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

Part 1: Marine Invertebrates

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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. 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, Sarah-Lena Reinhold. Renate Velzeboer from SACReD also collected RLS data during the March field trip.

Thanks to the marine taxonomists and other marine researchers who helped to identify photographs taken by SACReD divers during the April 2013 Kangaroo Island field trip. These include (in alphabetical order):

- Mr Bob Burn, Honorary Associate, Museum Victoria
- Dr Andrea Crowther, South Australian Museum
- Mr John Chuk, Platyhelminthes and Opisthobranch researcher, associated with Museum of Victoria
- Ms Audrey Falconer, Marine Research Group of the Field Naturalists Club of Victoria
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- Ms Shirley Sorokin, SARDI Aquatic Sciences, South Australia
- Dr David Staples, Museum Victoria
- Dr Robin Wilson, Museum Victoria.

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We are grateful to Dr Andrea Crowther from the South Australian Museum (SAM) for checking the opisthobranch and nudibranch collection at SAM, which enabled much of the content in **Appendix 2** to be included.

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

Part 1 - Marine Invertebrates

SUMMARY

In 2013, with assistance from the Australian Government's Caring for our Country program, and DEWNR's Natural Resources - Kangaroo Island (Kangaroo Island NRM Board), a joint field work was undertaken by Kangaroo Island Friend's of the Sea, an NRM-supported community group which uses a standard marine monitoring method developed by Reef Life Survey program, to monitor the species composition of reef sites on Kangaroo Island; and South Australian Conservation Research Divers (SACReD), a community-based marine group which aims to learn more about the distribution and habitats of rarely recorded, endemic, and other marine species of conservation interest at sites along the northern coast of Kangaroo Island.

Part of the field work aimed to contribute towards an understanding of the biodiversity of marine invertebrates in the KI area, so that populations of rare, uncommonly recorded and endemic species may be better conserved, and protected from threatening processes. The KI field work formed part of a larger, Statewide marine species research project in which SACReD has been involved since 2011. SACReD's current searches of invertebrate fauna include taxa in Anthozoa (anemones and corals); Prosobranchia (sea snails); Opisthobranchs / Heterobranchia (sea slugs / nudibranchs); Platyhelminthes (flatworms); Nemertea (ribbon worms); Polychaeta (sea worms); Ascidiacea (ascidians / sea squirts), and several other groups.

Between March 2013 and April 2013, 5 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 2,000 photographs of marine invertebrates. To date, 10 marine taxonomists and other specialists from around Australia have assisted SACReD's rare and endemic marine invertebrates' project in KI NRM region, by offering advice, and identifying macro-photographs of invertebrates taken by SACReD divers. A list of unidentified species has been prepared for which samples will later be collected and lodged at the South Australian Museum, for transfer to various taxonomists in south-eastern Australia. Results of the project to date have included records of taxa apparently not previously recorded anywhere else (i.e. "new", undescribed species); undescribed species of tropical affinity (some of which may not have previously been recorded in SA), and range extensions for rarely recorded species (previously known from only one or two records). Our group's field investigations, complemented by discussions with marine taxonomists, have helped to improve the state of knowledge about the distribution and habitat of a number of rarely recorded and endemic marine invertebrates in South Australia, as well as rarely recorded tropical species, and several undescribed and previously unrecorded taxa.

To date, targetted searches for marine invertebrate have been concentrated in few areas on Kangaroo Island, mainly the coves and bays of the northern and north-eastern coast. For many parts of the KI NRM region, little is known of the rarely recorded and endemic marine invertebrate fauna, other than the area between Western River Cove and Snug Cove, and parts of the north-eastern bays, where intensive collecting and photography occurred over several years during the late 1990s and early 2000s. Additionally, collecting trips to gather opisthobranchs for taxonomic description at museums occurred during the 1970s, and "specimen shells" (various species of valuable gastropod mollusc) have also been collected from sites off north-eastern Kangaroo Island, particularly during the 1980s and 1990s. 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 and collecting effort, it is not possible to determine true "rarity" over any spatial scale, or to produce reliable systematic maps of the range of various invertebrate species. It is planned that the next stage of this project will involve searches, macro-photography and specimen collection (for taxonomic identification) at areas within the KI NRM region which have not previously been searched, including more remote locations, and areas within and outside of the sanctuary zones of marine protected areas.

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1. Introduction

In South Australia, the distribution and taxonomic identity of marine invertebrates from numerous phyla are poorly known, and based on infrequent and opportunistic collections. Some species are known only from the type locality, and others from a single museum specimen. There has generally been a lack of survey work to catalogue the marine invertebrate fauna of SA, other than several targeted collections at few localities, during the 1970s, 1980s and 1990s. Also, in recent decades there has been a lack of staff within SA to work on the taxonomy of many major groups of invertebrates, particularly the identification of new and currently undescribed species. Reviews of the current status of marine invertebrates within two NRM regions of South Australia were undertaken in 2011 (Baker 2011a, b), based on a 4 year literature review of museum records (State, national and international); taxonomic databases; scientific monographs, papers and other literature; university and government survey reports; discussions with taxonomists, and divers' records and photographs. Those reviews also discussed national efforts to document the conservation status of marine invertebrates, and the application of threatened species legislation at national and state levels to marine invertebrate listings. The aforementioned reviews are being used to inform future survey efforts, to understand more about the marine invertebrate fauna in various coastal regions of South Australia, particularly marine species of conservation interest.

