserialis
Parma victoriae

Subtropical species (relatively low numbers) maintained by recruitment from areas further west by Leeuwin Current.

APPENDIX F3: Elasmobranch species that are expected, according to distribution information, to occur within the study area (after Gommon *et al.*, 1994; Dr. Barry Hutchins, pers. comm.).

Common name - Scientific name

Port Jackson shark - *Heterodontus portusjacksoni*
Bronze whaler - Carcharhinus brachyurus
Pencil shark - Hypogaleus hygaensis
School shark - Galeorhinus galeus
Gummy shark - Mustelus antarcticus
Whiskery shark - Furgaleus macki
Smooth-headed hammerhead - Sphyrna zygaena
White pointer shark - Carcharodon carcharias
Grey nurse shark - Carcharias taurus
Black-spotted catshark - Aulohalaelurus labiosus
Draughtboard shark - Cephaloscyllium laticeps
Gulf wobbegong - Orectolobus ornatus
Cobbler carpet shark - Orectolobus tentaculatus
Varied catshark - Parascyllium variolatum
Striped stingaree - Trygonoptera ovalis
Spotted stingaree - Urolophus gigas
Smooth stingray - Dasyatis brevicaudata
Eagle ray - Myliobatis australis

APPENDIX F4: Osteicthyes (bony fish) species that are expected, according to distribution information, to occur within the study area (after Gommon *et al.*, 1994; Dr. Barry Hutchins, pers. comm.).

Common Name - Scientific name

Shortfinned worm eel - *Muraenichthys australis*
Longsnout boarfish -Pentaceropsis recurvirostris
Longfinned worm eel - Muraenichthys breviceps
Knifejaw - Oplegnathus woodwardi
Green moray - Gymnothorax prasinus
Western kelpfish - Chironemus georgianus
Umbrella conger - Gnathophis umbrellabia
Silver spot - Threpterius maculosus
Blue sprat - Spratelloides robustus
Western Australian seacarp - Aplodactylus westralis
Beaked salmon - Gonorynchus greyi
Western crested morwong - Cheilodactylus gibbosus
Cobbler - Cnidoglanis macrocephalus
Redlip morwong - Cheilodactylus rubrolabiatus
Pink-headed frogfish - Batrachomoeus rubricephalus
Dusky morwong - Dactylophora nigricans
Sponge anglerfish - Echinophryne reynoldsi
Jackass fish - Nemadactylus macropterus
Smooth anglerfish - Phyllophryne scortea
Queen snapper - Nemadactylus valenciennesi
Dwarf shore-eel - Alabes hoesei
Yelloweye mullet - Aldrichetta forsteri
Smoothsnout clingfish - Aspasmogaster liorhyncha
Flattail mullet - Liza argentea
Western clingfish - Aspasmogaster occidentalis
Sea mullet - Mugil cephalus
Tasmanian clingfish - Aspasmogaster tasmaniensis
Snook - Sphyraena novaehollandiae
Western cleaner clingfish - Cochleoceps bicolor
Blackhead puller - Chromis klunzingeri
Spadenose clingfish - Cochleoceps spatula
Golden scalyfin - Parma bicolor
Green clingfish - Cochleoceps viridis
McCullochs scalyfin - Parma mccullochi
Longsnout clingfish - Parvicrepis spp.
Blue groper - Achoerodus gouldii
Smallfin clingfish - Parvicrepis parvipinnis

Common name – Scientific name

Blackspotted wrasse - Austrolabrus maculatus
Finetooth beardie - Eeyorius hutchinsi
Foxfish - Bodianus frenchii
Largetooth beardie - Lotella rhacina
Western King wrasse - Coris auricularis
Bastard red cod - Pseudophycis breviuscula
Little rainbow wrasse - Dotalabrus alleni
Slender blindfish - Dermatopsis multiradiatus
Castlenau's wrasse - Dotalabrus aurantiacus
Southern pygmy blindfish - Ogilbia spp.
Snakeskin wrasse - Eupetrichthys angustipes
Silver fish - Lepthatherina presbyteroides
Brownfields wrasse - Halichoeres brownfieldi
Surf sardine - Iso rhothophilus
Orangespotted wrasse - Notolabrus parilus
Red snapper - Centroberyx gerrardi
Maori wrasse - Ophthalmolepis lineolata
Swallowtail - Centroberyx lineatus
Senator wrasse - Pictilabrus laticlavius
Little pineapplefish - Sorosichthys ananassa
False senator wrasse - Pictilabrus viridis
Roughy - Trachichthys australis
Redband wrasse - Pseudolabrus biserialis
Knight fish - Cleidopus gloriamaris
Blue rock whiting - Haletta semifasciata
Macleays crested pipefish - Histiogamphelus cristatus
Little rock whiting - Neoodax balteatus
Brushtail pipefish - Leptoichthys fistularius
Rainbow cale - Odax acroptilus
Smooth pipefish - Lissocampus caudalis
Herring cale - Odax cyanomelas
Javelin pipefish - Lissocampus runa
Tubemouth - Siphonognathus argyrophanes
Sawtooth pipefish - Maroubra perserrata
Pencil weed whiting - Siphonognathus beddomei
Leafy seadragon - Phycodurus eques
Sharpnose weed whiting - Siphonognathus caninus
Weedy seadragon - Phyllopteryx taeniolatus
Longray rock whiting - Siphonognathus radiatus
Spotted pipefish - Stigmatophora argus
Longtail weed whiting - Siphonognathus tanyourus
Port Phillip pipefish - Vanacampus margaritifer

