MARINE SPECIES OF CONSERVATION INTEREST ON NORTHERN KANGAROO ISLAND - RESULTS OF 2013 FIELD WORK

Part 2: Marine Fishes

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Dedication

This report is dedicated to marine scientist Mr Danny Brock, formerly of the Coast and Marine Program, Kangaroo Island Natural Resources Management Board. Danny's involvement in numerous coastal and marine projects during the past decade has assisted marine research, monitoring and conservation initiatives on Kangaroo Island.

Acknowledgments

Thanks to the Australian Government's Caring for our Country program, and to staff of DEWNR's Natural Resources - Kangaroo Island (Kangaroo Island NRM Board) and Natural Resources - Adelaide and Mt Lofty Ranges (AMLR NRM Board), for providing resources which enabled marine surveys to be undertaken on northern Kangaroo Island in 2013, and some of the results to be written up in this report. Particular thanks go to Mr Danny Brock and Ms Alicia McArdle for their role in project coordination and management. Thanks also to Mr Kym Lashmar for correspondence about RLS data.

Thank you to Mr Tony Geyer of Kangaroo Island, for his expertise in boat handling and caring for divers in the water. SACReD divers and associates are most grateful for Tony's time and valuable assistance during the 2013 field work.

Thanks to the following persons (in alphabetical order), collectively from DEWNR, KI NRM and Kangaroo Island Friends of the Sea who collected Reef Life Survey (RLS) data during the March and April 2013 field trips: Danny Brock, James Brook, Dr Simon Bryars, Grant Flanagan, Heiri Klein, Kym Lashmar, Alicia McArdle, and Sarah-Lena Reinhold. Renate Velzeboer from SACReD also collected RLS data during the March field trip.

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SUMMARY

In 2013, with assistance from the Australian Government's Caring for our Country program, and DEWNR's Natural Resources - Kangaroo Island (KI NRM Board), field work was undertaken by South Australian Conservation Research Divers (SACReD), to learn more about the distribution and habitats of rarely recorded, endemic, and other marine species of conservation concern at sites along the northern coast of Kangaroo Island. The field surveys were undertaken during a companion project on reef monitoring, by Kangaroo Island Friend's of the Sea (FotS), an NRM-supported community group which uses a standard marine monitoring method developed by the international Reef Life Survey (RLS) program (Reef Life Survey 2013; Stuart-Smith et al. 2013).

Part of the field work aimed to learn more about the distribution of rarely recorded fishes (including endemic fishes) and other fishes of conservation interest in the KI coastal area, so that populations of such species may be better conserved, and protected from threatening processes. Between March 2013 and April 2013, five SACReD divers collectively spent more than 36 hours diving, at 8 subtidal reef sites and 1 jetty within the KI NRM region, and took more than 500 photographs of reef fishes of conservation interest. The field work relates to a project we began in 2007, through which we have aimed to (i) develop a suitable non-destructive technique to search for various uncommon reef fishes (mostly benthic, and many cryptic) throughout South Australia; and (ii) record and photograph such fishes, in order to learn more about their distribution, habitats, and habits. Our target list comprises more than 50 species from 14 families, for which little information is available on full distribution within South Australia.

Data on some of the reef fishes of conservation interest were also collected by FotS divers and KI NRM staff and associates, during RLS reef monitoring transects at 10 sites along the north coast of KI.

Results have indicated that both targetted searches in the benthos by SACReD divers and RLS transects by KI-FOTS provide a better indication of reef fish species composition on Kangaroo island reefs than either method alone. The data gathered during the Kangaroo Island field work in 2013 are providing an ongoing, cumulative body of useful knowledge - for example, presence of particular species of conservation interest at various locations within the range; and habitat requirements and usage. Over time, such information is useful for formal assessments of conservation status of reef fishes of conservation interest at international (e.g. IUCN Red List), national (*Environment Protection and Biodiversity Conservation Act 1999*) and State (rare and threatened species schedules) scales, and can also assist in the development of management plans to address coastal impacts which may affect populations of such fishes. The data will also assist conservation planning for nearshore reef fish habitats on Kangaroo Island, including management of activities in the zones Kangaroo Island's newly legislated marine parks.

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1. Introduction

There are more than a dozen families of uncommonly recorded reef fishes of conservation interest in South Australia (Baker 2008; Baker et al 2008a, 2008b, 2009a, 2009b; Baker 2012) and some of these families include species which may be endemic within South Australia, and to date, have not been found outside of this State. For a number of currently known species in such groups, a detailed, comprehensive search for information, using several thousand sources over a ten year period, has shown that there are few existing records in South Australia, and very little is known of the distribution within SA, the habitat requirements, biology, behaviour and ecology (Baker 2012). Many of these species could potentially be at risk of localised population decline, due to a combination of factors such as

- limited geographic range (or edge of range presence in South Australia);
- narrow depth range;
- strong habitat association (which makes them susceptible to various threatening processes);
- live-bearing mode of reproduction (and thus limited dispersal), and
- naturally low abundance.

Another group of reef fishes are more commonly recorded, but have vulnerable population characteristics such as long life span, slow growth, large body size, delayed reproduction, sedentary habits and strong habitat association, slow movement, and popularity as fishing targets in some areas. Examples of these fishes include Southern Blue Devil, Harlequin Fish and various wrasse species, such as Western Blue Groper (Baker 2007, 2011, 2012; Bryars et al. 2011, 2012).

Some of the results presented here are part of a long-term project which aims to help improve knowledge of the distribution and habitats of reef fishes of conservation interest, thereby assisting decision-making about their conservation needs. A number of these reef fishes, particularly those of limited known geographic range, very narrow depth range, or existence in areas of ongoing threatening processes, might require more formal means of protection or impact management.

2. Conservation of Marine Fishes

Threatened species legislation is designed to prevent the further decline (and eventual extinction) of rare or endangered species, by preventing over-exploitation, and/or by protecting critical habitats. Marine threatened species listings in most States of Australia mainly include marine mammals and birds. Most States in Australia also have specific legislation under which marine fishes can be listed as threatened. However, in South Australia, marine fishes can be listed as threatened under existing fisheries legislation. Under the *Fisheries Management Act 2007*, Western Blue Groper *Achoerodus gouldii* is formally protected from fishing in Gulf St Vincent, Spencer Gulf, Investigator Strait, and Backstairs Passage, although frequency of anecdotal reports of captures within the no-fishing zone indicates that this legislative protection may not be enforced. All members of the Syngnathidae family (all seadragons, seahorses, pipefish, pipehorses) are also protected under the *Fisheries Management Act 2007*, and although the entire group is listed under State legislation, the Syngnathidae contains both rare and very abundant species.

In South Australia, marine fishes can also be legally protected in Aquatic Reserves (declared under the *Fisheries Act 1982*, now known as the *Fisheries Management Act 2007*) and in sanctuary zones of marine parks. Acts in South Australia which can benefit marine fish conservation indirectly include the *Coast Protection Act 1972*, the *Environment Protection (Marine) Policy 1994*, and the *Marine Parks Act 2007*. The *National Parks and Wildlife Act* in South Australia also has schedules for threatened species, but marine fishes and marine invertebrates are not included on those schedules.

At a national scale, a small number of marine bony fishes which occur in SA are listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) as threatened species, and these include Australian Grayling *Prototroctes maraena*, Orange Roughy *Hoplostethus atlanticus*; and Southern Bluefin Tuna *Thunnus maccoyii*. Under the provisions of the *EPBC Act,* conservation advice and recovery plans are developed for listed threatened species, and for listed ecological communities. Key threatening processes are also recognised, and threat abatement plans are developed to try to reduce the impacts of threatening processes.

At a global scale, IUCN's Red List of Threatened Species (IUCN 2001) is widely recognised as a means of assessing and categorising the conservation status of species, including marine fishes. The IUCN Red List no longer includes a category of "rare", but some species which may qualify as rare due to very small or restricted population (with evidence of fluctuation or decline), or very restricted geographic range, may instead be listed as *critically endangered*, *endangered* or *vulnerable*, depending on specific numeric criteria. For example, according to IUCN criteria, if a species is known from 5 or fewer locations, it may satisfy criteria for listing as *vulnerable*. Many other criteria, including those relating to extent of occurrence and area of occupancy are also used to assess status (see IUCN 1994, 2001). In threatened species legislation, the category of "rare" may relate to either: a reduced area of occupancy and/or extent of occurrence, a sharp decline in abundance, small population sizes, and/or restricted extent of occurrence or area of occupancy, with specific criteria for each of those categories. Although not included as an IUCN category, a species may be considered "rare" according to geographic range (often narrow, in the case of rare species); narrow habitat range / specificity, and small local population size. Species which satisfy all three criteria are intrinsically vulnerable to decline. Many species are naturally "rare", due to low population numbers (local abundances) at any one location across the range, but may not be considered threatened due to their broad geographical distribution and relatively high overall abundance (Jones and Kaly 1995). The concept of "rare" differs according to the application, and can loosely refer to species that are not commonly recorded in surveys, but may not be truly rare in the biogeographic sense. Others are more common in deeper waters, and are thus unlikely to be recorded in shallow subtidal surveys, even if present in the area.

Ideally, species assessments using the criteria listed in **Table 1** below should only be undertaken using all known data on the species' range, and number of records. Also, even if a species qualifies for listing using any of the categories or criteria listed in **Table 1**, the accuracy of the assessment is time-specific, and may be revised in future as better information becomes available regarding distribution and relative abundance. This is particularly true for many of the small, uncommonly recorded and endemic fishes, which are known from very few, opportunistically collected records, and the true distribution may be much broader (and abundance may be considerably higher), than is considered from the currently available records. For some of the apparently uncommon marine fishes in South Australia, targetted searches of records have not been undertaken, and for some species, the few examples known were incidental captures, being recorded during general dredging or trawl surveys, or surveys undertaken for some other purpose.

One of the aims of South Australian Conservation Research Divers is to document the locations, habitats and potentially threatening processes for marine species in South Australia, not only for species which are rarely seen, or exist over apparently narrow geographical ranges, but also more commonly occurring fishes and invertebrates whose populations may be at risk of depletion from threatening processes. It is our hope, through education towards improved management of impacts, that such species will not need to be included on threatened species schedules in future.

Table 1: Summary of the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2011).

Summary of the five criteria (A-E) used to evaluate if a species belongs in a category of threat (Critically Endangered, Endangered or Vulnerable).

Use any of the criteria A-E	Critically Endangered	Endangered	Vulnerable
A. Population reduction	Declines measured over the longer of 10 years or 3 generations		
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%
A1. Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible **AND** understood **AND** have ceased, based on and specifying any of the following: **(a)** direct observation **(b)** an index of abundance appropriate to the taxon **(c)** a decline in AOO, EOO and/or habitat quality **(d)** actual or potential levels of exploitation **(e)** effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.			
A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under A1			
A3. Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on (b) to (e) under A1.			
A4. An observed, estimated, inferred, projected or suspected population reduction (up to a maximum of 100 years) where the time period must include both the past and the future, and where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under A1.			
B. Geographic range in the form of either B1 (extent or occurrence) AND/OR B2 (area or occupancy)			
B1. Extent of occurrence	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following:			
(a) Severely fragmented, **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			
C. Small population size and decline			
Number of mature individuals	< 250	< 2,500	< 10,000
AND either C1 or C2:			
C1. An estimated continuing decline of at least: (up to a max. of 100 years in future)	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations
C2. A continuing decline **AND** (a) and/or (b):			
(a) (i) # mature individuals in each subpopulation:	< 50	< 250	< 1,000
(a) (ii) or % individuals in one sub-population at least	90%	95%	100%
(b) extreme fluctuations in the number of mature individuals			
D. Very small or restricted population			
Either: Number of mature individuals	≤ 50	≤ 250	**D1.** ≤ 1,000
			AND/OR
VU D2. Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.			**D2.** typically: AOO <20 km² or number of locations ≤ 5
E. Quantitative Analysis			
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations (100 years max)	≥ 20% in 20 years or 5 generations (100 years max)	≥ 10% in 100 years

3. Characteristics that Determine Vulnerability of Marine Fishes

There are numerous recognised life history and population characteristics that can render marine species vulnerable to decline, and eventually to extinction. **Table 2** below lists many of these characteristics.

Table 2: Characteristics that render marine species vulnerable to population decline and eventual extinction (adapted from Jones and Kaly 1995; Roberts and Hawkins 1999 and Ponder et al. 2002, with additions).

Characteristic	Features shared by potentially vulnerable species
Population turnover	1. Long life span 2. Slow growth rate 3. Low natural mortality 4. Low production biomass
Reproduction	5. Low reproductive effort / output 6. Low fecundity 7. Highly variable reproductive output / prolonged periods of recruitment failure 8. Semelparous reproduction (i.e. reproduces once in a lifetime) 9. Large size at maturity and/or old age at maturity (i.e. long time to maturity) 10. Large difference in size between sexes 11. Sex change (particularly protandry: male stage followed by a female stage) 12. Forms spawning aggregations at predictable locations 13. Live bearing /or direct development of young from benthic eggs (compared with planktonic eggs) 14. Strong Allee effects in reproduction (i.e. when a reduction in population density has significant impacts on the ability of the organism to reproduce) 15. Brooding of young 16. Poorly dispersed benthic larvae (compared with widely dispersed planktonic larvae)
Capacity for Recovery	17. Short distance dispersal / limited dispersal ability 18. Poor competitive ability 19. Poor colonizing ability 20. Low adult mobility 21. Irregular recruitment by larval settlement and/or low level of larval settlement 22. Strong Allee effects at settlement (i.e. population fitness and growth reduced at low population densities).
Range & Distribution (related to Rarity)	23. Horizontal distribution restricted to nearshore area (compared with offshore) 24. Narrow depth range (= narrow vertical distribution) 25. Small geographic range / restricted distribution 26. High patchiness / fragmentation of population within range (i.e. composed of few small, highly fragmented populations) 27. High habitat specificity / specialisation 28. High vulnerability to habitat destruction by people
Trophic Level	29. High trophic level
Other Ecological Factors	30. Close association with threatened habitat, or threatened taxa (as commensals, food source etc.)
Commercial & Social Value	32. Value as food (promotes exploitation by commercial &/or recreational fishing / collecting) 33. Value in trade for collections / aquaria etc (promotes exploitation).
Other	34: High visibility (due to large size, bright colour / patterning, and/or presence in intertidal habitats) 35: Adults live in aggregations, or form feeding aggregations 36: Subject to large scale mass mortality events 37: Bycatch in commercial fisheries (e.g. trawls, gill-nets, long-line hooks, traps) 38: Coastal structures (dams, weirs etc) interfere with migration patterns

Some of these characteristics are found in various groups of invertebrates (discussed in **Part 1** of this report), but others are specific to fishes. In addition to the characteristics detailed above in **Table 2**, other factors which can increase the vulnerability of marine fishes to decline (particularly from over-exploitation) include a readily accessible habitat (e.g. if collected for food or trade); high visibility (i.e. large size and/or bright colours and patterns), and high value (especially highly valued food species, and some aquarium fishes) (Ponder et al. 2002).

Many marine species may qualify as potentially vulnerable due to restricted range (particularly apparent endemism within South Australia), apparent rarity (known from very few records), and small populations. Other characteristics, especially those associated with reproduction (mode, fecundity, frequency of spawning, total reproductive output, and survivorship of larvae and juveniles) are not known for many of these marine species. Inferences can be made from similar taxa - e.g. within the same family, or the same genus - that exhibit vulnerable population characteristics.