With support from the Australian Government's Caring for our Country program, and DEWNR's Natural Resources - Kangaroo Island (Kangaroo Island 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 interest at various sites along the northern coast of Kangaroo Island. The field work was undertaken during a companion project on reef monitoring, by Kangaroo Island Friend's of the Sea, an NRM-supported community group which uses the standard marine monitoring method developed by Reef Life Survey program. Part of the field work aimed to contribute towards an understanding of the biodiversity of marine invertebrates in the KI area, so that populations of rare, uncommonly recorded and endemic species may be better conserved, and protected from threatening processes. The KI field work formed part of a larger, Statewide marine species research project in which SACReD has been involved since 2011. SACReD's current searches of invertebrate fauna include rarely recorded and endemic taxa in Anthozoa (anemones and corals); Prosobranchia (sea snails); Opisthobranchs / Heterobranchia (sea slugs / nudibranchs); Platyhelminthes (flatworms); Nemertea (ribbon worms); Polychaeta (sea worms); Ascidiacea (ascidians / sea squirts), Crinoidea (Feather Stars), Holothuroidea (Sea Cucumbers), Ophiuroidea (Brittlestars), Asteroidea (sea stars), and several other groups. To date, 11 marine taxonomists and other specialists from south-eastern Australia have assisted SACReD's rare and endemic marine invertebrates' project in the KI NRM region, by offering advice, and identifying macro-photographs of invertebrates taken by SACReD divers. This report details some of the results so far.

2. Conservation of Marine Invertebrates in South Australia

South Australia's *No Species Loss* nature conservation strategy (DEH 2007) and the *Living Coast Strategy* (DEH 2004) both stated the South Australian government's commitment to providing protection for threatened marine species, including evaluation processes, and the development of recovery plans. To date, there has been no formal Statewide evaluation of potentially threatened marine invertebrates in South Australia, but a number of NRM-supported reports and projects have attempted to document the rare and potentially threatened marine invertebrate fauna in two NRM regions (Baker 2011a, 2011b, Baker et al. 2013 and 2013b, and this report). The *No Species Loss* strategy in SA is currently being updated in 2013.

In South Australia, although there is provision for listing threatened species under schedules of the *National Parks and Wildlife Act 1972*, invertebrates have not been listed under this Act as "protected animals", because "animals" are defined as mammals, birds and reptiles. Therefore, marine invertebrates in South Australia cannot be classified as rare, vulnerable or endangered under schedules of the *National Parks and Wildlife Act.*

In South Australia, marine invertebrates and their habitats can be legally protected in Aquatic Reserves (declared under the *Fisheries Act 1982*, now known as the *Fisheries Management Act 2007*) and marine parks. The fisheries legislation - section 42 of the former *Fisheries Act 1982* - enables various categories of "fish" (including invertebrates) to be declared as "protected", with collection prohibited. Acts in South Australia which can benefit marine invertebrate conservation indirectly include the *Coast Protection Act 1972*, the *Environment Protection (Marine) Policy 1994*, and the *Marine Parks Act 2007*.

Threatened species legislation at a national scale in Australia is discussed in Baker (2011a). At a global scale, IUCN's Red List of Threatened Species (IUCN 2001) is widely recognised as a means of assessing and categoring the conservation status of species. 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; IUCN Standards and Petitions Subcommittee 2011). 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 (Davey 1993). Species which satisfy all three criteria are intrinsically vulnerable to decline (Ponder et al. 2002). 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 the shallow subtidal (e.g. several meters deep), and therefore are unlikely to be recorded in intertidal surveys, even if present in the area. The reverse is also true (common in the intertidal, but unlikely to be recorded subtidally).

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.

3. Characteristics that Determine Vulnerability of Marine Species

There are numerous recognised life history and population characteristics that can render marine species vulnerable to decline. **Table 1** below lists many such characteristics, some of which are more common in bony fishes and sharks, but many also apply to invertebrates. In addition, there are other factors which can increase the vulnerability of marine invertebrate species to decline. Examples include a readily accessible habitat (e.g. if collected for food or trade); high visibility to collectors (i.e. large size and/or bright colours and patterns), and high value (especially specimen shells, or highly valued food species) (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 the majority of these marine invertebrates.

Inferences can be made from similar taxa - such as those within the same family, or the same genus - that exhibit vulnerable population characteristics. For example, in some gastropod molluscs in temperate waters, brooding of young or otherwise production of young via direct development (rather than having widely dispersed planktonic larvae), is often also associated with low fecundity and narrow geographic range of specific breeding populations, and these characteristics renders such molluscs at greater risk of extinction. Examples include the cowries and the volutes. However, for species with unknown modes of reproduction, whilst inferences can be made by comparison with what is known of closely related taxa, that is not always reliable, because there is often much variation, even within genera or within a species (Ponder et al. 2002).