Wavy grubfish - Parapercis haackei
Goblinfish - Glyptauchen panduratus
Tommyfish - Limnichthys fasciatus
Little scorpionfish - Maxillicosta scabriceps
Flathead sandfish - Lesueurina platycephala
Gurnard perch - Neosebastes pandus
Common stargazer - Kathetostoma laeve
Western red scorpion cod - Scorpaena sumptuosa
Jumping blenny - Lepidoblennius marmoratus
Minor gunard - Lepidotrigla spinosa
Notched threefin - Norfolkia incisa
Spiny gunard - Lepidotrigla papilio
Southern crested weedfish - Cristiceps australis
Latchet - Pterygotrigla polyommata
Kuiters weedfish - Heteroclinus spp.
Whitenose pigfish - Perryena leucometopon
Whitleys weedfish - Heteroclinus spp.
Warty prowfish - Aetapcus maculatus
Fewray weedfish - Heteroclinus spp.
Longhead flathead - Leviprora inops
Hutchins weedfish - Heteroclinus spp.
Yank flathead - Platycephalus speculator
Recherche weedfish - Heteroclinus spp.
Tassel-snouted flathead - Thysanophrys cirronasus
Adelaide weedfish - Heteroclinus adelaide
Western wirrah - Acanthistius serratus
Kelp weedfish - Heteroclinus eckloniae
Barber perch - Caesioperca rasor
Large-eye weedfish - Heteroclinus macrophthalmus
Breaksea cod - Epinephelides armatus
Earspot snakeblenny - Ophiclinops hutchinsi
Harlequin fish - Othos dentex
Variegated snakeblenny - Ophiclinops varius
Red seaperch - Hypoplectrodes cardinalis
Adelaide snakeblenny - Ophiclinus antarcticus
Black-banded seaperch - Hypoplectrodes nigroruber
Blackback snakeblenny - Ophiclinus gracilis
Bluedevil - Paraplesiops meleagris
Variable snakeblenny - Ophiclinus ningulus
Western bluedevil - Paraplesiops sinclairi
Whiteblotch snakeblenny - Ophiclinus pectoralis
Blue-lined hulafish - Trachinops brauni
Painted stinkfish - Eocallionymus papilio
Yellow-headed prettyfin - Trachinops noarlungae

Flathead goby - Callogobius depressus
West Australian jewfish - Glaucosoma hebraicum
Twospot goby - Eviota bimaculata
Sea trumpeter - Pelsartia humeralis
Longfin goby - Favonigobius lateralis
Woods siphon fish - Siphamia cephalotes
Bluespot goby - Pseudogobius olorum
Scarlet cardinalfish - Vincentia badia
Barracouta - Leionura atun
Smooth cardinalfish - Vincentia macrocauda
Dusky marine gudgeon - Thalasseleotris adela
Orange cardinalfish - Vincentia punctata
Frigate mackeral - Auxis thazard
Longfin pike - Dinolestes lewini
Skipjack tuna - Katsuwonus pelamis
King George whiting - Sillaginodes punctata
Blue mackerel - Scomber australasicus
Silver whiting - Sillago bassensis
Elongate flounder - Ammotretis elongatus
Tailor - Pomatomus saltatrix
Southern sole - Aseraggodes haackeanus
Skipjack trevally - Pseudocaranx dentex
Harrowed sole - Zebrias cancellatus
Sand trevally - Pseudocaranx wrighti
Spinytail leatherjacket - Acanthaluteres brownii
Samson fish - Seriola hippos
Bridled leatherjacket - Acanthaluteres spilomelanurus
Pomfret - Brama brama
Toothbrush leatherjacket - Acanthaluteres vittiger
Australian herring - Arripis georgiana
Southern pygmy leatherjacket - Brachaluteres jacksonianus
Western Australian salmon - Arripis truttacea
Black reef leatherjacket - Eubalichthys bucephalus
Silverbelly - Parequula melbournensis
Bluetail leatherjacket - Eubalichthys cyanoura
Red snapper - Chrysophrys auratus
Mosaic leatherjacket - Eubalichthys mosaicus
Mulloway - Argyrosomus hololepidotus
Yellowstriped leatherjacket - Meuschenia flavolineata
Red mullet - Upeneichthys vlamingii
Sixspine leatherjacket - Meuschenia freycineti
Woodwards pomfret - Schuettea woodwardi
Bluelined leatherjacket - Meuschenia galii
Slender bullseye - Parapriacanthus elongatus