4. Methods

Part of the aim of the Kangaroo Island surveys in 2013 was a regional extension of previous work undertaken in coastal waters in other parts of South Australia, by South Australian Conservation Research Divers (SACReD) to learn more about the distribution and habitats of rarely recorded and potentially threatened marine fishes, based on sighting records validated by photographs. Divers who attended the field trip were asked to take photographs of any benthic and cryptic fish species (which would include any that may be rarely recorded) that were observed during searches for rare and endemic invertebrate species (see **Part 1: Marine Invertebrates**, the companion report to this one). Divers were also asked to photograph any examples of Harlequin Fish, Western Blue Groper and Southern Blue Devil which were recorded. Between March 2013 and April 2013, a total of 5 SACReD divers collectively spent more than 36 hours diving, at 8 subtidal reef sites and 1 jetty within the KI NRM region. A dive log is available from the first author of this report. Sites at which divers searched are shown in **Map 1**. Sites are listed in **Table 3** below, in order of date, with corresponding depth of dive.

Table 3: Locations within the KI NRM region, where SACReD divers and associates searched for endemic, uncommonly recorded and potentially threatened marine fishes during field trips in March and April 2013.

Site name	Date	Latitude	Longitude	Depth
Green Cliffs Dive 1	25/03/13	-35.60117	137.2715	4m
Green Cliffs Dive 2	25/03/13	-35.60117	137.2715	5m
Stokes Bay West	25/03/2013	-35.62192	137.1879	6m
Ironstone Hill Reef	25/04/2013	-35.71954	137.97026	5m
Eastern Cove ("Lavers Reef")	25/04/2013	-35.76838	137.86508	6-7m
Ballast Head	26/04/13	-35.75762	137.80498	5-7m
American River - Muston	26/04/13	-35.80959	137.74546	3-6m
American River - Pelican Lagoon	27/04/13	-35.81736	137.77011	3.5-6m
Kingscote Jetty	26/04/13	-35.65575	137.64640	3-4m
Western River Cove	23/03/13	-35.67367	136.9700	5-6m

At each site, most of the divers searched for between 60 and 90 minutes each per dive, covering as much suitable habitat as possible during that time, at a given depth. Visual searches for demersal, benthic and cryptic fishes were made on the bottom, around rocks, in crevices, under ledges, around jetty piles and other structures (when at jetty sites), and amongst macroalgae. Photographs were taken when potential species of interest were found. Dive conditions were not ideal for benthic searches and macro-photography (**Figures 1A, 1B, 1C**). At some sites, such as Ballast Head and Lavers' Reef, visibility was poor, and at other sites (e.g. American River), there was also a significant current running.

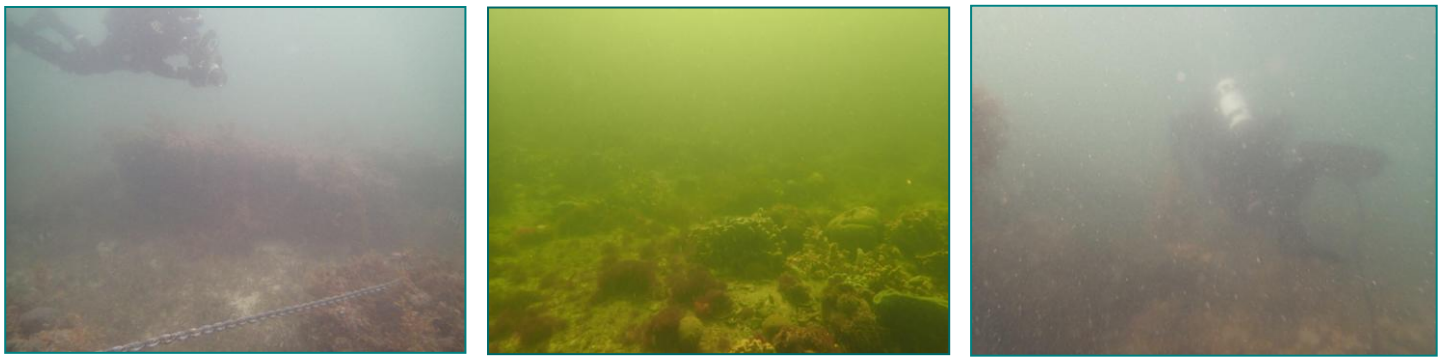


Figure 1: Examples of low visibility in the water at three dive sites during the April 2013 survey: Lavers Reef (A); American River (B); Ballast Head (C). Photos (c) H. Crawford.

Over all sites dived in March and April 2013, SACReD divers took approximately 500 photographs of fishes, including multiple shots of species of interest. Photos were sorted, labelled and catalogued, and identified to species level. Specialists in fish taxonomy of each phylum were contacted during the course of this project, and photos were sent for identification, confirmation of initial identification, or correction where needed.

Map 1: Reef sites along northern and north-eastern Kangaroo Island, in which SACReD members searched for and/or recorded marine invertebrate species of interest, during March and April 2013. Map (c) Google Earth.

Table 4: Locations within the KI NRM region, where Friends of the Sea divers and KI NRM staff and associates, undertook dives to collect Reef Life Survey data in March and April 2013. Grey-shaded rows indicate sites at which a SACReD diver also searched for uncommonly recorded and endemic marine invertebrates during RLS transect dives. *Direction* refers to the direction travelled by the diver along transect line from the starting point (East, West, North, North-East, South-East, or South-West).

Site name	Date	Latitude	Longitude	Depth (m)	Direction	Visibility (m)
Green Cliffs	25/03/2013	-35.60117	137.2715	5.5	W	8
Green Cliffs	25/03/2013	-35.60117	137.2715	4.1	E	8
Green Cliffs	25/03/2013	-35.60117	137.2715	7.2	E	8
Green Cliffs	25/03/2013	-35.60117	137.2715	4	W	8
Green Cliffs	25/03/2013	-35.60117	137.2715	5	W	8
Green Cliffs	25/03/2013	-35.60117	137.2715	6	W	7
Muston	22/03/2013	-35.80959	137.7455	4	N	6
Muston	22/03/2013	-35.80959	137.7455	6	E	8
Muston	22/03/2013	-35.80959	137.7455	4.1	E	6
Muston	22/03/2013	-35.80959	137.7455	4.2	N	6
Muston	14/03/2013	-35.80959	137.7455	7	N	7.5
Western River Cove	23/03/2013	-35.67367	136.9700	6.2	E	5
Western River Cove	23/03/2013	-35.67367	136.9700	5.8	E	5
Western River Cove	23/03/2013	-35.67367	136.9700	6	E	4
Stokes Bay West	25/03/2013	-35.62192	137.1879	5.5	E	6
Stokes Bay West	25/03/2013	-35.62192	137.1879	5.3	E	6
Stokes Bay West	25/03/2013	-35.62192	137.1879	7.5	E	5
Stokes Bay West	25/03/2013	-35.62192	137.1879	6	W	6
Lavers Reef	22/03/2013	-35.76838	137.8651	4.7	NE	6
Lavers Reef	22/03/2013	-35.76838	137.8651	5.3	E	8
Lavers Reef	22/03/2013	-35.76838	137.8651	5.4	W	8
Lavers Reef	22/03/2013	-35.76838	137.8651	7	E	7
Snellings Beach	17/04/2013	-35.66249	137.0744	6.3	W	16
Snellings Beach	17/04/2013	-35.66249	137.0744	5.2	W	16
Snellings Beach	17/04/2013	-35.66249	137.0744	5.9	E	16
Snellings Beach	17/04/2013	-35.66249	137.0744	5.4	E	16
White Point	23/04/2013	-35.56586	137.5915	6.7	NE	5
White Point	23/04/2013	-35.56586	137.5915	4.8	NE	5
White Point	23/04/2013	-35.56586	137.5915	4.2	NE	5
Kangaroo Head	24/04/2013	-35.71720	137.9047	6	W	5
Kangaroo Head	24/04/2013	-35.71720	137.9047	5.5	W	5
Kangaroo Head	24/04/2013	-35.71720	137.9047	5	E	5
Frenchman's	24/04/2013	-35.72204	137.7108	5.9	SE	8
Frenchman's	24/04/2013	-35.72204	137.7108	6	SE	8
Frenchman's	05/03/2013	-35.72204	137.7108	4.8	SW	8
Frenchman's	05/03/2013	-35.72204	137.7108	4.5	SW	8
Ironstone Hill Reef	25/04/2013	-35.71954	137.9703	5.4	E	5
Ironstone Hill Reef	25/04/2013	-35.71954	137.9703	5.1	E	5
Ironstone Hill Reef	25/04/2013	-35.71954	137.9703	5.5	W	5
Ironstone Hill Reef	25/04/2013	-35.71954	137.9703	5.2	W	5

The searches by SACReD divers for rare species and potentially threatened species were complementary to core reef monitoring work being undertaken during March and April 2013 by the NRM-supported volunteer group Kangaroo Island Friends of the Sea (KI FOTS), who are engaged in reef monitoring using the internationally-recognised Reef Life Survey method, developed at the University of Tasmania. RLS monitoring on KI has been undertaken since 2009, with support from the Reef Life Survey Foundation. In total, 30 reef sites have been surveyed along the north coast of KI, 12 of which have been selected for long-term reef health monitoring (KI NRM web site, 2013).

The results of the KI FOTS Reef Life Survey monitoring in March and April 2013 have been summarised in a separate report, and will not be reiterated here. However, the survey method will be briefly described, as results from both search methods (standard transects, and non-standard visual searches) are influenced by the chosen method. Using the RLS method, fishes are surveyed in two 5 m wide bands, parallel with a 50 m transect line. Two divers swim simultaneously along the 50m line, one either side of the line, and each one records fishes observed in a 5m swath on the side of the line along which he or she is swimming. The divers also swim above the tape measure and take photographs of the sea bottom at regular intervals, and record seaweed species and density. These data are all collated and analysed by the Reef Life Survey Foundation in order to gain an understanding of the condition of reefs over space and time. Sites at which RLs divers searched for fishes and invertebrates along transects during the March and April surveys are listed above in **Table 4**.

5. Results (i) Species Accounts

The following sections discuss marine fishes of conservation interest which were recorded during the Kangaroo Island survey in March and April 2013. Some of these species have a narrow geographic range, and others are found over a narrow depth range, or in specialised habitats. Several are potentially threatened due to their vulnerable population characteristics (e.g. slow growth, late age at maturity, large size, long life span, limited dispersal of young), factors which have contributed to their over-exploitation in commercial and/or recreational fisheries.

Plesiopidae (Blue Devil)

The family Plesiopidae contains the Blue Devils, Longfins, Prettyfins and Hulafish, distributed throughout the Indo-West Pacific. In Australia, there are 7 genera and at 19 named species (CSIRO 2013). One of the few species in the family which occur in South Australia is the Southern Blue Devil *Paraplesiops meleagris*, also known from Western Australia, and less commonly in Victoria. In SA, this species is known mainly from the eastern Great Australian Bight, the gulfs region, and Kangaroo Island. It has been recorded across northern north-eastern and north-western Kangaroo Island. Southern Blue Devil is a territorial species that occurs in the vicinity of inshore and deeper rocky reefs; often in caves and crevices, and under ledges / projections, usually between 5m and 45m (Scott et al. 1974, Hutchins and Swainston 1986; Kuiter 1996; Edgar 2000; Hutchins 2005; Reef Watch database records; Bryars 2011).

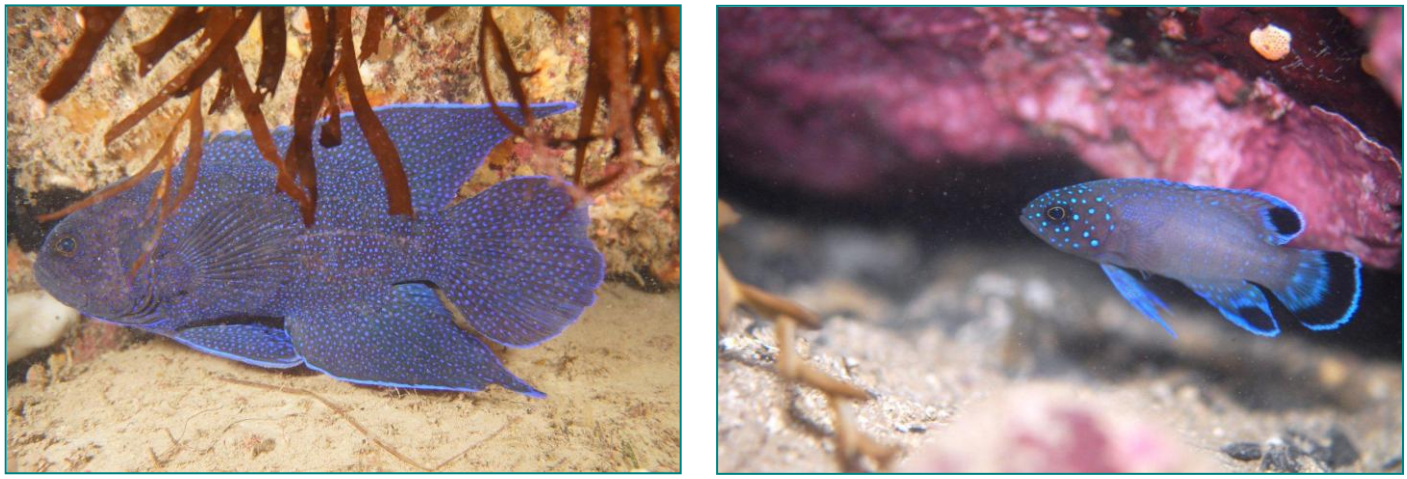


Figure 2: Southern Blue Devilfish. Adult recorded at Ironstone Hill (A) and juvenile recorded at Kangaroo Head (B). Photos (c) J. Manna (A); D. Muirhead, SACReD (B).

This species grows to about 36cm (Hutchins and Swainston 2001), and is long-lived. During ageing work in which growth rings were counted in otoliths from 48 specimens, the calculated ages ranged from 7 to 59 years (Saunders et al. 2010).

Southern Blue Devil is not commonly seen, possibly due to its habit of hiding in caves and crevices, and under rock ledges. The species is solitary in nature, and rarely are several seen together, unless one is a juvenile (Reef Watch 2002; recreational diving reports from WA; Baker et al. 2009b). Individuals defend the home territory, and rarely venture beyond the home ledge, crevice or small cave (Parks Victoria 2003; Bryars 2011). Females in Plesiopidae lay benthic eggs which have anchor-shaped hooks (Mooi 1990). Eggs are guarded by the male on the surface of the "home" crevice or cave (Parks Victoria 2003; S. Bryars, pers. comm. 2011).

During the 2013 field work, 16 Southern Blue Devil individuals were recorded from 4 locations along northern and north-eastern Kangaroo Island, including a juvenile at Kangaroo Head (**Figure 2B**). Most of the sightings (14) during the March and April field work were recorded on Reef Life Survey transects (**Table 5**), and the other two sightings - one juvenile and one adult - were recorded during rare and cryptic fish searches. At Kangaroo Head, an average of 3 Blue Devils per transect was recorded, higher than at the three other locations where this species was recorded during the 2013 surveys. This species also occurs at other locations along north-eastern and northern Kangaroo Island, such as Stokes Bay (data by S. Shepherd).