Table 1: 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 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 at 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. Regeneration from fragments does not occur 18. Short distance dispersal / limited dispersal ability 19. Poor competitive ability 20. Poor colonizing ability 21. Low adult mobility 22. Irregular recruitment by larval settlement and/or low level of larval settlement 23. Strong Allee effects at settlement (i.e. when reduction in population density has a significant effect on settlement strength)
Range & Distribution (related to rarity)	24. Horizontal distribution restricted to nearshore area (compared with offshore) 25. Narrow depth range (= narrow vertical distribution) 26. Small geographic range / restricted distribution 27. High patchiness / fragmentation of population within range (i.e. composed of few small, highly fragmented populations) 28. High habitat specificity / specialisation 29. High vulnerability to habitat destruction by people
Trophic Level	30. High trophic level
Other Ecological Factors	31. Close association with threatened habitat, or threatened taxa (as parasites or 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 / ornaments etc (promotes exploitation).
Miscellaneous	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

4. Methods

The Kangaroo Island surveys in 2013 were a regional extension of previous work undertaken in coastal waters in other parts of South Australia, by South Australian Conservation Research Divers (SACReD). For previous surveys, a preliminary list of target species was made, based on reviews of uncommon marine invertebrates in adjacent areas of South Australia (e.g. Baker 2011a, 2011b). Prior to the field trips, diver education included viewing photos of some of the target species, and provision of a written list of some of the target species. Divers had also previously viewed a slideshow of common and broadly distributed species which they should not photograph during the field work. 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 2** below, in order of date, with corresponding depth of dive.

Table 2: Locations within the KI NRM region, where SACReD divers and associates searched for endemic and uncommonly recorded marine invertebrates 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	28/04/13	-35.67367	136.9700	5-6m

At each site in **Table 2**, 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 invertebrates were made on the bottom, under rocks, in crevices, under ledges, on jetty piles and other structures (at jetty sites), and on (and amongst) macroalgae. Photographs were taken when potential species of interest were found. Dive conditions were not ideal for macro-photography. At some sites (such as American River), there was a significant current running, and at other sites, such as Ballast Head and Lavers' Reef, visibility was poor (**Figure 1A, 1B**).

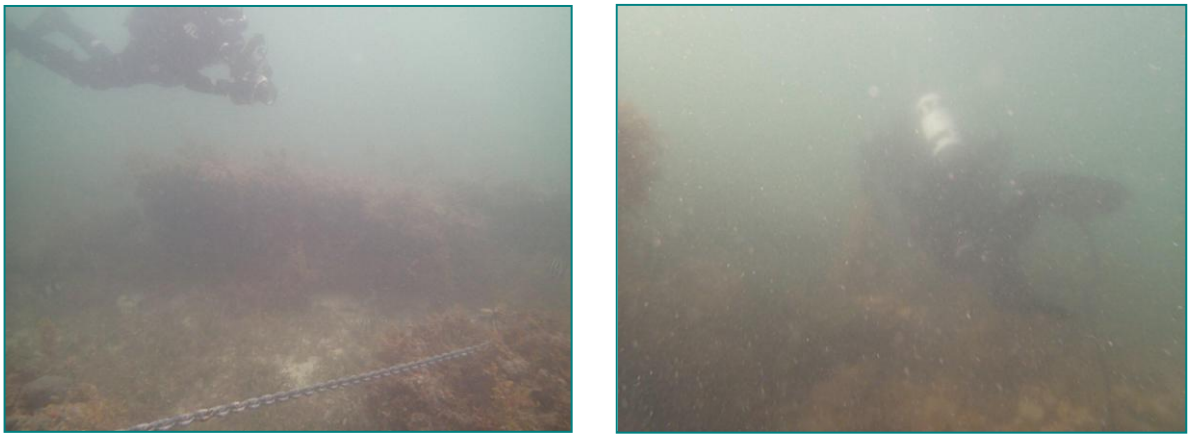

Figure 1: Examples of low visibility in the water at two dive sites during the April 2013 survey: Lavers Reef (A) and Ballast Head (B). Photos (c) H. Crawford.

The searches by SACReD divers for rare, endemic and potentially threatened species were complimentary 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 use the internationally-recognised Reef Life Survey (RLS) method, developed at the University of Tasmania. In the RLS method, invertebrates and cryptic fish are surveyed in two 1m wide bands on either side of a 50m transect line (2 x 1m x 50m per transect). During the March 2013 field work, a SACReD diver participated in some of the RLS monitoring dives undertaken by KI FOTS and NRM staff, and also searched for rare invertebrates during those 7 dives (**Table 3**). The results of the KI FOTS project have been summarised in a separate report, and will not be reiterated here, because no rare, endemic or potentially threatened invertebrate species were found using that method.

Table 3: Locations within the KI NRM region, where Friends of the Sea divers and KI NRM staff undertook dives to collect Reef Life Survey data in March and April 2013. Sites at which a SACReD diver searched for uncommonly recorded and endemic marine invertebrates during transect dives are highlighted in grey.

Site name	Date	Latitude	Longitude	Depth	Direction	Visibility
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

Several invertebrate samples (of platyhelminthes, polychaetes and nemerteans) were collected from sites below 2m deep during the April field trip and preserved for identification at a later date. Over all sites dived in March and April 2013 at Kangaroo Island, SACReD divers took more than 2,000 photographs of invertebrates. Photos were sorted, labelled and catalogued, and divided into phyletic groups. Animals in photographs were identified to species level where possible. Specialists in the 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.

