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Characterising the fish habitats of the Recherche Archipelago

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Professor Chari Pattiaratchi, Mike Cappo, Dr Jane Fromont,
Professor Mark Shortis, Simon Grove, Andy Bickers,
Katrina Baxter, Dr Nisse Goldberg, Mat Kletczkowski, James Butler**



Fisheries Research and Development Corporation Report
Project No. 2001/060

2001/060 - Characterising the fish habitats of the Recherche Archipelago.

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Characterising the fish habitats of the Recherche Archipelago – FRDC 2001/060
Final Report.

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2001/060 Characterising the fish habitats of the Recherche Archipelago

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OBJECTIVES

1. To identify, classify and map the distribution of, different benthic habitats in the Recherche Archipelago and link their distributions to bottom type and exposure to swells and currents.
2. To provide detailed ecological information to ensure the responsible management of aquaculture fisheries in the region.
3. To increase community awareness of fish habitats through community involvement in the development of baseline studies and ongoing monitoring programs.

OUTCOMES ACHIEVED TO DATE

1. The design of a hierarchical classification scheme of benthic habitats in the Recherche Archipelago. Modelling of the effectiveness of that classification scheme
2. An extensive habitat map of the Western Recherche Archipelago at both broad and functional habitat classifications and less detailed habitat maps of duke of Orleans Bay and Cape Arid to Middle Island.
3. An oceanographic model of the influence of ocean swells on the Western Recherche Archipelago. This model includes an assessment of swell driven shear at the benthos.

4. A broad scale fisheries-independent non-destructive survey of the demersal fish of the Recherche from Esperance Bay to Cape Arid. The survey was designed to capture habitat differences (habitats defined from the mapping exercise) in fish assemblages
5. A broad scale (within the Western Archipelago) survey of the infauna found in a range of soft bottom habitats (as defined from the mapping exercise) including coarse sands, rhodoliths and sparsely vegetated sands.
6. Fine scale diversity surveys of reef communities on islands in the archipelago from Figure of Eight to Middle Island. These surveys included assessments of macroalgae, sessile invertebrates and reef fish with depth and exposure to ocean swells. Thus they integrate information from both habitat mapping and physical oceanographic modelling.
7. Finally, the project is a joint Esperance community (through the Recherche Advisory Group - RAG), research scientist and resource management project. The commitment of RAG has allowed the researchers to efficiently transfer scientific information to the general public of Esperance and the South Coast of Western Australia and keep the research focussed on management outcomes.

NON TECHNICAL SUMMARY

Extensive broad scale surveys were made in the relatively clear waters of the Recherche Archipelago. Where there was adequate light penetration sidescan sonar was used allowing almost photographic quality imagery of seafloor texture to be obtained from swaths of up to 400 m wide. Drop and towed video systems were used to obtain more detailed information about the physical and biological nature of the seabed in areas identified from the acoustic mapping. A total of 1054 km² of habitats were mapped within the Recherche Archipelago. A total of 813 km² was mapped in the Esperance region, 142 km² in the Cape Arid region and 99 km² in the Duke of Orleans region.

Habitats were described as combinations of the identifiable physical and biological characteristics (Appendix 2- Habitat Mapping. Biological factors were classified in terms of observation of cover of dominant community and by the presence of a

number of biological assemblages. Physical factors were classified in terms of depth, substrate and relief. These descriptions resulted in a hierarchical classification where broad habitats were further classified into functional habitat types). Of the 5 broad types, sand represented 28.3 % of the area mapped, low profile reef 33.4 %, seagrass 20.1 %, rhodoliths 13.7 % and high profile reefs 4.6 %. These percentages varied across the regions. At a more detailed level of the classification hierarchy, 27 functional habitat types were mapped, reflecting the variation with each of the 5 broad types.

Fish assemblages within these habitats were sampled using baited stereo-video and single camera systems (Main report – Fish Distributions). In this study there were statistically distinctive fish assemblages between Seagrass, Reef, Rhodolith and Sand habitats although Sand and Rhodoliths were very similar. These habitat differences were also apparent in the numbers of species and individuals, with samples from Reef habitats having the greatest mean numbers of species and individuals followed by Seagrass and then Sand and Rhodolith habitats. There were no differences between macroalgal canopy forming species but there was a significant difference in fish assemblages within seagrass and reef habitats with different densities of flora. Changes in the density of flora within specific habitats and relief appear to exert the greatest influence on the structure of reef fish assemblages. Analysis of the sub-habitats based on floral density and relief of reef habitats show that while in some cases distinctive fish assemblages occupy distinctive habitats, normally there is a continuum or transition of species between different combinations of floral density and relief with distinctive fish assemblages at the ends of the continuum.

The benthic macrofaunal communities varied according to the substrate habitat (Appendix 4). Drop camera video surveys indicated a wide variety of soft substrate environments ranging from fine sands to gravel. The character and diversity of soft substrate macrofaunal assemblages were related to the structural complexity of the bottom. Habitat structural complexity was provided by sediment characters, or by biogenic structures, including macroalgae, sessile invertebrates and rhodoliths. Sediments ranged from sand to sandy gravel, with very little mud content. Organic content was significantly correlated to rhodolith content, but not to mud content. Those sediments with a high degree of sorting were associated with low diversity and abundance. The highest diversities and species richness were found in the rhodolith beds. Sediment grain size and sorting are determined by characteristics of near-bed

flow regimes (e.g. shear stress (see Appendix 3 for Oceanographic data) that can directly affect the benthos through food and larval supply and particulate flux.