Table 5: Details of Southern Blue Devil sightings, recorded during Reef Life Survey transects in March and April 2013.

Site name	Dates	Depth/s or Depth Range (m)	No. Transects in which Blue Devils were Sighted	No. Blue Devil Sightings	Average No. Blue Devils Sighted Per Transect
Frenchman's	05/03/13; 24/04/13	4.5 - 6	2	2	1
Ironstone Hill	15/04/13; 24/04/13	5.2 - 5.5	4	5	1.25
Laver's Reef	22/03/13	5.4	1	1	1
Kangaroo Head	24/04/13	5	2	6	3

The sightings above from 2 survey periods, give no indication of population estimates at the locations listed in **Table 5**, because there is a low probability of sighting cryptic, cave-dwelling species such as Southern Blue Devil. Repeated surveys, using methods to identify individual fish (i.e. facial markings) are required to generate population estimates. During RLs transects in March and April 2013, this species was recorded only at the eastern sites.

The size of the Southern Blue Devil population across the long but relatively narrow reef strip of northern and north-eastern Kangaroo Island has not been determined. However, research work on the Fleurieu Peninsula has indicated the importance of small sections of reef as a permanent home base for members of this long-lived species (Bryars 2011; Bryars et al. 2012). At one reef off the metropolitan coast, the home range was estimated to be very small (approximately 33 linear metres of reef), and even at one recognised location of comparatively high density, only 30 - 40 fish may reside (Bryars et al. 2012).

Results from the aforementioned metropolitan and Fleurieu Peninsula survey work on southern Blue Devil (Bryars 2011, Bryars et al. 2012) have highlighted the potential vulnerability of this strongly site-associated species, members of which may live their entire lives in one small reef area. Photographs taken of several individual Blue Devils over 4 to 5 year periods indicate residency of each fish in the same reef area over those periods (Bryars 2011).

Southern Blue Devil is vulnerable to population decline because it is a slow-moving, strongly site-associated, inquisitive and territorial species found on nearshore reefs, over a relatively narrow depth range (Baker 2007, 2011; Bryars 2011; Bryars et al. 2012). It occurs in low population densities (usually solitary or in pairs), and may not reproduce every year (Bryars 2011). These characteristics, coupled with the strongly site-attached reproduction, make populations vulnerable to impacts, such as localised over-fishing, collecting for aquaria, or habitat impacts.

Southern Blue Devil is part of the bycatch in some fisheries, such as commercial long-lines in South Australia (e.g. Fowler et al. 2009). This species is fished recreationally in Western Australia and South Australia. The South Australian (SARDI) data from a National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) reported that 809 Southern Blue Devils were caught and kept by recreational fishers in South Australia during the survey time period from May 2000 to April 2001. Blue Devil has also been collected in WA for the aquarium trade.

Serranidae (Harlequin Fish)

The Serranidae is a large family of reef fishes, including groupers, rockcods, orange perches, butterfly perches, wirrah, harlequin fish and other related species. Many of the groupers and rockcods are found in tropical and sub-tropical waters, and are highly valued as eating, sports and aquarium fish, and for dive tourism. Many serranid species are at or near the upper end of their food chains; therefore, there are usually few residents at any one locality. Individual reefs may only have one or two very large resident groupers, and because these large individuals may be several decades old, it takes a long time for over-fished groupers to be replaced. Commercial, sports and subsistence fisheries are often biased (by means of hook size and fishing techniques) towards the capture of larger adults, which are usually the males (Heemstra and Randall 1993; Sadovy 1997; Pogonoski et al. 2002). Some species may aggregate to spawn at well defined times and locations, which further increases their vulnerability. A number of species are hermaphrodites, but Harlequin Fish (see below) in southern Australia is not known to change sex with age or size (S. Bryars, pers. comm. 2010). Groupers differ from many commercially fished species because they are exploited in a wide variety of ways and at different phases of their life-history (Pogonoski et al. 2002). In summary, many members of Serranidae appear to be particularly vulnerable to anything other than low levels of fishing pressure due to their slow growth rate, low reproductive rate, long life span, large size at sexual maturation, sex change (in some tropical and sub-tropical species), and low natural mortality.

One of the best known Serranidae fishes in South Australia is the Harlequin Fish *Othos dentex*. As indicated by fishing capture records (Henry and Lyle 2003), this species is apparently more common in WA (Hutchins and Swainston 1986; Gomon et al. 1994), and it is reported to have previously occurred as far east as Victoria during the 19th century (Gomon 2002). In South Australia, the species is known from numerous reef areas around the State, ranging from the Great Australian Bight through to Encounter Bay and surrounds (Baker 2011, 2012, and references therein). On Kangaroo Island, locations where *O. dentex* has been recorded include Dudley Peninsula (e.g. Penneshaw, Hog Bay area, Kangaroo Head, Snapper Point, Ironstone Hill and other locations), and sites along the north coasts, such as Cape Forbin (**Figure 3**), Western River Cove and Cape Dutton (D. Muirhead, pers. comm., Edgar et al. 2006; Brock and Kinloch 2007; Shepherd et al. 2009; Baker et al. 2010; Bryars et al. 2012).

During the 2013 Kangaroo Island field work, two specimens of *O. dentex* were recorded by SACReD divers at Ironstone Hill on the north-east coast (**Figure 4**).

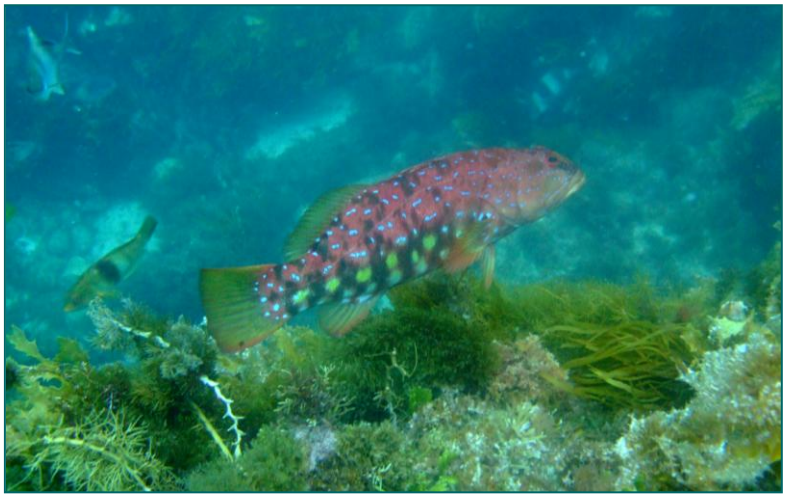


Figure 3: Harlequin Fish, recorded at Cape Forbin in 2008. Photo (c) A. Brown, SACReD.

Harlequin Fish occur on reefs, usually deeper than 5m, and extending deeper than 30m, as evidenced from bycatch data in Commonwealth-managed shark gillnet fisheries (AFMA 2002; Walker et al. 2003) and demersal gill-net and demersal long-line fisheries in WA (McAuley and Simpfendorfer 2003). Habitat for this species includes moderately exposed coastal rocky reefs, near reef drop-offs, over reef "lumps" (i.e. small rises surrounded by flatter benthic topography, in coastal waters), in caves, under ledges, and in shipwrecks that serve as artificial reefs (May and Maxwell 1986; Hutchins and Swainston 1986; Edgar 2000; SA and WA recreational fishing and diving reports). During dives over a 20 year period, one recreational diver in SA recorded the species at 11 sites, mainly in moderate to high wave energy areas. Depths of sightings ranged from 6m to 25m deep, but *O. dentex* was mainly recorded at depths over 10m (D. Cowan, unpubl. data, 1980 – 2001). This species is not abundant in most of the reef areas where it occurs in South Australia. During a study in which individuals were photo-catalogued to recognise individuals using facial markings, the number of *O. dentex* specimens recorded was too low for a population estimate to be made. During that study, after 800 minutes of diver search time, only 3 Harlequin Fish were sighted, and after 1,540 minutes searching time, only 6 animals were sighted, all of these at only one of the 5 reefs surveyed (Bryars 2010, 2011).

This species may reside for long periods at particular "home" reef locations. During a study in eastern Gulf St Vincent, divers observed an individual Harlequin Fish periodically at the same location on one southern metropolitan reef for 3 years (Bryars 2011).

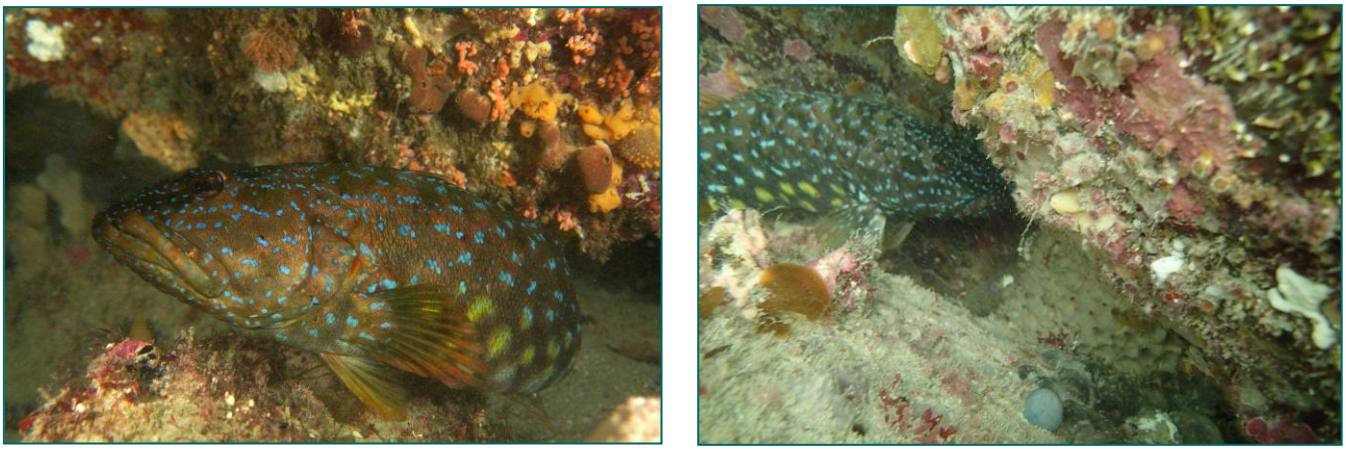


Figure 4: Two Harlequin Fish, recorded at Ironstone Hill during the 2013 field work. Photos (c) J. Manna (A); (c) H. Crawford, SACReD (B).

Harlequin Fish grows to around 75cm - 76cm (Hutchins and Swainston 1986; Kuiter, in Gomon et al. 1994). The species can grow to well over 3kg (Australian Anglers Association 2010). Hutchins and Swainston (2001) reported a maximum weight of 5.94kg. Harlequin Fish is a relatively long-lived species, possibly to more than 40 years (S. Bryars, pers. comm. 2010), and growth slows markedly after the fish reach about 40cm long (Saunders et al. 2010). During a study of the otoliths of *O. dentex* individuals collected from commercial sources (e.g. charter boats, fish processors and recreational fishers) numerous individuals were aged at more than 30 years (Saunders et al. 2010). The specimens in the study came from Kangaroo Island, southern Fleurieu Peninsula, western Eyre Peninsula, and southern WA. During a more recent study, 37 Harlequin Fish were collected by SARDI personnel from sites along northern Kangaroo Island for an aquaculture feasibility study, and 31 of these were aged. Calculated ages of the sample ranged from 6 to 32 years (Li and Hutchinson 2013).

Harlequin Fish is a "sit-and-wait" ambush predator (S. Shepherd, pers. comm. 2005), that feeds on abalone such as *Haliotis rubra* (S. Shepherd, per. comm.), decapod crustaceans (S. Bryars, pers. comm. 2010) and various small fish species (Scott et al. 1974; Masuda and Allen 1993, cited by Froese and Pauly 2013). Recent research has indicated that Harlequin Fish is a diurnal feeder (Bryars et al. 2012).

Little is known of the reproduction. A study of 31 individuals collected from Kangaroo Island indicated a 1:1 sex ratio (Li and Hutchinson 2013). Recent research in South Australia has shown no evidence for protogynous hermaphroditism in *O. dentex* (S. Bryars, pers. comm., 2010), in contrast to the sex change from female to male over time that is usual in members of the sub-family Anthiinae to which *Othos dentex* belongs (P. Heemstra, South African Institute for Aquatic Biodiversity, pers. comm. 2006).

The species is popular with anglers and spearfishers in both WA and SA, wherever it occurs and is accessible (Smith 2000; Reid 2001; Fishing Western Australia 2004; Wade 2003; Murton 2003; recreational fishing records, cited by Australian Angers Association Inc., 2013; records from Australian Underwater Federation Inc.; Henry and Lyle 2003; recreational fishing reports, cited in Baker 2004). Harlequin Fish was one of the targeted species in spear-fishing competitions in South Australia during the 1970s and 1980s (see Ottaway et al. 1980; Johnson 1985a, 1985b). More recently, Harlequin Fish was listed as one of the targets in the 54th Australian Spearfishing Titles 2006, held on northern Kangaroo Island (Australian Underwater Federation 2006), and specimens over 1kg were eligible to be caught. Charter boat companies in both WA and SA catch Harlequin Fish, and fishing web sites promote the capture of this species (references in Baker 2004). Charter boat catches of Harlequin Fish in SA are confidential, and this species is listed under "other - aggregated species" in charter boat catch statistics (Knight and Vainickis 2011). The National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003; SARDI data 2005) reported that about 157 Harlequin Fish were caught and kept by recreational fishers in South Australia during the survey time period (May 2000 to April 2001), considerably fewer than the number caught in WA (see Henry and Lyle 2003).

Harlequin Fish is also a part of the commercial scalefish fisheries bycatch in SA (Fowler et al. 2009). In shallow inshore waters, lobster pots infrequently catch Harlequin Fish in both SA and WA (Sloan 2003; Department of Fisheries, Western Australia 2004). The species is recorded as a minor component of the bycatch in the temperate demersal gillnet and demersal long line fisheries in WA, and is discarded (McAuley and Simpfendorfer 2003). The limited amount of qualitative and quantitative information available on the fishing of *Othos dentex* suggests that a greater number of these fish are taken per annum by recreational fishing and charter boat fishing, than by commercial fishing. In recent years, there has been an expansion in the number of charter boat vessels in SA, and also in the geographic area where such vessels target reef fish, including Harlequin Fish. Compared with the west coast of SA and islands around Eyre Peninsula, the northern and north-eastern Kangaroo Island is not one of the main target areas for anglers and charter boats catching this species.

Harlequin Fish is a large, solitary, long-lived, slow-growing, late-maturing species, which apparently forms semi-resident populations (e.g. Bryars 2011; Bryars et al. 2012), and is strongly site-associated with reefs, including caves in reefs. Recent research on north-eastern Kangaroo Island showed that Harlequin Fish in that area were likely to have a small home range (which may be less than 200 m along the shore reef, and less than 6000 m^2 in area) (Bryars et al. 2012). This species occurs in low abundance per reef area, and fishing records from WA and SA indicate that the majority of populations may be found over a relatively narrow depth range. This species is highly vulnerable to fishing-induced population decline. Like other large serranid fishes, populations are susceptible to localised depletion due to the life history (Heemstra and Randall 1999; Pogonoski et al. 2002; Saunders et al. 2010), and populations require a high degree of protection (Harrison 2001; Department of Fisheries WA 2004). *O. dentex* is a popular food fish, and is highly targetted in most accessible areas where it occurs, by line fishers, spear fishers and charter boats. This species has an inquisitive nature, which makes it vulnerable to capture by spearfishers. Since at least the 1980s, various life history characteristics of Harlequin Fish are known to have made it susceptible to impacts from spear-fishing, and numbers are reported to have been reduced in accessible areas of SA and WA due to "heavy spear-fishing pressures" (Hutchins and Swainston 1986).