5. Results

Anthozoa (Anemones and Corals)

The Class Anthozoa includes the sea anemones and stinging sea anemones, tube anemones, jewel anemones, zoanthid anemones, soft corals, gorgonian corals, hard corals, and sea pens. Members of the Class Anthozoa occur as polyps or colonies of polyps, most of which can reproduce either sexually (by releasing sperm and eggs into the water, which fuse to become a mobile larva which disperses), or asexually, by budding off tiny new individuals from the body wall (Edgar 2008; Gowlett-Holmes 2008). The taxonomy of anthozoans in south-eastern and southern Australia is poorly known. Much of the previous anthozoan identification work was based largely on museum specimens, which bear little resemblance to live specimens. A number of named species may really be the same species, and conversely, a single named species may contain several species that have not yet been correctly identified. Field guides have been known to depict the same species under different names, or use the same name for different species. In some cases, species attributed to a particular genus (e.g. *Epiactis*) might actually not belong to a single genus, but have been assigned to it because they seem to belong nowhere else (D. Fautin, Professor of Ecology and Evolutionary Biology, and Curator of Natural History Museum and Biodiversity Research Centre, University of Kansas, pers. comm. 2009).

Establishing an Australian species inventory, and also determining species' distributions, and the relationship (and overlap) between species of anemone in Australia, New Zealand and other regions, would involve measuring nematocysts of animals from these regions, and comparing morphology and histology. Some species known from one locality are likely to occur much more widely, but records are scarce, because collecting efforts have been opportunistic over the decades, and not systematic. The existence of cryptic species further complicates determination of distribution. The less commonly recorded species of anemone are difficult to identify from photographs, and some remain undescribed. Identification beyond family is a specialist undertaking that requires, in many instances, information about the nematocysts or fertility (D. Fautin, Professor of Ecology and Evolutionary Biology, University of Kansas, pers. comm. 2011). Much work remains to be done, and the taxonomy of anemones is still poorly known (D. Fautin, University of Kansas, pers. comm. 2009, 2011). The taxonomy of a number of anemones in eastern and southern Australia is currently being revised (M. Mitchell, pers. comm. 2012), and will contribute to an improved knowledge of the diversity of this groups in southern Australian waters.

A number of undescribed anemones have been recorded in the KI NRM region by SACReD divers and associates, including two species which may not have been previously recorded, and cannot be identified without examination of internal structures (e.g. nematocysts).

Figure 2A shows a small pink anemone with swollen tentacle tips, photographed at Pelican Lagoon. This species likely belongs to the tropical genus *Telmatactis* (M. Mitchell, pers. comm. 2013), in the Isophelliidae family. To date, there are six species in *Telmatactis* known in Australia, all recorded from Queensland (Scott 2014). The undescribed species from South Australia has also been recorded in the gulfs area of SA (e.g. Gowlett-Holmes 2008). A second unnamed species, for which family is uncertain, was recorded at Kingscote during a night dive (**Figure 2B**). This anemone might belong in the Aiptasiidae (A. Crowther, South Australian Museum, pers. comm. 2013; M. Mitchell, pers. comm. 2014), another anemone family for which there is little published information in Australia, and few records. The photographed example had a bright green column. The green colouring of the column may be indicative of the presence of zooxanthellae or zoochlorellae algae. Anemones which contain these symbiotic algae have photosynthetic properties, and may thus make their own food as well as consuming particles. Specimens are required for taxonomic examination. A long-tentacled anemone, embedded in sponge, was also recorded at Kingscote during a night dive (**Figure 2C**), and this may also be in the Aiptasiidae. The taxonomic affinity of this anemone cannot be determined without examination of the nematocysts of the column (A. Crowther pers. comm., 2013).

Figure 2: Undescribed species in genus *Telmatactis* (A); unidentified species, possibly in the Aiptasiidae family (B); unidentified species, possibly in stinging anemone family Aliciidae, or Boloceroididae, genus *Bunodeopsis* (C, and inset); possibly undescribed species in Actiniidae (M. Mitchell, pers. comm. 2013) (D); *Edwardsia vivipara*, a live-bearing burrowing anemone (E); species in *Epiactis*, related to *E. australiensis* and *E. "thomsoni"* (F).
Photos: © L. Baade (A, F); H. Crawford (B, C, D); D. Muirhead (E).

Another possibly undescribed anemone species was recorded on reef at Ironstone Hill (**Figure 2D**). This small species, with an orange column and short orange tentacles, may be in the Actiniidae family (M. Mitchell, associate of Museum Victoria, pers. comm. 2013).