Horseshoe leatherjacket - Meuschenia hippocrepis
Orangelined bullseye - Pempheris spp.
Stars-and-stripes leatherjacket - Meuschenia venusta
Rough bullseye - Pempheris klunzingeri
Chinaman leatherjacket - Nelusetta ayraudi
Common bullseye - Pempheris multiradiata
Rough leatherjacket - Scobinichthys granulatus
Buffalo bream - Kyphosus sydneyanus
White-barred boxfish - Anoplocapros lenticularis
Rock blackfish - Girella tephraeops
Shaws cowfish - Aracana aurita
Zebrafish - Girella zebra
Ornate cowfish - Aracana ornata
Footballer sweep - Neatypus obliquus
Rigid boxfish - Caprichthys gymnura
Sea sweep - Scorpis aequipinnis
Spiny boxfish - Capropygia unistriata
Banded sweep - Scorpis georgiana
Prickly pufferfish - Contusus brevicaudus
Moonlighter - Tilodon sexfasciatum
Ringed pufferfish - Omegophora armilla
Western butterflyfish - Chaetodon assarius
Small-spined porcupinefish - Allomycterus pilatus
Squareback butterflyfish - Chelmonops curiosus
Globefish - Diodon nicthemerus
Old wife Enoplosus armatus
Short sunfish - Mola ramsayi
Short boarfish - *Parazanclistius hutchinsi*
Oblong sunfish - Triurus laevis

APPENDIX AQ1 - Potential land-based aquaculture ventures

Areas identified by Fisheries WA as potentially suitable for land-based aquaculture and the relevant selection criteria:

Potential land-based sites:

- Bandy creek;
- Areas of industrial zoned land in Esperance;
- Rural land east of Esperance and east of Duke of Orleans Bay;
- Crown and freehold land at Wharton, Duke of Orleans Bay, perhaps in conjunction with infrastructure and backup facilities at Condingup.

Selection criteria:

- Water quality;
- Topography, soil type and surrounding land use;
- Legal issues;
- Access to site;
- Capital cost;
- Conservation sensitivity;
- Utilities, &
- Proximity to market.

APPENDIX AQ2 - Potential sea-based aquaculture ventures

Areas identified by Fisheries WA as potentially suitable for sea-based aquaculture and the relevant selection criteria.

Potential sea-cage sites:

- York Group
- Mart Group
- Remark Group
- Tory Island
- Mondrain Island

Mondrain, York and Tory Islands were considered unsuitable for large-scale sea cage aquaculture. Many sites throughout the Archipelago were considered suitable for the location of barrels and bottom cages for abalone growout.

Selection criteria:

- water depth;
- waves;
- currents and flushing;
- salinity;
- water temperatures;
- contamination;
- nutrient status of water;
- algal blooms;
- wind;
- sea floor topography;
- access;
- land-based infrastructure, and;
- visual impact.

APPENDIX AQ3 Candidate species for potential aquaculture activities

PRIMARY *

Common Name, Species Name, Culture method

Abalone	*Haliotis spp.*	Land-based; Sea cage
Marron	*Cherax tenuimanus*	Ponds; Land-based
Yabby	*Cherax albidus*	Land-based dams
Pink snapper	*Pagrus auratus*	Sea cage; Land-based tanks/ponds
Silver perch	*Bidyanus bidyanus*	Pond/land-based
Southern bluefin tuna	*Thunnus maccoyii*	Sea cage

SECONDARY **

Common Name, Species name, Culture method

Oysters	*Saccostrea spp.*	
Oysters	*Ostrea spp.*	Racks, long lines
Dhufish	*Glaucosoma hebraicum*	Tank/cage
Marine aquarium spp.		Various Tanks
Yellowtail kingfish	*Seriola spp.*	Sea cage; Land-based
Flounder	*Pseudorhombus spp.*	Sea cage; Land-based tanks/ponds
Trout (Rainbow)	*Onchorynchus mykiss*	
Trout (Brown)	*Salmo trutta*	Sea cage; Land-based ponds/tanks
Black bream	*Acanthopagrus butcheri*	Sea cage; Land-based tanks/ponds

* The primary species are those considered to have good prospects for aquaculture development.
** The secondary species are those considered to have aquaculture potential in the future, subject to the development of suitable culture technologies.