Other than those captured by charter boat fishers, numbers of Harlequin Fish taken by recreational fishers are not monitored in SA. Individuals which are incidentally caught when fishers are targetting other species, are like to suffer severe barotrauma (Saunders et al. 2010) and have a low probability of survival. Given the life history characteristics of this strongly site-associated species, coupled with the fact that live specimens caught incidentally by anglers, rock lobster pots, shark gillnets, or long lines have a low probability of survival, closed areas (marine reserves / sanctuary zones) may be one of the most effective ways of protecting populations of Harlequin Fish in the long term (Pogonoski et al. 2002; Baker 2004).

Othos dentex apparently exists over a relatively narrow depth range, and therefore coastal processes and developments which damage nearshore reef ecosystems may have a negative impact on populations of this species. Some researchers consider that the absence of this species at sites where it previously occurred may be an indicator of polluted conditions, such as increased siltation (Gomon 2002).

Harlequin Fish is currently one subject of a community-based Reef Watch "Feral and In Peril" program in SA, which aims to monitor the distribution and abundance of a number of potentially threatened species at various diving and snorkelling locations around the State. Additionally, the work of Bryars (2010, 2011) and colleagues have highlighted the importance of Harlequin Fish as a "flagship" fish species for improved conservation and fishery management efforts in South Australia. Harlequin Fish also has value for diving eco-tourism. A number of divers are involved with a research project to monitor numbers of *O. dentex* on reefs in parts of South Australia, and more than 50 individual fishes have been photo-catalogued (e.g. Bryars 2011).

Northern Kangaroo Island may provide a lightly fished "refuge" for Harlequin Fish populations, and this is recognised in recent designation of sanctuary zones in marine parks of northern and north-eastern Kangaroo Island. Adequately-sized and appropriately located sanctuary zones in reef areas are the most suitable form of protection for this species (Bryars et al. 2012), because fishing regulations (such as bag limits, and minimum or maximum size limits) would not be beneficial, due to the barotrauma which occurs upon capture and release of Harlequin Fish.

It is noted that the capture and destruction of 37 Harlequin Fish from northern and north-eastern Kangaroo Island over several months for research in 2011 (e.g. Li and Hutchinson 2013) is incompatible with both the public and scientific the conservation concern for this species.

Labridae (Western Blue Groper, Brown-spotted Wrasse)

The Labridae is a large family of marine fishes, distributed throughout tropical and temperate waters of the Atlantic, Indian, and Pacific oceans. The Labridae is the second largest marine fish family, and is one of the most morphologically and ecologically diversified families of fishes in size, shape, and colour (Westneat and Alfaro 2005). In Australia, Labrids are the second most species-rich fish family, with around 175 species in 44 genera known from Australian waters (Randall et al. 1997; data by Hoese et al., cited by Leis 2010). About 80 species in 31 genera occur in temperate Australian waters (Leis 2010). Labrids are diverse in shape and colour, and members of the family also vary greatly in size, ranging from 4.5cm to around 2.3m, although many are less than 15cm. Most species swim primarily using the pectoral fins ("labriform" swimming), and specialised dentition is a characteristic of the family. Labrids have a protrusible mouth, and most have teeth that jut outward. Sex reversal is the norm in Labrids, and most species have two or three sex-related colour or body forms. Most species change colour and sex with growth, from an initial phase (IP) of males and females, the latter able to change sex into an often brilliantly coloured terminal male phase (TP). Males dominate several females. All Australian Labrids, so far as is known, spawn small (0.6-1.1 mm diameter) pelagic eggs, with a short larval life (Leis 2010).

Kangaroo Island reefs support numerous species in Labridae (**Table 6**), including common species such as the Blue-throated wrasse *Notolabrus tetricus*, as well as uncommon species such Western Foxfish *Bodianus frenchii*, a western Australian species for which Kangaroo Island is the eastern edge of the geographic range in southern Australia, and the south-eastern Australian species Purple Wrasse *Notolabrus fucicola*, for which Kangaroo Island is the western edge of the range.

Table 6: Species in Labridae which occur in Kangaroo Island, in alphabetical order (data from Brock and Kinloch 2007; Baker et al. 2008b, 2009b; Baker 2012 and references therein, S. Shepherd, unpubl. data, and Australian Museum records).

Latin Name	Common Name
Achoerodus gouldii	western blue groper
Austrolabrus maculatus	black-spotted wrasse
Bodianus frenchii	western foxfish
Dotalabrus aurantiacus	Castelnau's wrasse / pretty polly
Eupetrichthys angustipes	snakeskin wrasse
Notolabrus fucicola	purple wrasse
Notolabrus parilus	brown-spotted wrasse
Notolabrus tetricus	blue-throated wrasse
Ophthalmolepis lineolatus	Maori wrasse
Pictilabrus laticlavius	senator wrasse
Pseudolabrus rubicundus (= *psittaculus*)	rosy wrasse

Western Blue Groper: The largest wrasse in SA is the Western Blue Groper *Achoerodus gouldii* (**Figure 5**) which also occurs in Victoria and Western Australia (Hutchins and Swainston 1986; Pogonoski et al. 2002). In SA, the species is known from most parts of the State. It is less common on coastal rocky reefs east of Investigator Strait and the Murray River Mouth (Shepherd et al. 2002; Shepherd and Brook 2003), but does occur in deeper waters south of Kangaroo Island (SESSF bycatch data, cited by S. Bryars, pers. comm. 2008).

Young juvenile groper settle in sheltered macroalgae and shallow rocky bottoms. Juveniles are usually found in shallow, protected waters, including lagoonal areas adjacent to wave-exposed coasts (data by S. Shepherd, sited in Baker 2011). Adults are more common offshore on reefs in waters deeper than 10m, but in some areas where fishing pressure is low, they also occur in very shallow water (e.g. 1m deep). Although depth ranges to about 80m, Western Blue Groper is more commonly seen in the shallower part of the range, where divers and fishers record it. Groper change colour with age. Juveniles are greyish green or greenish brown. Females and older juveniles are greenish.

Large males are deep blue, sometimes with a white band on the edge of pectoral fins and tail fin. Maximum size is about 170cm. The biology of Western Blue Groper is well known compared with many other reef fishes in SA (Shepherd 2005; Shepherd and Brook 2005; Coulson et al. 2007, 2009). *A. gouldii* grows to around 1.75m, and is long-lived (to about 70 years), with most of the growth occurring in the first 20 years of life (Coulson et al. 2007). Western Blue Groper eat a variety of crustaceans, molluscs and echinoderms, and this species is considered to be a keystone predator in the temperate reef ecosystems of which it is a part. On reefs, it may partly control the abundance of crabs (which prey on small abalone), and sea-urchins, which consume seaweeds (Shepherd et al. 2002). Of interest is the sex change from female to male with increasing size, and the haremic social structure of this species, in which one male may dominate one or two females and several sub-adults. A study in south-western WA reported that groper females typically first become mature at about 650 mm and 15-20 years, and typically change sex to males at 800-850 mm length and 35-39 years of age (Coulson et al. 2007). As sex change occurs over a narrower range in lengths (650-900 mm) than in ages (15-49 years), it is apparently related more to size than age (Coulson et al., 2007). In addition, not all females are destined to become males (Coulson et al. 2007). Surveys in SA have shown the existence of "hotspots" of juvenile recruitment, where abundance and density of juveniles is highest (e.g. Shepherd and Brook 2004; Shepherd et al. 2005).

Groper are commonly recorded around all sides of Kangaroo Island. Examples include northern (e.g. Harvey's Return, Snug Cove, Stokes Bay, Cape Cassini), north-eastern (relatively high numbers at various sites between Kangaroo Head and Penneshaw, including Christmas Cove) and eastern Kangaroo Island (e.g. Cape Coutts, Moncrieff Bay) (data by S. Shepherd, 2002 - 2008). Some of the locations where Western Blue Groper were recorded during the 2013 field work are shown in **Table 7**. At these sites, an average of 2 groper per transect were recorded at Laver's Reef and Kangaroo Head, also the locations where the greatest numbers were recorded.

Table 7: Details of Western Blue Groper sightings, during Reef Life Survey transects in March and April 2013.

Site name	Dates	Depth/s or Depth Range (m)	No. Transects in which Groper were Sighted	No. Groper Sightings	Average No. Groper Sighted Per Transect
Stokes Bay West	25/03/13	5.5 - 7.5	5	6	1.2
Snellings Beach	17/04/13	6.3	1	1	1
Frenchman's	05/03/13	4.5	1	1	1
Ironstone Hill	25/04/13	5.1 - 5.4	4	6	1.5
Laver's Reef	22/03/13	5.3 - 5.4	4	8	2
Kangaroo Head	24/04/13	5 - 6	6	14	2.3

Figure 5: Western Blue Groper, recorded at Cape Forbin on northern KI, 2008. Photo (c) K. Smith

Generally, adult Western Blue Groper are strongly site associated, and do not move far from their "home reefs", which provide cover and feeding opportunities. Young-of-the-year are found in the shallowest inshore reefs, and they move into slightly deeper water (2 – 3 m deep) as they grow. The next sub-adult stage lasts for about 10 years, during which time the greenish-coloured individuals remain on sheltered, nearshore reefs. Studies in SA have shown that groper at this stage (about 20 – 60 cm long) occur in densities of about 1 to 8 per 100 m of coastline (Shepherd 2005). In some areas, the fish move into deeper water as they continue to grow. Older, sexually mature gropers are often found in deeper water (e.g. 20+ m), and some migrate further into even deeper waters, to about 50m (Shepherd 2005). An inshore to offshore movement of sub-adults to adults is also supported by the observations of Coulson et al. (2007) in WA. However, in some less accessible areas of South Australia which may be lightly fished (e.g. parts of southern Yorke Peninsula) larger individuals occur close to shore.

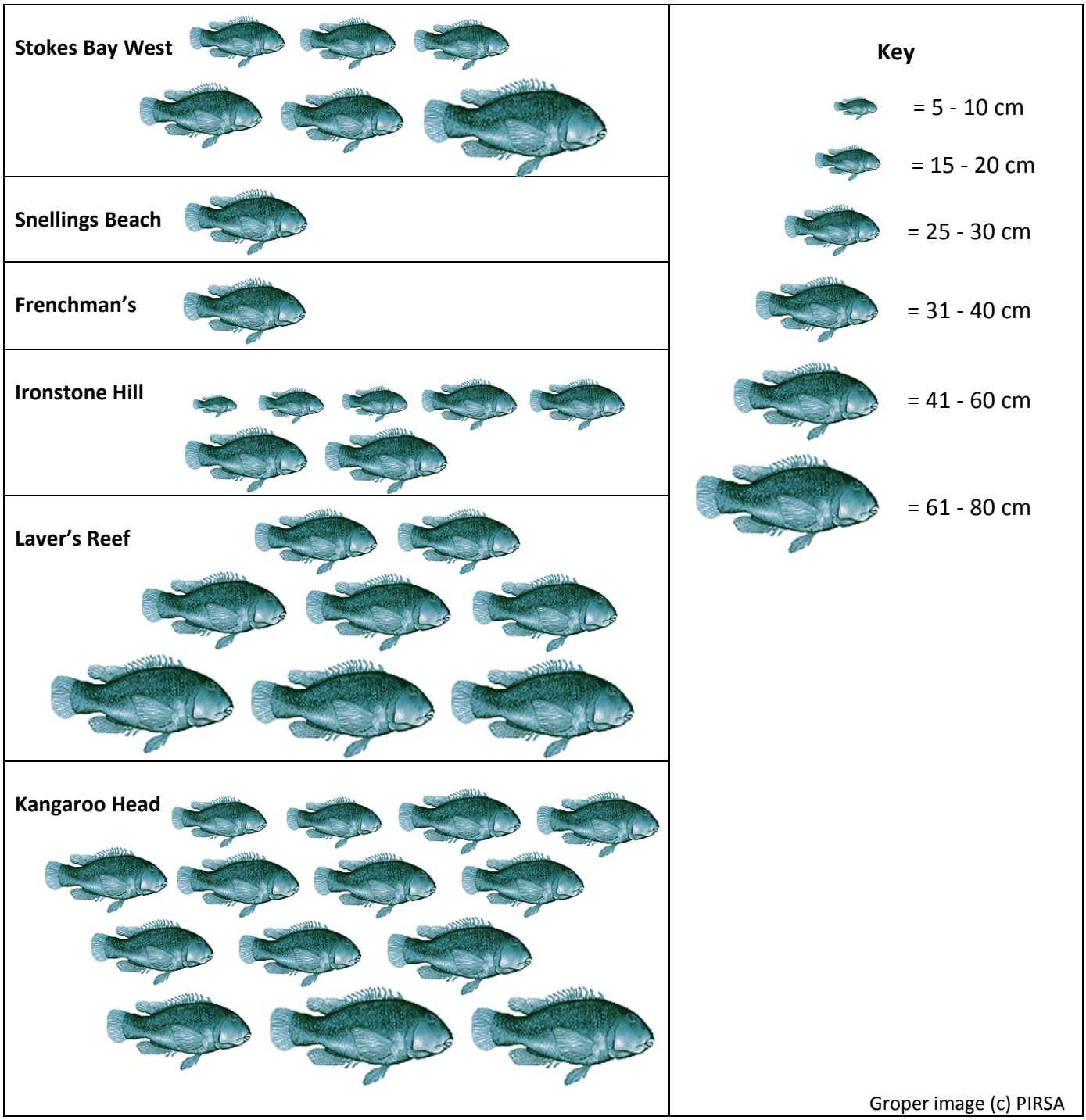
The size range of Western Blue Groper recorded by Reef Life Survey divers during the 2013 field work are shown in **Table 8**. It is clear from the presence of small individuals at Ironstone Hill that recruitment has occurred recently in that area. At all of the sites, sub-adult groper (e.g. 20 - 60cm) were recorded. The largest individual recorded (75cm) was found in the Stokes Bay area, and larger animals (e.g. 61cm - 74cm) were also recorded at Kangaroo Head and Laver's Reef in Eastern Cove.

In a study of the species relative abundance and distribution on northern Kangaroo Island (Shepherd et al. 2002), adult males occupied a home range, which at several sites was estimated to vary from 4,000 to 16,000 m^2. At some sites, males exclusively occupied about an 80 – 120 m section of the coast. Females and sub-adults were found to be strongly site-associated, and swam in loose aggregations (Shepherd et al. 2002).