One family for which there is one named species and several unnamed species in South Australia is the Edwardsiidae, a group of burrowing anemones which live in sand, attached in the sand to a rock, pebble or shell fragment (Gowlett-Holmes 2008). The named species in South Australia, and the one most commonly recorded, is *Edwardsia vivipara* Carlgren 1950 (**Figure 2E**), a live-bearing anemone known from both SA (including KI NRM region) and Victoria (Thomas and Shepherd 1982; McKinnon et al. 2003). It grows to about 6cm, and is found in sand and mud, out in the open, mainly on sheltered coasts, between 1m and 10m (Gowlett-Holmes 2008). *Edwardsia vivipara* has a brown or black column, and white star-shaped tentacles which protrude from the sand and are quickly withdrawn upon disturbance (Thomas and Shepherd 1982). This species may contain symbiotic zooxanthellae algae (Gowlett-Holmes 2008), which would enable the anemone to produce its own food photosynthetically, in addition to taking in food.

Another example of an undescribed anemone species is the bright orange-red anemone with tentacles which have a central stripe (**Figure 2F**), which was recorded by SACReD divers at Ironstone Hill on KI, and has also been found at several locations on Yorke Peninsula (Baker et al 2013), and in other parts of SA and south-eastern Australia. A specimen collected under permit during SACReD's January 2013 field trip to western Yorke Peninsula is currently being examined by an associate of Museum Victoria, to determine its taxonomic identity. The red anemone may be a colour variation of *Epiactis australiensis*, a probable brooding species that is widespread in SE Australia, and may possibly be the same species as what is currently known as *Epiactis thomsoni*, a red (or sometimes red and white striped) species which occurs in New Zealand as well as south-eastern Australia. However, there may be several species in the *Epiactis* complex, including unnamed ones. Taxonomic work is required on the colour variations across the range, to determine how many species there are, and therefore live specimens to match with the photos of colour variants from different locations are very important (M. Mitchell, Museum Victoria, pers. comm. 2012).

There are several hard corals that occur in the Kangaroo Island region. Two of the hard coral species in South Australia, *Scolymia australis* (Milne Edwards and Haime 1849) and *Plesiastrea versipora* (Lamarck 1816) which are widespread and not uncommon, are discussed here due to the vulnerability of populations to decline, particularly over the long term.

Scolymia australis (**Figure 3A**) is mainly solitary in form, found on tropical and temperate Australian reefs from about the intertidal to about 20m deep. It is bright green, and contains symbiotic zooxanthellae algae, from which it derives nutrition. This species also feeds nocturnally on plankton, by extending it polyps. *Plesiastrea versipora* is a colonial coral that forms plates and "bommie" shapes in temperate waters, but is also widespread in the tropical to warm temperate Indo-Pacific, where it can form reefs. Like *Scolymia*, it contains symbiotic zooxanthellae algae, from which it derives nutrition, but also feeds on plankton. *Plesiastrea* can form colonies from a few centimetres up to about 3m across (Edgar 2008).

The two corals discussed above are widespread and not uncommon, and are not considered to be currently threatened on a global scale (e.g. DeVantier et al. 2008; Sheppard et al. 2008; Turak et al. 2008). However, there may be localised threats for particular populations of shallow water species, such as sedimentation of nearshore reefs; nutrient enrichment of coastal waters (e.g. from dredging, coastal developments or discharges), and physical damage from trawling and/or dredging. The undeveloped coastline of northern Kangaroo Island (compared with eastern Gulf St Vincent, for example) provides a refuge for these species from threats such as water pollution.

Hard corals such as *Plesiastrea versipora* (**Figure 3B**) are very slow growing in temperate areas, with rates of less than 1cm per year (Burgess et al. 2009). For example, the base of a 24 cm *Plesiastrea* core that has been analysed from Spencer Gulf was dated at 151 years (Burgess et al. 2004). Burgess et al. (2009) studied 6 colonies of *Plesiastrea* in the South Australian gulfs, and coral age estimates ranged from 90 to 320 years (from counting density bands in X-radiographs), or from 105 to 381 years (using a mass spectrometer). Large, old colonies of *Plesiastrea* in South Australia are rare, and it is considered likely that such colonies below 10m deep have been removed in the gulfs region by trawling (which has occurred since the 1960s). *Plesiastrea versipora* is one of the species for which records of sightings are being collected in South Australia as part of the *Feral and in Peril* program (Conservation SA 2005). Temperate corals, including those in South Australia, may be threatened during this century by global warming, with examples of damaging processes including sea level rise, increased temperature and UV exposure, increased disease susceptibility, increased severity of El Nino–Southern Oscillation events and storms, and increasing ocean acidification (Wilkinson 2004; Carpenter et al. 2008; DeVantier et al. 2008, in: International Union for Conservation of Nature - IUCN 2012).