Candidate species for potential aquaculture activities were based on the consideration of the following criteria:

- market potential;
- known culturing techniques;
- level of technology required to culture new species;
- any existing (or planned) sources for fry or fingerlings from within the region;
- suitability with the culture systems predicted for the Recherche, and;
- suitability of the species to the area.

APPENDIX A1: Species of algae identified by Dr John Huisman (Murdoch University) and Dr Gary Kendrick (University of Western Australia)(source Capes survey, 1999)

Acanthophora dendroides
Acrocarpa sp
Amphiroa gracilis
Apjohnia laetevirens
Aserococcus bullosus
Callophycus harveyanus
Callophycus sp
Carpopeltis elata
Carpopeltis spongeaplexus
Caulerpa flexilis
Caulerpa hedleyi
Caulerpa obscura
Ceramium sp
Champia sp
Claviclonium ovatum
Codium sp
Ceoloclonium sp
Craspedocarpus sp
Curdiea obesa
Cutleria sp nov
Cystoseira grevillei
Cystophora monilifera
Cystophora pectinata
Cystophora retorta
Cystophora sp2
Dasyphylla priessi
Dictyopteris australis
Dictyopteris plageogramma
Dictyota naevosa
Dilophus fastigiatus
Dictyosphaeria sericea
Dictymenia tridens
Echinothamnion mallardiae
Ecklonia radiata

Erythroclonium sonderi
Euptilocladia spongeosa
Galaxaura marginata
Glossophora nigricans
Griffithsia sp
Halimeda cuneata
Haloplegma preissii
Acrocarpa robusta
Adelophyton sp
Amphiroa anceps
Antithamnion hanowioides
Areschougia sp
Botryocladia sonderi
Callophycus oppositifolius
Callophyllus sp
Carpopeltis sp
Caulerpa brownii
Caulerpa germinata
Caulerpa longifolia
Caulerpa simpliciuscula
Champia compressa
Cladisiphon sp
Caulocystis uvifera
Codium spongiosum
Colpomenia sp
Crustose corallines
Cutleria multifida
Cystoseira trinodis
Cystophora harveyi
Cystophora moniliformis
Cystophora racemosa
Cystophora sp1
Dasyclonium incisum
Dasya sp
Dictyopteris muelleri
Delisea pulchra
Dictyota sp
Dilophus sp
Dictymenia sonderi
Echinothamnion hystrix
Ecklonia radiata with multiple holdfasts
Epiphloea bullosa
Erythroclonium minuta
Euptilocladia articulata
Gloiosaccion brownii
Gracilaria preissiana
Griffithsia teges
Halopteris sp

Haraldiophyllum erosum
Heterosiphonia crassipes
Hemineura frondosa
Hyroclathrus clathratus
Hypnea ramentacea
Jania pulchella
Kuetzingia canaliculata
Laurencia cruciata
Laurencia filiformis
Laurencia sp2
Lobophora variegata
Metamastophora flabellata
Metagoniolithon stelliferum
Myriodesma serelata
Pachydictyon sp
Peyssonnelia novae-hollandiae
Peyssonnelia sp
Platyhalia angustifolia
Plocamium cartilagineum
Plocamium preissianum
Psilothalia sp
Pterocladia lucida
Pterocladia sp
Rhodymenia sonderi
Sargassum sub-genus sargassum
Sargassum sub-genus arthrophycus
Sargassum linearifolium
Sargassum podocanthum
Sargassum spinuligerum
Sargassum varians
Scinaia sp
Sporochnus sp
Tylotus obtusatus
Zonaria sp

Haloplegma sp2
Hennedya crispa
Heterosiphonia muelleri
Haliptilon roseum
Hypoglossum sp
Hypnea sp
Jania sp
Laurencia brongniartii
Laurencia elata
Laurencia sp1
Lobospira bicuspidata
Melobesia sp
Metagoniolithon radiatum
Myriodesma quercifolia
Myriodesma sp
Padina sp
Peyssonnelia rubra
Phaecelocarpus sp
Platyhalia quercifolia
Plocamium mertensii
Polysiphonia sp
Pterocladia capillacea
Pterocladia rectangularis
Rhipiliopsis robusta
Rhodopeltis australis
Sarconema filiforme

Sargassum fallax
Sargassum pinnate species
Sargassum sp
Sargassum tristichum
Scaberia agardhii
Scytothalia dorycarpa
Spyridia dasyoides
Thuretia quersifolia
Vidalia spiralis
Zonaria turneriana

APPENDIX SG1: Seagrass species found within the Recherche Archipelago region (after Campey *et al.,* (2000); D.A. Lord & UWA (2001); Kirkman (1997); Walker, (1991); Waycott, (1998 & 2000)).