More recently, acoustic tracking work by S. Bryars (Bryars et al. 2012) on the movements of 15 Western Blue Gropers (69–112-cm total length; 7–31-kg weight) at a site off Harvey's Return indicated that most of the fish displayed high site fidelity. Residency time for 10 of the 11 fish with useful data was 91–100% at a narrow strip of fringing coastal reef (about 1km long and 40m wide) throughout a 12-month period. Mean home-range along-shore length and area were estimated at 1,076m (+/- 83m s.e.), and 45,188 m^2 (+/- 3,497m^2 s.e.) respectively (Bryars et al. 2012). These results indicated the importance of the shallow and relatively narrow reef area along the north coast of Kangaroo Island as a living area for this species, and it is noted that unsuitable (i.e. non-reef) habitat occurs in much of the deeper water area of western Investigator Strait seaward of the north coast reef strip. Such reef site-residency also indicates the potential vulnerability of groper populations to localised and regional impacts.

Northern Kangaroo Island is within the legislatively protected area for Western Blue Groper, where fishing is not permitted. There have been numerous anecdotal reports over the years that fishing for this species does occur in Investigator Strait, within the closed area. It is clear from both the survey data and the research project work over the past decade on Kangaroo Island that a number of nearshore reefs along northern and north-eastern Kangaroo Island are important habitat for this species.

Table 8: Size range of Western Blue Groper during Reef Life survey transects in March and April 2013



Brown-spotted Wrasse: Another wrasse species of conservation interest in South Australia is the Brown-spotted (also known as Orange-spotted) Wrasse *Notolabrus parilus* (**Figure 6**). This species has a broad southern Australian distribution, from Shark Bay in WA, through to Port Phillip Heads area in Victoria (Gomon et al. 1994; Plummer et al. 2003), but it is most abundant in WA (Hutchins 1994). It is less common and found in smaller numbers in SA (Hutchins and Swainston 1986; Edgar 2000), and extremely rare in Victoria, which is the edge of the species range (Edgar 2000). There is also a record from northern Tasmania (Warman and Bryan 2004). In South Australia, this species has been recorded - usually in low numbers - from most parts of the coast, from the Great Australian Bight through to the Victorian border. Using the timed swim technique (Shepherd et al. 2004), during visual surveys of 175 nearshore reef locations across the South Australia, *N. parilus* was recorded at only 42 sites, and in greatest abundance at Rapid Bay Jetty off the Fleurieu Peninsula (21 per 2000m^2), and near Point Sinclair off western Eyre Peninsula (53 per 2000m^2) (data by S. Shepherd 2003, 2005).

Figure 6: Example of female Brown-spotted Wrasse. Photo (c) D. Muirhead, SACReD

During the early to mid 2000s, it is noted that during a visual surveys of fishes at 32 sites along northern and north-eastern Kangaroo Island coast, using the timed swim technique, Brown-spotted Wrasse was recorded at only one of those sites (Emu Bay) (Shepherd et al. 2004). In 2005-6, during surveys at 8 nearshore reef sites around Kangaroo Island (4 north coast, 1 north-east and 3 south coast), no *N. parilus* individuals were recorded (Brock and Kinloch 2007). However, there are previous records from other locations on northern and north-western Kangaroo Island, and also north-eastern and eastern Kangaroo Island (Dudley Peninsula), and the Pages Islands, east of Kangaroo Island. During periodic surveys from 2002 to 2008 on northern Kangaroo Island, *N. parilus* was recorded at 7 of 13 surveyed sites, and most records were from surveys undertaken by SACReD in 2008. Estimated densities were low, ranging from about 0.5 per 2000m^2 at Emu Bay, to 4 per 2000m^2 at Snelling Beach. Other sites at which *N. parilus* was recorded included Western River Cove, Snug Cove, Stokes Bay, Dashwood Bay and Boxing Bay (Shepherd et al. 2009). The SACReD surveys in 2008 utilised the timed swim visual census method outlined in Shepherd et al. (2009) and included 4 replicate timed swims (survey transects) at some sites and 8 replicates at others.

During the March and April 2013 surveys, this species was recorded at 8 reef sites (**Table 9**), ranging from Western River Cove in the west to Kangaroo Head in the east, at depths between 4 and 7m. At these sites, 1 or 2 individuals per transect were recorded, and *N. parilus* was not sighted on all transects at each of these sites.

Table 9: Details of Brown-spotted Wrasse sightings, during Reef Life Survey transects in March and April 2013.

Site name	Dates	Depth/s or Depth Range (m)	No. Transects in which *N. parilus* were Sighted	No. *N. parilus* Sightings	Average No. *N. parilus* Sighted Per Transect
Western River Cove	23/03/13	6	3	5	1.6
Stokes Bay West	25/03/13	5	1	1	1
Green Cliffs	25/03/13	5 - 7	4	6	1.5
Snellings Beach	17/04/13	5 - 6	2	3	1.5
Frenchman's	05/03/13	4	1	1	1
Ironstone Hill	25/04/13	5	1	1	1
Laver's Reef	22/03/13	4 - 5	3	4	1.3
Kangaroo Head	24/04/13	5	2	2	1

Brown-spotted Wrasse inhabits shallow rocky reefs, from 1m to about 20m (Gomon and Russell, in Gomon et al., 1994; Edgar 2000), although specimens may also be found on reefs at slightly lower depths (e.g. Harvey et al. 2004). In WA, juveniles and females have been recorded abundantly in macroalgae-covered rocky reef areas in coastal waters (particularly reefs with dense cover of *Ecklonia* kelp and other canopy-forming species), and juveniles have also been recorded in seagrass beds (e.g. Valesini et al. 2004; Harvey et al. 2004). In SA, *N. parilus* has been recorded on reefs of various wave exposure, ranging from low energy reefs, such as Rocky Point in American River (USNM record 1966, cited in Anonymous 2001), to exposed coastal reefs, such as islands off southern Eyre Peninsula (K. Branden and S. Shepherd, unpublished data, 1987) and Speeds Point, off western Eyre peninsula (data by S. Shepherd, J. Brook and K. Brown, 2003).

Brown-spotted Wrasse grows to around 49cm (Hutchins and Thompson 2001; Edgar 2000), although specimens of that size are uncommon (e.g. Lek et al. 2012). One of the largest sizes recorded is 1.8kg, being a specimen taken from Kangaroo Island in 1965 (Hutchins and Swainston 1986; Australian Anglers Association 2010). This species lives for at least 12 years (Lek et al. 2012), and females may change to males at approximately 6 - 8 years. Some female Brown-spotted Wrasse change sex, but not colour, at a small size.

Lengths of the 23 individuals recorded during the March and April field surveys on Kangaroo Island are shown below (**Figure 7**). The length scale relates to length categories on the RLS survey forms. Of interest was the record of a large individual west of Stokes Bay, estimated to be at least 50cm long, and two others from Frenchman's (in Western Cove), and Lavers Reef (Eastern Cove), reported to be at least 40cm long. Although there is a possibility that sizes may have been over-estimated (which is one of the caveats of using the visual census method), it is probable that these individuals were mature male adults, and possibly at a late life stage, as indicated by age-length models developed for this species in WA (see Lek et al. 2012). In other parts of South Australia, specimens of 40 - 50cm are rarely recorded. It is also evident that recent recruitment has occurred, as indicated by the observation of specimens of 5 - 7.5cm long, at Snellings and Ironstone Reef on the north coast, and Lavers Reef in Eastern Cove.

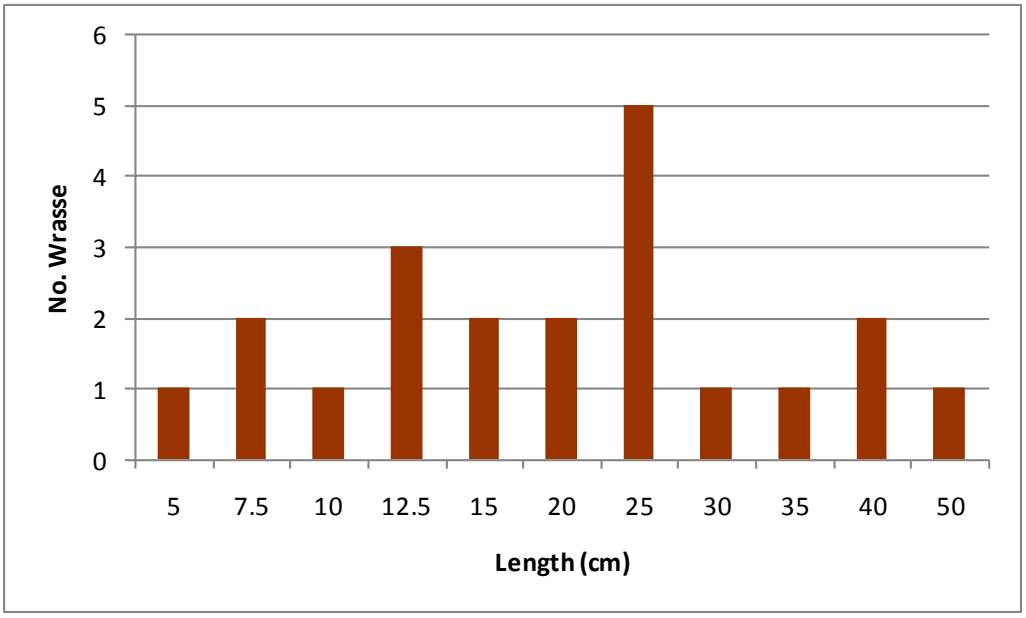


Figure 7: Numbers and length classes of Brown-spotted Wrasse recorded during Reef Life Survey transects, March and April 2013.

Part of northern Kangaroo Island may be functioning as a refuge for larger, older male *N. parilus*, which are rarely observed in other parts of South Australia (S. Shepherd, unpubl. data from > 200 reef sites). Brown-spotted Wrasse is taken by recreational fishers in various parts of SA, and sports fishing associations (e.g. ANSA and AAA) keep records of the maximum sizes caught. Recreational fishing catch and effort statistics for *N. parilus* are not available in South Australia, as catches of wrasse species are aggregated. This species is taken in far greater numbers in WA (e.g. > 10,000 specimens per year) where it is more plentiful (e.g. National Recreational and Indigenous Fishing Survey results, in Henry and Lyle 2003), and catches may have increased in recent years, due to reduced numbers of more popular legal-sized target species (Harvey 2004). The species is also taken by spear fishers. Previously, Brown-spotted (listed as Orange-spotted) Wrasse was one of the targeted species in spear-fishing competitions in SA during the 1970s and 1980s (see Johnson 1985a, 1985b, and tables in Ottaway et al. 1980). The recorded maximum size of Brown-spotted Wrasse taken by spear fishing was a specimen of 1.814kg, caught at Gull Rock (near Maslins Beach) in Gulf St Vincent in 1972.

Apart from recreational fishing, populations of *N. parilus* are commercially fished in deeper waters, in some parts of the geographic range. Brown-spotted Wrasse is a smaller component of commercial catch of 3 wrasse species in SA, and the majority of the catch comprises Blue-throated Wrasse (Knight and Johnson 1999; Knight et al. 2002). Between the 1980s and the mid 2000s, the highest catches were during the 1997/98 and 1998/99, when 47t per annum were taken in both years. During the early and mid 2000s, annual catch of all commercial wrasses ranged between 20t and 27t per annum. The proportion of Brown-spotted Wrasse in the catch cannot be determined from available data, but it is lower that than the catch of Blue-throated Wrasse. Wrasse catches in SA are not included in recent catch and effort statistics reports in SA (e.g. Knight and Tsolos 2012). *Notolabrus parilus* is a bycatch species in the South Australian Rock Lobster fishery, and may be retained for use as bait (Sloan 2003). A bycatch survey showed that Brown-spotted Wrasse is caught in the Northern Zone of the S.A. Rock Lobster Fishery (Brock et al. 2004), which includes Kangaroo Island. Based on bycatch sampling in 2002/03 (in which 8 specimens of *N. parilus* were caught in 1% of the pot lifts, and in 1% of the fishing days), the annual catch of Brown-spotted Wrasse in the Northern Zone may be in the vicinity of 800 individuals.

In an associated logbook monitoring program, Brown-spotted Wrasse was not recorded to species level (see Brock et al., 2004); however the catch of unspecified wrasses in both the Northern Zone and Southern Zone may include a proportion of *N. parilus*, particularly in the former.

Other than the above, there appears to be little information available on the extent to which near-shore populations of *N. parilus* are fished, nor on the specific population impacts of fishing. However, as is the case with other fishes in Labridae, Brown-spotted Wrasse has a number of characteristics that make it vulnerable to over-exploitation, and population decline. This species is strongly site-associated within reef systems, particularly shallow, near-shore reef habitat, and is most vulnerable to capture in such areas (as shown in recreational fishing statistics, particularly for WA), and heavily fished populations may suffer imbalances in population structure, related to protogynous hermaphroditism (i.e. sex change) in this species.

Additionally, in some parts of its range, the nearshore habitats in which this species occurs are subject to damaging processes, such as eutrophication from sewage and wastewater discharges and agricultural run-off, sedimentation, and physical damage from dredging and near-shore developments. Although these are not significant issues in many parts of Kangaroo Island, other than in areas of Western and Eastern Cove, it is noted that in the long term, changes to reef habitat quality in the nearshore area may be a concern, given the reef-specificity and narrow depth range of this species.

Syngnathidae (Seadragons)

The Syngnathidae is a large group of fishes which have a series of bony rings enclosing an elongate body. Syngnathids have no pelvic fins, and some species also lack caudal, dorsal, anal, and/or pectoral fins. The tail is prehensile in some species, and can wrap around supports such as marine plants. Syngnathids feed on minute invertebrates sucked into a tubular snout. Males have a brood pouch in which the eggs are laid, and where they are fertilized and incubated (Kuiter 2000). Most syngnathids have a relatively low reproductive potential, with the numbers of eggs in a single batch typically in the low hundreds or less. The number of young in each brood will generally be lower in the smaller-sized species (Kuiter 2000). The family includes the seadragons, pipefishes, pipehorses and seahorses. Both seadragon species in South Australia, the weedy seadragon *Phyllopteryx taeniolatus* and the leafy seadragon *Phycodurus eques*, occur along the northern coast of Kangaroo Island (Baker 2005). Both species are legislatively protected in South Australia under the *Fisheries Management Act 2007*. Generally, many of the life history characteristics of seadragons make them susceptible to impacts, and vulnerable to population decline. Such characteristics include low population densities; strong habitat association; small home range sizes (Connolly 2002a,b) and low mobility; possible low rates of natural adult mortality (due to low levels of predation, hence human-induced mortality may disrupt population dynamics); monogamy and localised reproduction; aggregation for feeding and/or breeding; small brood sizes, and strong association between adults and young (see Baker 2007 and Brown, Baker and Connolly 2008 for summary, and references).

During the Kangaroo Island field work in March and April 2013, only one seadragon was recorded during rare species searches (**Figure 8**), and none were recorded along transects during the RLS surveys. There are previous records of both weedy and leafy seadragons from various locations along northern and north-eastern Kangaroo Island. Numerous records from divers were submitted to the community-based Dragon Search program by Kangaroo Island resident and visiting divers during the 1990s and early 2000s (see Baker 2005, and **Table 10** below). A number of the locations are relatively inaccessible, but others are accessible from shore. The strong site association and limited mobility of seadragons means that they are vulnerable to potentially threatening process, such as habitat loss (e.g. of nearshore kelp beds), incidental capture in fisheries, and collection (including illegal capture) for the aquarium trade.

Figure 8: Leafy Seadragon, recorded in April 2013 at a northern Kangaroo Island site (not disclosed here, for conservation reasons). Photo (c) H. Crawford, SACReD.