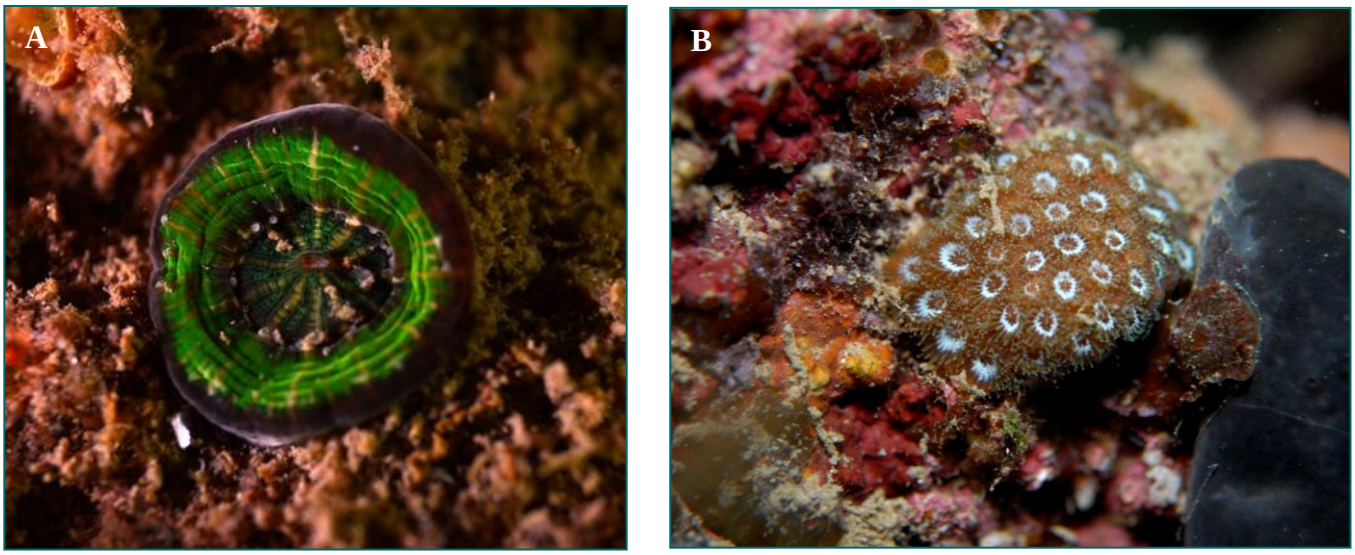

Figure 3A,B: *Scolymia australis* (A); *Plesiastrea versipora* (B). Photos: © L. Baade (A), D. Muirhead (B)

Bryozoans (Lace "Corals" and Moss Animals)

Bryozoans are small, colonial animals (zooids) which live in an exoskeleton produced by the colony. The exoskeleton is mineralised in some groups of bryozoans. Some bryozoans form flat, perforated, or encrusting colonies which look like stony corals. Others form fan-shaped colonies on stalks, and some have erect colonies with many stems and branches, which are often mistaken for seaweeds. Zooids within bryozoan colonies are tightly packed, but each has it own "cell" to live in. Bryozoans are filter-feeders, and there are specialised zooids in some colonies, some used in defence, and others as hatcheries for fertilised eggs. There are hundreds of bryozoan species in SA, and most are difficult to identify without microscopic examination. Some bryozoans are quite large, such as the 30cm high *Adeona grisea*, which lives deep on the floor of Backstairs Passage. An unidentified species in the dome-shaped *Lunulites* genus occurs in Investigator Strait sediments off northern and north-eastern Kangaroo Island (Shepherd and Sprigg 1976); it is supported, cleaned and sometimes propelled along by specially adapted colony members. Broken bryozoan exoskeletons form a significant component of sand in South Australia.

The stalked species *Parmularia smeatoni* (**Figure 4A**) was recorded at Ironstone Hill during the April 2013 field work. This bryozoan is usually found attached to pebbles, or rock in sand (Gowlett-Holmes 2008), in seagrass beds, or in mixed reef patch and seagrass habitats. An unusual feature of this species is its ability to deflate its supporting stalk when it is disturbed, and collapse the colony disc on to the sea floor (Gowlett-Holmes 2008). To date, this species has only been found in South Australia (ABRS 2010).

The second of several uncommonly recorded bryozoan species photographed during the April 2013 field work was a species in the genus *Nevianipora* (**Figure 4B**). In Australia, the few named species in this genus are largely tropical (ABRS 2010; CSIRO 2013). There is at least one unnamed species in *Nevianipora* in South Australia (e.g. Gowlett-Holmes 2008, p. 59). Species in the genus form hard, flattened colonies with numerous irregular branches (Bock 1982). The species identify and full distribution of the *Nevianipora* bryozoan recorded at Ironstone Hill has not been determined.