Amphibolis antarctica
Amphibolis griffithii
Halophila decipiens
Halophila ovalis
Halophila ovata
Heterozostera tasmanica
Posidonia angustifolia
Posidonia australis
Posidonia coriacea
Posidonia denhartogii
Posidonia kirkmani
Posidonia ostenfeldii
Posidonia sinuosa
Syringodium isoetifolium
Thalassodendron pachyrhizum

APPENDIX V1: CSIRO biological, hydrological and core sample data from the Recherche Archipelago region on a series of voyages from 1951 to 1981.

DATA SOURCE	DATA TYPE	DATA FORMAT	CRUISE NAME	YEAR	MORE INFO	COMMENT LOCATION
National Geophysical Data Centre	core		Eltanin ELT35	1968 - 1972	see files: ngdc*	south of Recherche
National Geophysical Data Centre	core		Robert Conrad RC08	1964	see files: ngdc*	south of Recherche
National Geophysical Data Centre	core		Vema VM16 - VM33	1960 - 1976	see files: ngdc*	south of Recherche
National Geophysical Data Centre	core		Horizon LSDH	1962	see files: ngdc*	south of Recherche
National Geophysical Data Centre	core		Argo MSN	1961	see files: ngdc*	south of Recherche
National Geophysical Data Centre	core		Discovery	1951	see files: ngdc*	south of Recherche
CSIRO Marine, Data Centre	biological	not digitised	Diamantina DM1/60	1960	see printouts from MARlin	exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM1/60	1960	see printouts from MARlin	exact location uncertain
CSIRO Marine, Data Centre	biological	not digital	Diamantina DM1/61	1961		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM1/61	1961		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM7/69	1969		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM2/71	1971		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM3/71	1971		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM2/72	1972		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM4/73	1973		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Diamantina DM1/75	1975		exact location uncertain
CSIRO Marine, Data Centre	hydrology	ascii text	Courageous 031	1978	see printouts from MARlin	Great Australian Bight
CSIRO Marine, Data Centre	hydrology	ascii text	Courageous 032	1978		Great Australian Bight
CSIRO Marine, Data Centre	hydrology	ascii text	Courageous 033	1978		Great Australian Bight
CSIRO Marine, Data Centre	biological	oracle db	Courageous 046	1979		Great Australian Bight
CSIRO Marine, Data Centre	hydrology	ascii text	Courageous 046	1979		Great Australian Bight
CSIRO Marine, Data Centre	biological	oracle db	Courageous 047	1979		Great Australian Bight
CSIRO Marine, Data Centre	hydrology	ascii text	Courageous	1979		Great Australian

			047			Bight
CSIRO Marine, Data Centre	biological	not digitised	Courageous 048	1979		exact location uncertain
CSIRO Marine, Data Centre	biological	not digitised	Soela SO1/80	1980	see printouts from MARlin and cruise summary	marginal to Recherche
CSIRO Marine, Data Centre	hydrology	ascii text	Soela SO1/80	1980		marginal to Recherche
CSIRO Marine, Data Centre	biological		Soela SO3/80	1980		outside Recherche area
CSIRO Marine, Data Centre	hydrology		Soela SO3/80	1980		outside Recherche area
CSIRO Marine, Data Centre	hydrology		Soela SO6/80	1980		outside Recherche area
CSIRO Marine, Data Centre	biological	not digitised	Soela SO6/80	1980	see printouts from MARlin and cruise summary	includes Cape Le Grand
CSIRO Marine, Data Centre	biological	not digitised	Soela SO3/81	1981	see printouts from MARlin and cruise summary	includes Salisbury and Cooper Islands
CSIRO Marine, Data Centre	biological		Soela SO5/81	1981		Great Australian Bight
For Cruise reports contact: CSIRO Marine Library: library@hba.marine.csiro.au						
World Data Centre for Marine Geology and Geophysics: www.ngdc.noaa.gov/mgg/curator/curator.html						