Table 10: Locations along N and NE Kangaroo Island in which seadragons have been recorded opportunistically by divers for the Dragon Search program (from Baker 2005, and Dragon Search, unpubl. data). W = weedy seadragon; L = leafy seadragon.

Location (W to E)	Dates	No. of Sightings	Type
Western River Cove area	1992, 1995, 1998	5	W
Snug Cove area (2 locations)	1991, 1992, 1994	3	L, W
Cape Cassini area (beach wash record)	1998	1	W
Kingscote area	1999, 2002	2	L
Kangaroo Head to Penneshaw area	1992, 1993, 1995 - 1999, 2002	91 (includes multiple dives in some months)	L
Ironstone Hill area	1992, 1999	3	L

Apogonidae (Cardinalfishes)

One site-associated family of reef fishes with limited dispersal ability is the Apogonidae - the cardinalfishes. The *Vincentia* cardinalfishes are benthic, mouth-brooding species (Allen 1999) with localised reproduction and limited dispersal, and they are found mainly in shallow subtidal seagrass beds and/or nearshore reefs. All of these characteristics may increase the vulnerability of such species to localised impacts. One of the less commonly recorded species is the Scarlet Cardinalfish *Vincentia badia* (**Figure 9**), known from central and southern coastal waters in Western Australia, and western and central coastal waters in South Australia. In this State, *V. badia* has been recorded in metropolitan Gulf St Vincent, southern Fleurieu / Backstairs Passage area, Investigator Strait / northern Kangaroo Island, and parts of northern, central, eastern and southern Spencer Gulf (museum, survey and fisheries bycatch records, cited in Baker et al. 2009a,b). In South Australia, cardinalfishes (including the commonly recorded species *V. conspersa*) have been caught in low numbers in both prawn and blue crab fisheries (Carrick 1997, Richardson 1999, Currie et al. 2007). Little is known of the relative abundance, biology and population dynamics of cardinalfishes. Taxonomic work is required to determine the number of *Vincentia* species in South Australia.

For these fishes, more information on the distribution, habitats, biology, vulnerable population characteristics and potentially threatening processes, is provided in the chapter on Apogonidae, in Baker (2012). During the Kangaroo Island survey in April 2013, cardinalfishes were recorded at Pelican Lagoon, and Kingscote.

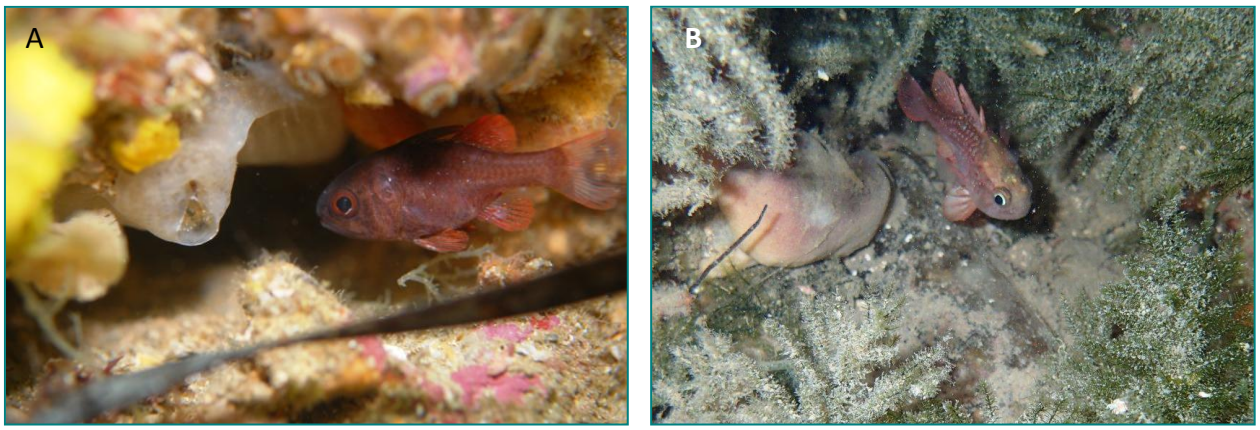


Figure 9: *Vincentia badia* at Pelican Lagoon (A) & Kingscote (B). Photos (c) D. Muirhead (A), H. Crawford, SACReD (B).

Tripterygiidae (Threefins / Triplefins)

Species in another benthic, egg-brooding group - the triplefins (Tripterygiidae) - are commonly known within South Australia, and some are apparently abundant and widely distributed (Baker 2009). However, the potentially vulnerable population characteristics of the whole group is noted here, such as strong site association; the guarding of benthic eggs in a "nest"; and use of shallow coastal habitats that may be subjected to localised impacts (Baker 2009).

Of the triplefins, the Crested Threefin *Trinorfolkia cristata* (**Figure 10**) is of particular conservation interest because it is known mainly from South Australia. There is one published record from the Great Australian Bight in south-western Australia (identified by R. Kuiter), and one unverified record from Port Philip Bay in Victoria, dated 1978. This small (to 9cm) reef-associated species has been commonly recorded on shallow reefs, and appears not to be rare within the main part of the range, with records from numerous locations in South Australia (Baker 2009; Baker et al. 2009a,b). During the Kangaroo Island surveys in 2013, this species was recorded at 4 locations, with an average sighting of one per 50m transect at Frenchman's and Kangaroo Head, and around 2 per transect at Laver's Reef in Eastern Cove, and Muston in American River (**Table 11**). This species has been found to date over a narrow depth range, from the intertidal to about 15m deep. Similar to the cardinalfishes, processes which impact upon the extent, quality and species composition of nearshore reefs may adversely affect populations of site-associated nearshore reef fishes such as Crested Threefin. However, there are no specific data for threefins.

Figure 10: *Trinorfolkia cristata*, upside-down in a crevice, at Kangaroo Head. Photos (c) D. Muirhead, SACReD.

Table 11: Details of Crested Threefin sightings, during Reef Life Survey transects in March and April 2013.

Site name	Dates	Depth/s or Depth Range	No. Transects in which Crested Threefin were Sighted	No. Crested Threefin Sightings
Frenchman's	05/03/13; 24/04/13	4.5m, 6m	2	2
Laver's Reef	22/03/13	4.7 - 5.4m	5	9
Muston	22/3/113; 24/03/13	4.1m - 7.5m	5	8
Kangaroo Head	24/04/13	5m - 6m	2	2

Bythitidae (Blindfishes)

Fishes in the Bythitidae are viviparous (i.e. they bear live young). Many members of the family occur in deep water; however a sizeable number occur on shallow waters, on rocky reefs (Gomon, in Gomon et al. 1994). Bythitid fishes have internal fertilisation and associated copulatory structures, which is unusual in fishes. Most species attain a small maximum size, and have a large mouth, reduced ventral fins, and elongate dorsal and anal fins, which are sometimes connected to the caudal fin (Gomon, in Gomon et al. 1994). Species within the family that are commonly called Blindfishes are rarely blind. Although some species have non-functional eyes because they live in total darkness, most are sighted, and use their eyes to swim around in the open at night-time (B. Hutchins, ex-WA Museum, pers. comm. 2006). One of the two species in South Australia, *Dermatopsis multiradiatus*, was recorded in American River during the April 2013 survey (**Figure 11**). This small species (to about 11cm) is known as the Slender Blindfish or Yellow Eelpout, and is mainly found in Western Australia, and western South Australia. Kangaroo Island is the eastern edge of the range. Slender Blindfish lives in rubble, and under ledges, on shallow reefs, and mixed seagrass and reef habitats, down to about 15m deep (Nielsen et al. 1999; Hutchins 2005; Gomon et al. 2008). This species shelters in crevices and under rocks during the day, and swims around seagrass and algae at night to feed (Saunders 2012). Most records in SA are from the Coffin Bay area (Saunders 2012), and the gulfs region, but there are also verified records from southern Kangaroo Island, and from Cape Cassini and Kingscote on northern Kangaroo Island. A photograph of this species in Gomon et al. (2008) was taken by R. Kuiter (pers. comm.) late last century at the same location in American River as the 2013 photo. American River in considered to be an important, protected habitat for this live-bearing, strongly site-associated species.

Figure 11: *Dermatopsis multiradiatus* at Pelican Lagoon. Photos (c) H. Crawford, SACReD

Ophiclinidae (Snake-blennies)

Ophiclinid fishes are small, cryptic, benthic species found in coastal areas of seagrass and macroalgae. Members of the family are viviparous (they bear live young), and therefore reproduce at localised scales and have low dispersive ability, characteristics that can increase vulnerability to processes causing population decline. There are around 10 species in South Australia, and one of these, the Spotted Snake-blenny *Ophiclinops pardalis* has not been recorded in other States, and may thus be endemic within SA waters. It has previously been suggested that *O. pardalis* may be the same as the Earspot Snake-blenny *Ophiclinops hutchinsi* (George and Springer 1980) from the Recherche Archipelago in Western Australia, and that the taxonomic identity of specimens from SA and WA should be compared (Hoese et al. in Gomon et al. 1994, cited by Pogonoski et al. 2002).

During the past century, Spotted Snake-blenny *O. pardalis* has been recorded uncommonly from various locations in South Australia. Examples include the eastern Great Australian Bight; far northern and northern Spencer Gulf; eastern and south-western Spencer Gulf; eastern Spencer Gulf; estuarine area near the "heel" of Yorke Peninsula and other locations in the vicinity; northern metropolitan Gulf St Vincent; southern Kangaroo Island, and the bays of north-eastern Kangaroo Island (P. Smith, unpubl. data, 1976; Hoese et al., in Gomon et al. 1994; Kuiter 1996; Anonymous 2001; B. McDonald, unpubl. data, cited by Brook 2002; P. Jennings, SARDI, unpubl. data 2003; South Australian Museum data, cited by R. Foster, pers. comm. 2007; Australian Anglers Association 2010; Australian Museum records, W.A. Museum record, Museum of Victoria records, S.A. Museum records, cited in OZCAM database 2013).

From 2007 to 2010, during targetted searches for cryptic benthic fish species across more than 50 locations in South Australia, a number of species in Ophiclinidae were recorded (e.g. Baker et al. 2008a, 2008b, 2009a, 2009b, 2010), but *O. pardalis* was not recorded at any site. During the April 2013 field work on Kangaroo Island, Spotted Snake-blenny was recorded at Pelican Lagoon (**Figure 12**).

Spotted Snake-blenny *O. pardalis* is a small species (to 7cm). It is found within plant litter at the base of (and amongst) roots of seagrass (Hoese et al., in Gomon et al. 1994), and in mixed rock, seagrass and macroalgae habitat, under seagrass mats or rocks (Kuiter 1996). In northern Spencer Gulf, the species has been recorded near a mangrove-lined creek (Museum of Victoria records, 1984, cited in OZCAM database 2013). Specimens have been recorded from beam trawl sampling of seagrass beds in Spencer Gulf (B. McDonald, unpubl. data, cited by Brook 2002). In Spencer Gulf, the species has been found to at least 17m deep (e.g. P. Jennings, SARDI, unpubl. data 2002).

The benthic nature and strong site-association of this species with shallow vegetated habitats, makes it potentially vulnerable to population decline from processes and developments which damage estuarine areas and shallow bays, particularly areas of seagrass mats. It is noted that *O. pardalis* has also been recorded in nearshore reef habitats, and therefore degradation of reefs in some areas might also be a threatening process, but there are no specific data on the effects of reef degradation on clinid species. Information on the distribution, relative abundance, habitat requirements and biology may help in better determining the susceptibility of snake-blennies to threats such as habitat degradation. However, without substantial survey effort using a variety of techniques (including destructive techniques such as netting), the difficulty of determining distribution and relative abundance of small, cryptic, benthic species such as snake-blennies is noted.

Figure 12: *Ophiclinops pardalis* at Pelican Lagoon. Photos (c) H. Crawford, SACReD

A second species in the Ophiclinidae which was recorded during the April 2013 field work is the Eel-blenny *Peronedys anguillaris*, also known as the Eel Snake Blenny (**Figure 13**). This species is mostly known from South Australia and southern Western Australia (Recherche Archipelago) (Pogonoski et al. 2002; Hutchins 2005; Atlas of Living Australia 2013). Although this species is uncommonly recorded, the known distribution in South Australia covers the western and central part of the coast. Examples of locations in which Eel-blenny has been recorded include the eastern Great Australian Bight; parts of Spencer Gulf (including trawl records); a site on the "toe" of Yorke Peninsula; south-western Gulf St Vincent; and the bays of north-eastern Kangaroo Island, such as Pelican Lagoon, American River and Nepean Bay (Hoese et al., in Gomon et al. 1994; CSIRO Marine Research record; photographs by J. Lewis, 2004; S.A. Museum records, 1905, 1938, 1960, 1965, and 1977; SA Museum data, cited by R. Foster, pers. comm. 2007; Saunders 2009; Museum of Victoria records; Australian Museum records).

Eel-blenny is known mainly from seagrass habitats, but has also been found on reef, from the low intertidal and about 6m deep (Pogonoski et al. 2002; Hutchins 2005). The species is known from among seagrass roots (Hoese et al., in Gomon et al. 1994), in calm bays and still estuaries. Habitats include sandy mud-bottomed estuaries with prolific seagrasses forming mats over decaying ones, such as Pelican Lagoon and other parts of American River on Kangaroo Island (Kuiter 1993; 1996; Pogonoski et al. 2002; National Museum of Natural History record, cited by Anonymous 2001). During the April 2013 field work in American River, Eel-blenny was recorded at Muston, in shelly sand habitat with *Zostera* (*Heterozostera)* and *Halophila* seagrass, green macroalgae and filamentous red macroalgae.

Eel-blenny grows to 13cm (Hoese et al., in Gomon et al. 1994). Eel-blenny is of conservation interest for several reasons. It is a benthic species which is strongly associated with specific seagrass habitat types over a narrow depth range (less than 10m), in shallow, protected bays, and such habitats appear critical to the survival of Eel-blenny (Pogonoski et al. 2002). Therefore, it may be vulnerable to habitat impacts in some areas, such as physical disturbance to habitat and siltation from dredging, channel development, boating in shallow seagrass beds; also sediment- and effluent-induced dieback of seagrasses and macroalgae etc. It is noted that one specimen of Eel-blenny was recorded in dredge washings from Spencer Gulf (South Australian Museum record 1938), and dredging of sandy and muddy channels in shallow water may pose a threat to this species. Eel-blenny may be vulnerable to disturbance such as power boating in shallow seagrass beds, other forms of habitat degradation, and pollution (R. Kuiter, pers. comm. to T. Flaherty 1995; Kuiter 1996). Pogonoski et al. (2002) also reported that pollution and habitat degradation in shallow nearshore areas might be a threat to Eel-blenny populations; this threat is exacerbated by the apparent restricted distribution of this species.

In some of the areas where this species occurs, it is noted that seagrass habitat has suffered impacts, such as Nepean Bay on Kangaroo Island (e.g. Edyvane 1997; Gray 2000). Furthermore, various shallow seagrass habitats in Gulf St Vincent and Spencer Gulf are subject to sedimentation from coastal runoff, effluent discharge, physical damage (dredging, channel development, boating etc) and other impacts that reduce the spatial extent and density of seagrass cover (e.g. for Gulf St Vincent, see Shepherd 1970; Hart, 1996, 1997; Westphalen et al. 2005). However, there are no specific data on the potential impacts of such habitat loss upon Eel-blenny populations in any part of the range.