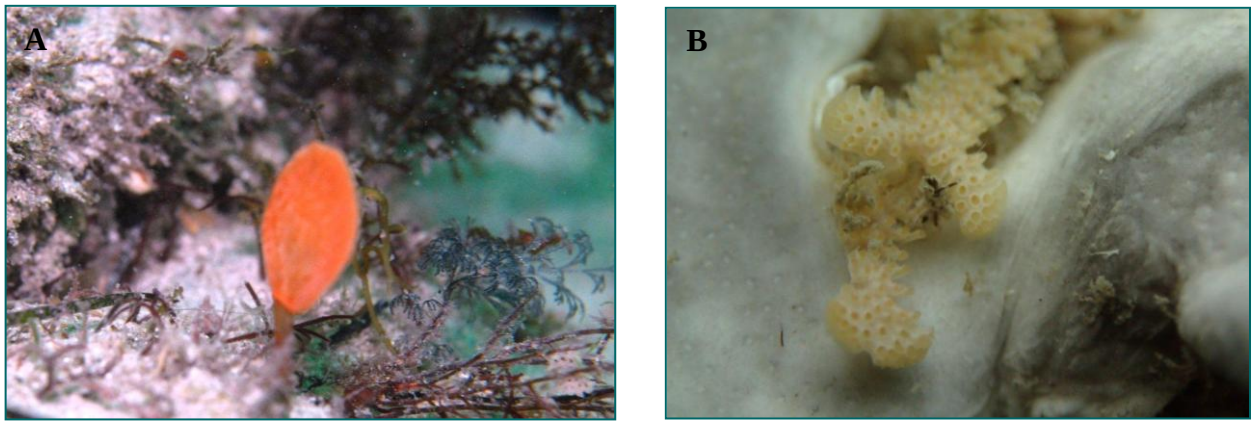

Figure 4A,B: *Parmularia smeatoni* (A); *Nevianipora* sp. (B). Photos: © D. Muirhead (A); H. Crawford (B)

Platyhelminthes (Flatworms)

Flatworms comprise a large group of animals with soft, flattened bodies. They have no blood vessels or respiratory organs, and oxygen and metabolic waste diffuse into and out of cells directly (Newman and Cannon 2003). Therefore, most flatworms are necessarily flat to facilitate gas exchange. Flatworms are hermaphrodites, with both sexes in the one body. Some species reproduce young directly from capsules; others produce eggs that hatch into tiny larvae that join the plankton. Many species can also reproduce by fragmentation. Globally, there are thousands of flatworm species, and the best known are brightly coloured and patterned, and sometimes mistaken for nudibranchs. The flatworm fauna of southern Australia is poorly known, with numerous undescribed species (Gowlett-Holmes 2008). In recent years, the Marine Research Group (MRG) of the Field Naturalists Club of Victoria has been collecting specimens for later identification by museum taxonomists, and many undescribed species have been collected and photographed from the intertidal (e.g. Falconer and Altoff 2012). In South Australia, SACReD divers and associates have recorded a number of uncommonly seen and undescribed species during invertebrate searches over the past couple of years (e.g. Baker et al. 2013a, 2013b).

One example of an undescribed flatworm is shown below in **Figure 5A and B**, a white flatworm from Pelican Lagoon, photographed in strong current during the recent Kangaroo Island field trip in April 2013. This undescribed species, likely in the genus *Thysanozoon*, may be the same as one which has been recorded occasionally in Victoria (J. Chuk, pers. comm. 2013). There are various unnamed *Thysanozoon* species in southern Australia. Identification of visually similar flatworm species in *Thysanozoon* is a specialist task, requiring examination of reproductive pores on the ventral side and/or serial sectioning of the reproductive structures (M. Litvaitis, University of New Hampshire, pers. comm. 2011).

Also of interest is a black flatworm photographed at Baudin Beach (Eastern Cove) by SACReD associate P. Mercurio in 2010 (**Figure 6**). This species is likely to be in the Eurylepidae (J. Chuk, per. comm. 2013), but it may not have been previously recorded in South Australia, and resembles in appearance a number of tropical species with head tentacles, in the genera *Eurylepta* or *Pseudoceros*.

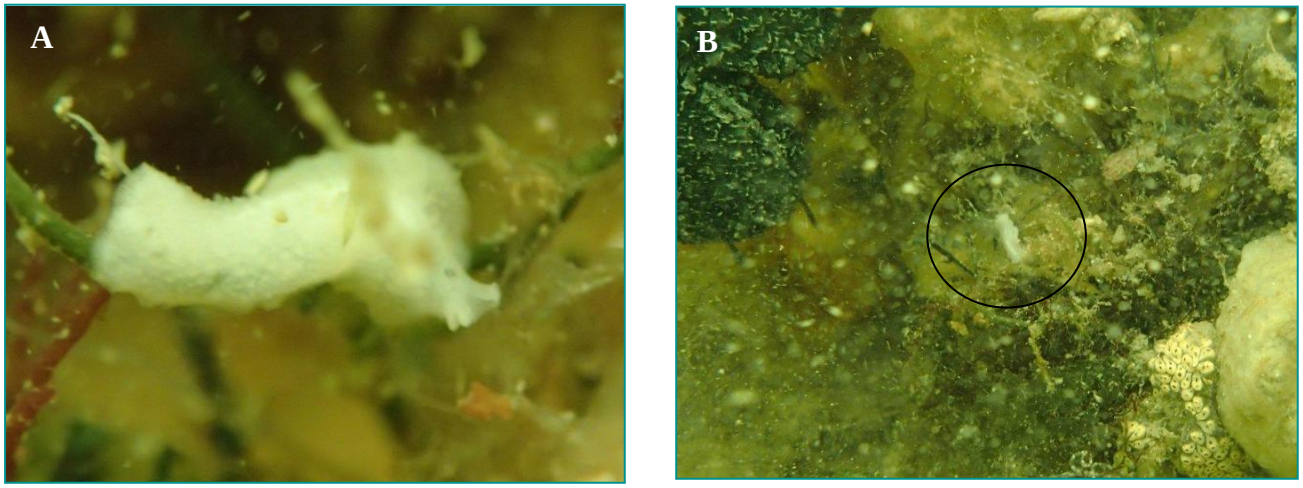

Figure 5A and B: Undescribed species in *Thysanozoon*.
Photo © H. Crawford. Identification by J. Chuk.