In general, most macroalgae were relatively rare, with >60 % of total species richness from sampled islands contributed <5 g 0.25 m⁻² (Appendix 5). Macroalgal assemblages showed strong links with exposure, depth, and island location. Differences in assemblages were consistent across islands groups, primarily due to a difference in dominant taxa with exposure. Where *Ecklonia* and *Scytothalia* are clearly dominant at exposed reefs, diversity is reduced compared to assemblages dominated by *Sargassum* and *Cystophora*. The broad distribution of most macroalgae infer that variation in species present among quadrats with niche overlap are common features, making species-specific generalities difficult. How species with low abundances maintain their populations in the relatively exposed archipelago is intriguing and remains to be investigated.

Of the six benthic invertebrate phyla examined in this study, the sponges and the bryozoans were the dominant taxa (Appendix 6). Sponges represented approximately 72% of all fauna collected, bryozoans 10%, ascidians and sea-stars 7%, and hydroids and corals both 2%. A total of 644 individual Demosponges, from 11 out of 15 orders, were collected from 250 quadrats at 10 sites along the Recherche Archipelago.

At the island level all invertebrate fauna showed a similar pattern with variation occurring among islands. This pattern suggests that there was no broad uniform Archipelago wide pattern rather some islands possessed their own suite of fauna. There were no patterns in distribution of sessile benthic invertebrates with exposure in multivariate and univariate analyses. The exception was sponge orders for those islands sampled across two substrata (Figure of 8 and Mondrain Islands) in which there was greater variation between each exposure than within.

As well as characterising the fish distributions within the Recherche Archipelago, this report presents the outcomes of 6 separate components of FRDC 2001/060, and integrates their outcomes. The individual components are as follows:

- Review of existing biological, oceanographic and geomorphological data;
- Benthic habitat mapping in the Recherche Archipelago
- Oceanography of the Recherche Archipelago;
- Sub-tidal soft substrate communities;

- Macroalgal diversity of the Recherche Archipelago;
- Sponge and ascidian communities of the Recherche Archipelago

KEYWORDS: habitat, classification, mapping, oceanography, benthic, algae, infauna, sessile invertebrate

ACKNOWLEDGEMENTS

The FRDC survey 2001/060 “Fish Habitats of the Recherche Archipelego” has as one of its main objectives:

- *To increase community awareness of fish habitats through community involvement in the development of baseline studies and ongoing monitoring programs.*

The Esperance community has been involved throughout the project as individuals, businesses, community groups, and through the Recherche Advisory Group. The research group has prepared a web page, posters, articles in the popular magazines Landscape and Ecos, regular interviews on ABC Radio, TV and local newspaper articles, educational materials and regularly presented seminars and presentations in Esperance and Perth. The research group has been also involved in helping to run a Tuna Cage Fishing Public Workshop. All of this community activity has been continuously documented as outcomes of our communications strategy at each milestone to FRDC.

As an extension of the FRDC (2001/060) biophysical survey a new program, to develop social and economic profiles of the Recherche Archipelago began in November 2004. Project Manager Neil Lazarow, from the Coastal Cooperative Research Centre (Coastal CRC) is consulting with the Esperance community to map current uses of the Archipelago by locals and visitors alike. This will include a profile of commercial and recreational fishing, tourist operations, commercial shipping and any other ways the Recherche Archipelago is currently used. Information obtained from this project will complement the environmental data obtained by the present three year FRDC project in which RAG has also been a partner. Funding for the project has come from the Department of Conservation and Land Management, RAG, Shire of Esperance and the Coastal CRC.

This project has benefited enormously from the generosity of the Esperance community, whose help, advice and friendship have been instrumental in the development and implementation of the project. Our appreciation and thanks is

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- Members of the Recherche Advisory Group (RAG)
- All the volunteers from UWA and Esperance who assisted in the field
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1.0 GENERAL INTRODUCTION

1.1 Background

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 8.1 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 8.1 V1).

Bathymetry

Within the Recherche region the continental 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 8.1 - 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 an 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 8.1 - 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 8.1 - 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 8.1 - 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 8.1 - 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 compiled 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 8.1 - I4), Prosobranchs (Appendix 8.1 - I5), Sea slugs (Appendix 8.1 - I6), Bivalves (Appendix 8.1 - I7) and Cephalopods (Appendix 8.1 - 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 *Charyophyllia 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 8.1 - 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 8.1 - 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 8.1 - 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 endemism. In adjacent regions, such as the Fitzgerald biosphere, numerous macroalgal species have been found to be present (Appendix 8.1 - 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 8.1 - 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 8.1 - 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 8.1 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 8.1 - F3 and 8.1 - 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, bight 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 (*Monacanthidae spp.*), hapuku (*Polyprion oxygeneios*), blue-eyed trevalla (*Hyperoglyphe antarctica*) and grey-banded rock cod (*Epinephelus septemfasciatus*), 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 (*Neoplatycephalus 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 8.1 - Aq1 & 8.1 - Aq2. Candidate species suitable for potential aquaculture ventures were also identified (Appendix 8.1 - 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 Recherche Archipelago region having inadequate, or no bathymetric information.

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