Like other members of the family, Eel-blenny is a live bearer (Neira et al. 1998). Viviparous fishes have low dispersive ability, a characteristic that can increase vulnerability to processes causing population decline. Eel-blenny is known mainly from the gulfs region in South Australia, with isolated records from south-western Australia. There is little information on the full distribution, and relative abundance within the range, and very little knowledge of the biology and population dynamics of this species. The biology and accurate distributional range of this species needs to be further investigated to determine its susceptibility to threats such as pollution and habitat degradation (Pogonoski et al. 2002). Additionally, data on relative abundance and habitat requirements may also help in better determining the susceptibility of snake-blennies and eel-blennies to threats. The difficulty of determining distribution and relative abundance of small, cryptic, benthic species such as eel-blennies is noted, given that non-destructive surveys in South Australia, other than the field work of SACReD since 2007, have not targetted such species, and destructive methods (such as dredging and netting) are usually required to determine destruction and relative abundance of such species.

Figure 13: *Peronedys anguillaris* at Muston, American River. Photos (c) H. Crawford, SACReD

Pataecidae (Prowfishes)

The Pataecidae is a small family of marine fishes, endemic to Australia. The Prowfishes are relatives of the Velvetfishes, and have a high dorsal fin that stretches the length of the body, and no ventral fins. The body of Prowfishes is wedge-shaped, with no scales, and some species are covered with fleshy papillae or wart-like bumps (Poss, in Gomon et al. 1994). Body shape in the family Pataecidae is laterally compressed, with a long, continuous dorsal fin. This assists in camouflage, because laterally compressed fish have a strong resemblance to seaweed. There are 3 genera known, all endemic to Australian waters, each with a single species (Gomon et al., 1994; CSIRO 2013). Two members are widely distributed in southern Australia, the Warty Prowfish *Aetapcus maculatus* and the Red Indianfish *Pataecus fronto*, and the third, the Whiskered Prowfish *Neopataecus waterhousii*, is rarer and has a more limited distribution than other two (Hutchins and Swainston 1986; Gomon et al. 1994; Australian Museum 2012).

Although Whiskered Prowfish is quite broadly distributed in southern Australia (i.e. found in WA and SA, and occasionally in Victoria), it is seldom encountered by divers or fishers (Hutchins and Swainston 1986; Gomon et al. 1994; Hutchins 2001). Gulf St Vincent in SA is the type locality of Whiskered Prowfish (Eschmeyer 2006). In the late 1800s, a number of museum specimens were collected in the "Adelaide area" in Gulf St Vincent (Hureau 1991; Anonymous 2000, cited in Froese and Pauly 2013). Specimens were also collected from the metropolitan area of Gulf St Vincent during the 1960s and 1970s (South Australian Museum records). Examples of other locations in SA from where the species is known include the Great Australian Bight; parts of Spencer Gulf; southern Yorke Peninsula; northern and north-eastern Kangaroo Island (e.g. American River); Encounter Bay, and the upper South East (e.g. southern Lacepede Bay area, and Robe area) (Glover 1979; CSIRO Marine Research data 1967; SA Museum records; Currie and Sorokin 2010). During the 2013 field work on Kangaroo Island, a Whiskered Prowfish individual of was recorded by K. Lashmar at Snellings Beach, during RLS transect survey (**Figure 14**).

N. waterhousii occurs in moderately shallow coastal waters, and is occasionally seen in floating seaweed, such as *Sargassum* (Hutchins and Swainston 1986; Gomon et al., 1994; Australian Museum 2012). There is little information about the habitat. In SA, the species has been recorded on "sandy bottom with sparse vegetation" (South Australian Museum record from 1974). Similarly in WA, Whiskered Prowfish has been recorded in the vicinity of sandy substrate (Hyndes et al. 1999), and in Victoria, it has been recorded on reefs and in "sponge gardens" (Bray and Gomon 2011; data by S. Dreezer). Most published examples to date have come from the depth range 15m to 30m, but deeper examples are occasionally recorded - e.g. 39m, 45m (CSIRO Marine Research data 1973; South Australian Museum records; Currie and Sorokin 2010; Bray and Gomon 2011). The example from Kangaroo Island during the 2013 field work was recorded at 6m deep. Whiskered Prowfish grows to around 19cm (Gomon et al., 1994), and this species is extremely variable in colour. Examples include brown body with a network of thin red lines; brownish / kelp-coloured body with greyish-pink blotches that resemble crustose coralline algae (as in the example from Kangaroo Island: **Figure 14**), or orange body with white blotches that resemble encrusting sponge.

Whiskered Prowfish is not targetted by fishers, but sometimes it is found in lobster pots (Hutchins and Swainston 1986; Gomon et al. 1994). It is noted that the Whiskered Prowfish was not recorded during bycatch surveys in the South Australian Rock Lobster Fishery (e.g. Prescott 2001; Brock et al. 2004). Given the habitat of this species, it is likely to be a component of the bycatch in benthic trawls (including prawn trawls); however data are lacking. It is noted that one specimen was recorded during an otter trawl survey of 120 sites in Spencer Gulf in 2007 (Currie and Sorokin 2010), but the frequency of capture in prawn trawls in South Australian waters is not known.

The inshore distribution, benthic nature, and apparent uncommonness of this species in southern Australia may make populations susceptible to decline from habitat impacts in some areas. Baker (2004) summarised many of the habitat impacts in various other parts of SA in which this species has been recorded.
There is no knowledge of reproduction in this species. If dispersal is low, and recruitment of the next generation is strongly site-associated and localised, then that mode of reproduction may increase the vulnerability of populations to site-specific impacts.

To summarise, Whiskered Prowfish is of conservation interest due to its uncommonness (Australian Museum 2012), benthic existence, strong habitat association, low densities per habitat area, slow movements, and probable localised reproduction; all being characteristics that can increase the vulnerability of populations to decline from localised impacts. Additionally, metropolitan Gulf St Vincent is the type locality for this species, and the gulf has been subject to extensive habitat modification and degradation during the past century since the type specimens were collected. In some parts of the range, the species is occasionally taken as bycatch in rock lobster pots, and, given the habitat of this species, is likely to also be a component of the bycatch in benthic trawls. There is very little information known about the relative abundance, biology (particularly growth, longevity and reproduction), habits, and population dynamics of this species.

Figure 14: *Neopataecus waterhousii* from Snellings Beach. Photos (c) K. Lashmar

Antennariidae (Anglerfishes)

Anglerfishes are mostly tropical, and usually benthic. Of the 12 genera that occur globally, 6 of those occur in southern Australia. Distinctive features of anglerfishes include the short, deep, and slightly compressed body; lateral eyes; a large mouth with several rows of small flat teeth; tube-like gill openings (behind and below the base of each pectoral fin) used for jet propulsion; elongate and leg-like pectoral fin lobes (used for crawling); and the first dorsal spine modified into a freely moving, luring apparatus, consisting of a stalk (illicium) and usually an esca (a terminal "bait") (Pietsch and Grobecker 1987; Pietsch, in Gomon et al. 1994; Pietsch 1999; Edgar 2000). The skin of anglerfishes is often spiny, or covered with cutaneous filaments and appendages, which serve as effective camouflage in reef-dwelling species. The colour and pattern of anglerfishes are highly variable, ranging from white, yellow, pink, orange, red, to dark brown and black. Anglerfishes are voracious carnivores that live on the sea floor, and feed on fishes or crustaceans that are attracted to the angler's wriggling esca. However, shallow water coastal species rely less upon this mechanism for prey capture, compared with deep water species. Anglerfishes have large, trapdoor-shaped mouths, and are capable of rapidly seizing large fish that fall prey to their feeding approach, which is to "lie in ambush". Some anglerfish species resort to cannibalism, even if the other is a potential mate. The females usually lay eggs that are embedded in a gelatinous mass, and in temperate species, the eggs are attached to the body of a parent (Pietsch and Grobecker 1980, 1987). The benthic habit, low fecundity, brooding of eggs and limited dispersal ability of anglerfishes makes them susceptible to localised impacts, and increase the vulnerability of such fishes to population decline.

Only one species of anglerfish, the Smooth Anglerfish or White-spotted Anglerfish *Phyllophryne scortea* (**Figure 15**) was observed and photographed at the northern Kangaroo Island sites visited during March and April 2013. The lack of sightings may relate to the cryptic appearance of anglers (hence they are difficult to detect), and the nocturnal behaviour (NB only one night dive was undertaken during the surveys). The example from American River, sighted in April 2013, may have been a female about to lay eggs (R. Arnold, University of Washington, pers. comm. 2013).

Figure 15: *Phyllophryne scortea* at inner American River, April 2013. Photo: (c) H. Crawford, SACReD

Phyllophryne scortea is found on shallow reefs, jetties, and in turf and sponge habitats in Tasmania, Victoria, SA and southern WA. In South Australia, there are records from the eastern Great Australian Bight through to the Fleurieu Peninsula and Kangaroo Island. The species is considered to be common in parts of Gulf St Vincent (GSV), below jetties, and in boulder reefs. The Smooth Anglerfish is also a minor component of the prawn trawling bycatch in Spencer Gulf. *P. scortea* has been recorded to around 45m deep, but is usually found in shallower depths, less than 15m, and the minimum depth reported is 1m.

Smooth Anglerfish are not often seen because they usually live under rocks / boulders, ledges, or pieces of debris, commonly hanging upside down. Specimens, particularly those observed in the Yorke Peninsula area of South Australia, are highly variable in colour and pattern (e.g. orange-red, orange, yellow, white, pink, brown, dark grey, or black, with variably coloured blotches and other markings). Smooth Anglerfish have numerous cutaneous appendages on the body, and cream, white and/or pink patches that resemble coralline algae, and provide camouflage. The esca ("bait") of the Smooth Anglerfish's lure mimics an amphipod on which sand gobies (*Nesogobius* species) feed, and the Smooth Anglerfish feeds on these gobies.

For anglers that rely upon sponge habitats, any processes that result in removal of sponges might also adversely affect populations. Examples include trawling; coastal dredging; land-based discharges that cause sedimentation and / or eutrophication; benthic damage due to excessive and unregulated diving. Some temperate anglerfishes are sought after in the specialist aquarium trade (which may cause localised population depletion), but there is no information on the capture of this species in southern Australia for that purpose.

6. Results (ii) RLS Transects Summary

The results of the KI FOTS Reef Life Survey monitoring in March and April 2013 have been summarised in a separate report (Reinhold et al. 2014), and will not be repeated here. However, a brief summary is provided below, of fish species numbers per site, and various species which were recorded only at one of the 10 sites (**Table 12**). The average number of fish species recorded per transect varied from 2.6 at Muston (a unique, shelly-sand site in American River, rich in sponges and green seaweeds) to 11 at Western River Cove. Other sites at which 8 to 9 fishes per transect were recorded included reefs at Stokes Bay and Snellings Beach on the north coast, and north coast; Frenchman's in Western Cove, Laver's Reef in Eastern Cove, and Kangaroo Head on the Dudley Peninsula.

Table 12: Number of fish species recorded per site and per transect during Reef Life Surveys, March and April 2013.

Site	Date(s)	No. Transects	Total No. Bony Fish Spp. Recorded	Average No. Fish Spp. per Transect	No. Fish Spp. Recorded Only at that Site
Green Cliffs	25/03/2013	6	36	6	3 or 4 (1 unverified)
Muston	14/03/2013; 22/03/2013	5	13	2.6	1
Western River Cove	23/03/2013	3	33	11	1, 2 or 3 (2 unverified)
Stokes Bay West	25/03/2013	4	33	8.3	1 or 2 (1 unverified)
Lavers Reef	22/03/2013	4	37	9.3	1 or 2 (1 unverified)
Snellings Beach	17/04/2013	4	36	9	2 or 3 (1 unverified)
Kangaroo Head	24/04/2013	3	26	8.7	2
White Point	23/04/2013	3	13	4.3	-
Frenchman's	05/03/2013, 24/04/2013	4	34	8.5	-
Ironstone Hill Reef	25/04/2013	4	23	5.8	-

For 7 of the 10 sites at which Reef Life Survey transects were undertaken in March and April 2013, a number of fish species were recorded only at one site. **Table 13** lists such species, including several which have not been verified, and may have been mistaken for other, more commonly recorded species which are similar in appearance. Examples include Banded Sweep (similar to Sea Sweep) and Elongate Bullseye (similar in appearance to Orange-lined Bullseye). Some of the fishes recorded at only one site are small benthic species which may sometimes be missed when present at other sites (e.g. weedfish, Snakeskin Wrasse and Dragonet), and others are mobile species which move between habitats (e.g. Snook, and Southern School whiting) and hence are unlikely to be commonly recorded during reef surveys. Some of the species recorded only at one site mainly occur in deeper waters, and hence their presence on shallow reefs is incidental (e.g. Barber Perch).

One of the species on the Conservation Council of South Australia's "In Peril" list of fish species which may be vulnerable to population depletion was recorded at only one site, that being the Long-snouted Boarfish *Pentaceropsis recurvirostris*, sighted at Western River Cove. This is a territorial, slow-moving species, which belongs to a family of long-lived fish species, the Pentacerotidae. It is easily speared, and also caught by other fishing gear. In some parts of southern Australia, populations have been depleted by over-fishing using a variety of methods (Baker 2008, 2011, and references therein), and lightly fished or unfished "refuge" areas are uncommon in nearshore areas. Parts of Kangaroo Island serve that role for Long-snouted Boarfish.

Table 13: Fish species recorded at only one site, during Reef Life Surveys, March and April 2013.

Site	Date(s)	No. Transects	Fish species recorded by divers only at that Site
Green Cliffs	25/03/2013	6	• Painted Stinkfish *Eocallionymus papilio* • Short-headed Worm Eel *Scolecenchelys breviceps* (species unverified, but assumed to be one of the 3 worm eel species which occur in shallow waters in SA) • Snook *Sphyraena novaehollandiae* • Southern Roughy *Trachichthys australis* (unverified)
Muston	14/03/2013; 22/03/2013	5	• Smoother Angler *Phyllophryne scortea*
Western River Cove	23/03/2013	3	• Velvet Leatherjacket *Meuschenia scaber* (unverified) • Banded Sweep *Scorpis georgiana* (unverified) • Southern School Whiting *Sillago bassensis* • Long-snouted Boarfish *Pentaceropsis recurvirostris*
Stokes Bay West	25/03/2013	4	• Dragonet *Bovichtus angustifrons* • Elongate / Slender Bullseye *Parapriacanthus elongatus* (unverified)
Lavers Reef	22/03/2013	4	• Snakeskin Wrasse *Eupetrichthys angustipes* • Notched Threefin *Trinorfolkia incisa* (unverified)
Snellings Beach	17/04/2013	4	• Goblinfish *Glyptauchen panduratus* • Stars and Stripes Leatherjacket *Meuschenia venusta* (unverified) • Whiskered Prowfish, *Neopataecus waterhousii*
Kangaroo Head	24/04/2013	3	• Barber Perch *Caesioperca rasor* • Weedfish *Heteroclinus* sp.
Frenchman's	05/03/2013, 24/04/2013	4	-
White Point	23/04/2013	3	-
Ironstone Hill Reef	25/04/2013	4	-

7. Discussion

A summary of locations within the KI NRM region in which fish species of conservation interest have previously been investigated includes the following studies. Note that surveys relating specifically to recreational fishing catches are not included here:

- During the 20th century, museum expeditions were made in 1966 and 1975 to document the fish fauna of Kangaroo Island. C.J.M Glover of the SA Museum wrote up the results in the *Natural History of Kangaroo Island* (Tyler et al. 1979), along with previous records, such as the collections of A.H. Zietz in 1887-88. Not all of the 231 fish species known from Kangaroo Island during the 20th century were documented in Glover's chapter, but of those which were, a number of uncommonly recorded and strongly habitat-associated fishes were included, such as several weedfish and pipefish species, as well as blindfish and shore eel.
- In 2002, Scoresby Shepherd of SARDI Aquatic Sciences and colleagues surveyed of juvenile, sub-adult and adult Western Blue Groper abundance and habitat preference at 10 locations along the north (7 sites), west (1 site) and east (2 sites) coasts of KI (Shepherd et al. 2002). During those surveys, other reef fishes (including some species of conservation interest such as Brown-spotted Wrasse) were recorded.
- In 2004, KI NRM visually estimated fish species abundances and size compositions along measured transect lines, or during standard timed swims, at reefs in Emu Bay, D'Estrees Bay and Hanson Bay (Shepherd et al. 2004). Species of conservation interest which were recorded include Western Blue Groper *Achoerodus gouldii*, Blue-throated Wrasse *Notolabrus tetricus*, and Purple Wrasse *N. fucicola*.

- In November 2007, as part of a South Australian government-supported small grant project, divers from SACReD surveyed 16 locations along north-eastern and eastern Kangaroo Island in November 2007, and documented records of common reef fish species, rarely recorded species, endemic species, and potentially threatened commercially and recreationally fished reef species, using timed directional swims, and visual searches (Baker et al. 2008; Shepherd et al. 2008, 2009).
- In December 2008, as part of a Commonwealth-funded grant project, divers from SACReD surveyed 9 locations along northern Kangaroo Island in December 2008, and documented records of common reef fish species, rarely recorded species, endemic species, and potentially threatened commercially and recreationally fished reef species (Baker et al. 2009b; Shepherd et al. 2009). Species of conservation interest which were recorded using timed swims include Western Blue Groper *Achoerodus gouldii*, Blue-throated Wrasse *Notolabrus tetricus*, Brown-spotted wrasse *Notolabrus parilus*, Maori Wrasse *Ophthalmolepis lineolatus*, Harlequin Fish *Othos dentex*, Bight Redfish *Centroberyx gerrardi*, Swallowtail *Centroberyx lineatus*, Southern Blue Morwong *Nemadactylus valenciennesi*, Long-snouted Boarfish *Pentaceropsis recurvirostris*, and Southern Blue Devil *Paraplesiops meleagris*. The uncommonly seen Western Upsidedown Pipefish *Heraldia* sp. was also recorded.
- In 2009, a summary of reef fish studies was produced (Shepherd et al. 2009), which included studies of the abundance of the Western Blue Groper in the KI area (Shepherd et al. 2002), the abundance of reef fishes at a number of sites around the island (Shepherd et al. 2004; Brock and Kinloch 2007); the abundance of species at some north coast sites (Shepherd and Baker 2008) and the fishes of NE Kangaroo I. in Nepean Bay and Eastern Cove (Shepherd et al. 2008). The report included the results of reef fish surveys in the region conducted in 2002-05 (reported by Shepherd and Baker 2008) and of more recent SACReD surveys in November 2007 and December 2008.
- In 2009 and 2010, an acoustic telemetry tracking project was undertaken at a site on north-western Kangaroo Island, monitoring movements and estimating the home range of Western Blue Groper in the area (Bryars et al. 2012).
- In 2010 and 2011, an acoustic telemetry tracking project was undertaken at a site on north-eastern Kangaroo Island, monitoring movements and estimating the home range of Harlequin Fish in the area (Bryars et al. 2012).

In South Australia, considerable research has now been undertaken on several fished species of conservation interest which occur on Kangaroo Island (Harlequin Fish, Western Blue Groper and Southern Blue Devil - e.g. Bryars 2011, Bryars et al. 2012), and it is important that the results of such studies are utilised in SA government-based impact management strategies, and in conservation planning, including the placement and monitoring of sanctuary zones. Sanctuary zones of marine parks on Kangaroo Island have now been legislated (DEWNR 2013), but it is important that the performance of these zones is monitored over time, according to well-defined and justifiable criteria. This includes the adequacy of locations, size of zones, and suitability of boundaries for protection of both habitat and species populations (including fishes of conservation interest).

In contrast to some of the larger, more charismatic reef fishes, far less is known about the current distribution, relative abundance, and life history of many apparently uncommon or rare marine fishes, including a number of SA endemic species, for the following reasons:

(i) few areas have been comprehensively surveyed (and previous surveys were not targetted towards finding rare or endemic species, as specified above); hence there are substantial gaps in survey and collecting effort for numerous areas;

(ii) the inability to compare “like with like”, because records are an amalgamation of data using different sampling techniques, variable survey or collecting intensity per area, and different time scales (ranging from the present back to several decades);

(iii) the majority of the rare marine fishes in SA are known from few specimen records, some of which date back to the early or mid 20th century;

(iv) some possibly rare and/or endemic marine fishes live in cryptic and under-surveyed habitats, such as caves, crevices, the underside of boulders, or are well camouflaged in the vicinity of sponges, macroalgae, or at the base of seagrasses.

Current field searches by SACReD members have helped to improve the state of knowledge about the distribution and habitat of a number of rarely recorded marine fishes in various coastal reef areas of South Australia (e.g. Baker et al. 2008a, 2008b, 2009a, 2009b). The current 2013 field work on northern and NE Kangaroo Island is complementary to previous reef fish surveys we have undertaken, using both visual transects (timed swim method), and targetted searches of the benthos (e.g. Baker et al. 2008b, Shepherd et al. 2008, 2009).

The combination of Reef Life Survey transects and specific searches by divers in reef micro-habitats can be helpful in determining the fish species composition in nearshore reef areas. As shown in the results of the 2013 field work on Kangaroo Island, neither method alone is sufficient to document reef fish composition. There were reef fish species recorded by RLS transects and not by targetted independent searches, and vice versa. One example is Harlequin Fish - none were recorded in RLS transects, but 2 were observed and photographed during targetted searches by SACReD divers.

In addition to assisting the documentation of reef fish composition, the RLS program on Kangaroo Island has many other benefits. This long-term program to monitor densities of fishes, invertebrates and seaweeds in coastal rocky reef communities is generating data which can be used for detecting changes in reef "health" over space and time. RLS monitoring on Kangaroo Island has been undertaken since 2009, and 12 of the 30 reef sites which were surveyed, have now been selected for long-term reef health monitoring. The program will be useful, with the development of the marine parks program in South Australia, for comparing sanctuary and non-sanctuary zones over space and time. The RLS program is also a valuable way of bringing the local Kangaroo Island diving community ("citizen scientists") together with marine scientists, to work towards mutual marine research, management and conservation goals.

Reefs on northern Kangaroo Island are in comparatively good health compared with those along Adelaide metropolitan coastline, which have suffered from multiple degrading processes, such as over-fishing, run-off from coastal development, effluent and stormwater discharge, sedimentation and marine debris. Kangaroo Island reefs are therefore good subjects for long-term monitoring and comparison.

It is noted that a national spearfishing competition was held on northern Kangaroo Island in 2006, and reef fishes of many species from this relatively lightly fished area were targetted, including species of conservation concern such as Harlequin Fish, Long-snouted Boarfish, and Rock Ling. In 2014, the national spearfishing competition is being held again on Kangaroo Island, but Harlequin Fish and Long-snouted Boarfish have now been removed from the target list.

A number of the accessible reefs around Kangaroo Island are also fished periodically by recreational fishers and charter boats, likely at lower frequency than in some other parts of South Australia. The recent closure of some areas of Kangaroo Island to fishing will provide an opportunity for reef changes to be documented over space and time. In areas protected from fishing, ecological changes can occur over time in composition of reef fishes, invertebrates and seaweeds (Edgar and Barrett 1999; Halpern 2003; Edgar and Stuart-Smith 2009; Edgar et al. 2009), and the Kangaroo Island reefs would provide an ideal subject for such investigations.

An example of "reef health" on Kangaroo Island may be presence of Harlequin Fish, which are now rarely recorded along metropolitan and southern Fleurieu reefs, but are more commonly recorded along northern and north-eastern Kangaroo Island, as indicated by results of several surveys during the past decade (described in this report), as well as the capture of 37 individuals from northern Kangaroo Island for an aquaculture project in 2011 (Li and Hutchinson 2013).

Surveys and fishing records (Baker 2004, 2012) indicate that there are few other parts of the central South Australian coast where this species is commonly recorded. In other areas where this species may occur in any appreciable numbers, such as island reefs south of Spencer Gulf and Eyre Peninsula, and reefs the eastern Great Australian Bight, the species is not protected from fishing pressure.

The reefs of northern and north-eastern Kangaroo Island may provide an important, lightly fished refuge for Harlequin Fish, and this should be considered in management arrangements for marine parks, including management of fishing access. Similar statements could be made for Western Blue Groper and Southern Blue Devil, which live along much of the narrow coastal rocky strip of northern and north-eastern Kangaroo Island. Kangaroo Island reefs are also important habitat for Brown-spotted Wrasse, and the large individuals recorded here are rarely observed anywhere else in South Australia. A number of other species which are listed in South Australia by the Conservation Council as "In Peril" also occur on Kangaroo Island reefs, such as Southern Blue Morwong (Queen Snapper), Long-snouted Boarfish, Leafy Seadragon and Weedy Seadragon, and three species of Wobbegong shark.

In addition to reef habitats, areas such as the legislatively protected Pelican Lagoon on Kangaroo Island provide important habitat for a number of narrow range, uncommon recorded, site-associated fish species, including live-bearing fishes such as Spotted Snake-blenny *Ophiclinops pardalis*.

Kangaroo Island is situated at the boundary of two major biogeographical regions (Womersley 1984 and 1990; Baker 2004), and therefore supports fish species from both the warm temperate Flindersian province, and the cool temperate Maugean Sub-Province. Data from Kangaroo Island reefs can assist biogeographical studies over a southern Australian scale. Although the shallow subtidal reef strip of northern and north-eastern Kangaroo Island is narrow in depth and distance from the coast, and the northern reefs grade into seagrass further offshore (Shepherd and Sprigg 1976; Baker 2004), this reef strip supports a rich and diverse fish fauna, including a number of species which are potentially threatened, as discussed above. Patch reefs within Kangaroo Island bays are similarly important. It is notable that on comparatively small patch reefs such as Laver's Reef in Eastern Cove and Frenchman's in Western Cove, similar numbers of fishes per transect were recorded as occurred at Western River Cove on the north coast, where the highest average number of fish species per RLS transect was documented during the 2013 field work.

There are still many gaps in the knowledge of reef fish species composition around Kangaroo Island, and little is known of the distribution, relative abundance habitats, life history (e.g. reproductive mode, which provides an indication of resilience or vulnerability to environmental impacts) and ecology of many reef fishes. In addition to monitoring work both inside and outside of marine park sanctuary zones, specific field research is required. Non-invasive techniques include careful observation and macro-photography of benthic populations at regular intervals over time, which can provide some indication of habitat association and fidelity, growth, reproductive status and (for benthic reproducers which guard the young) brood size and success.

Additionally, further conservation status assessment (including a Statewide assessment) of reef fishes in South Australia is required over time. Many reef fishes may be considered rare or data deficient, based on the paucity of records. A high but currently unquantifiable number of apparently rare species are likely to be more widespread but have not yet been sampled due to their small size and/or cryptic habits. Without substantial survey effort, it is not possible to determine true "rarity" over any spatial scale, or to produce reliable systematic maps of the range of various fish species.

A comprehensive description of the true biodiversity, biogeography and value of reef fishes in South Australia cannot be undertaken without considering the rare, endemic and other potentially threatened species. Rarely recorded, live-bearing, strongly habitat-associated species in particular deserve more emphasis due to their vulnerability, and considering that most reef fish studies to date across southern Australia have focussed on "iconic" and charismatic species, or on commercially valuable species.

8. Summary of Recommendations

- Ongoing support for the Reef Life Survey program on Kangaroo Island should be provided at both Commonwealth and State levels, to ensure that long-term data collection can continue to occur at reef monitoring sites. The RLS program on Kangaroo Island, which has been operating since 2009, is a reliable and sensitive monitoring method, and should be continued both in and out of sanctuary zones of marine parks, and in Aquatic Reserves, not only to provide baseline data, but to detect and monitor ongoing changes over time. This will assist in determining the impacts of local activities (such as fishing, and coastal developments, for example), and global-scale stressors (e.g. climate change).

- Undertake further surveys to better determine the composition, distribution and relative abundance of rarely recorded and endemic fish species in South Australia, particularly in and adjacent to sanctuary zones of marine parks, and in Aquatic Reserves; also in data-poor areas (i.e. those which are infrequently surveyed), and in port areas, boat harbours and metropolitan bays, and other highly modified areas where threatening processes exist.

- Consider increased habitat protection for species on northern Kangaroo Island which are vulnerable to over-exploitation, such as Harlequin Fish, Western Blue Groper, Orange-spotted Wrasse and Southern Blue Devil. This would include restrictions on fishing and collecting in areas where these species occur.

- Targetted research work should be undertaken where possible on the abundance, biology (particularly growth, longevity and reproduction), habits, and population dynamics of rarely recorded and endemic species.

- Protection is required for habitats with which live-bearing benthic fishes such as snake blennies and eel-blenny are strongly associated. Examples of threatening processes include physical damage (e.g. from boats, anchors, dredging etc), sediment smothering, and nutrient enrichment. In particular, it is important to protect where possible existing Aquatic Reserves and also sanctuary zones of marine parks, from physical impacts, nutrient enrichment, and sedimentation, especially those which are known to provide habitat for apparently endemic / limited range species of fishes.

- Further studies are required to determine the current distribution of benthic fish species known only from very few records (particularly old records from the late 19th and early 20th century). Some of these species are small and inconspicuous, and require trained taxonomists for their precise identification. Specialised training of divers is also required, to help them identify rarely recorded and endemic fishes of conservation interest, at sites across the KI NRM region.

- Separation of species in commercial catches of wrasses in South Australian waters is required, and catch statistics should be monitored over space and time. Over time, in areas which are shown (e.g. through RLS monitoring) to be “hot-spots” for wrasse abundance, fishing should be prohibited, to protect reef populations of these long-lived, site-associated species from over-exploitation. Measures to reduce the bycatch mortality of wrasse species in rock lobster pots (and on lines) should be introduced, along with a prohibition on retention for bait when caught.

- Further investigation and assessment of the conservation status of marine species in South Australia is required, particularly a Statewide status assessment (as recommended in DEH’s 2007 *No Species Loss* nature conservation strategy, which was revised in 2012).

- Following a Statewide assessment (see above), listings under the schedules of the *SA National Parks and Wildlife Act* or other suitable legislation should be considered. Complementary to listing would be the development of regional and local conservation strategies. Recovery plans may also be required in future - for example, in the case of some exploited species.

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