Figure 6: Possibly undescribed species in Eurylepidae.
Photo © P. Mercurio. Identification by J. Chuk.

Polychaeta - Sea Worms

Polychaete worms are segmented, muscular invertebrates which have a distinct head (with sensory and/or feeding appendages), body and tail region. Polychaetes usually have parapodia ("feet") with bristles on each segment. Seas worms are found in all marine environments. Of interest are the reef-dwelling polychaetes, which have an important role in the breakdown of organic matter in the substrate, and also in the shredding of plant material, making it more available to other consumers (Australian Museum 2012). There are more than 80 families of polychaete worms, and over 14,000 named species worldwide (Read and Fauchald 2013).

For a number of polychaete families, there have been no comprehensive studies of the species in Australian waters (R. Wilson, Museum Victoria, pers. comm. 2012). One example is the Lumbrineridae (thread worms), for which the literature is not helpful in determining the diversity and distribution of Australian species. An example recorded by SACReD diver L. Baade at Ballast Head on northern KI is shown in **Figure 7A**.

Figure 7: Unidentified species in family Lumbrineridae (A); an unidentified species in Dorvilleidae, which may be a colour variant of the widespread *Dorvillea australiensis*, or an unnamed species (B, C); unidentified commensal species in Polynoidae (D); unidentified species in genus *Eunice* (E); unidentified species in Terebellidae (F). Photos: © L. Baade (A, F); © H. Crawford (B, C, E); © D. Muirhead (D).

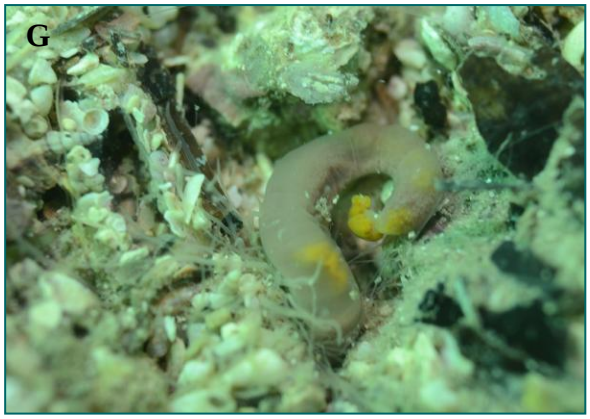

Figure 7 (cont): Unidentified species in Terebellidae (G, H). Photos: © L. Baade (G); © D. Muirhead (H).

According to most recent listing in the Australian faunal directory (last updated in 2003 for the Lumbrineridae), there are about 11 named species in Australia, and only two of those had been recorded in South Australia at that time. In little known families such as the Lumbrineridae, the descriptions for most species which are documented in Australia were published earlier during the 20th century when it was thought that polychaetes mainly had cosmopolitan distributions, yet when such species have been re-examined, it is often found that a suite of narrower-range species had previously been "lumped" under a single name (R. Wilson, Museum Victoria, pers. comm. 2012). For species in such families, much taxonomic work has yet to be done, including detailed comparison of named species in Australia and overseas, and matching of undescribed species with those named species (using preserved specimens, live material and macro-photographs).

Another polychaete family for which there are few named species in South Australia is the Dorvilleidae. The Australian Faunal Directory listing for Dorvilleidae (last updated in 2011 by P. Hutchings and M. Yerman) reported 14 named species in Australia, with 3 of these species recorded to date in South Australia. Worms in Dorvilleidae range in size from minute to at around 10cm long. Dorvilleid worms may be free living (these are often carnivorous), symbiotic or parasitic, and the latter often live inside various parts of decapod crustaceans (Wilson et al. 2003). There are various records of unidentified species in this family from locations in Gulf St Vincent (e.g. Loo 2001, Tanner et al. 2003) and in the Great Australian Bight (Currie et al. 2007). One named species which occurs in South Australia is the reef-dwelling worm *Dorvillea australianesis,* which is found under rocks on reefs, to at least 12m deep (Gowlett-Holmes 2008). Two other named species, *Schistomeringos loveni* (Kinberg 1865) and *S. paraloveni* Hartmann-Schröder 1985, have been reported from the South Australian gulfs, and the first of these also has a very broad distribution in Australia. **Figure 7B** and **C** depicts a worm from Ballast Head on Kangaroo Island, which may be an unusual colour variation of *D. australiensis*, or a closely related unnamed species.

One of the species-rich polychaete families in Australia is the scaleworms, Polynoidae, with more than 30 genera and at least 70 named species in Australia (Australian Faunal Directory 2013). There are more than two dozen unnamed species awaiting description. Polynoids have flattened bodies, with paired, overlapping scales on the surface. One unusual species which superficially resembles those in *Lepidonotus* but is likely to belong to another genus (R. Wilson, Museum Victoria, pers. comm. 2013), is shown in **Figure 7D.** This species may live in the in the tube of the terebellid worm with which it is seen in the photograph.

Mutually beneficial (symbiotic and commensal) relationships are known between scaleworms and various other marine invertebrates (e.g. Martin and Britayev 1998), including relationships with other families of polychaete worms. Such relationships have rarely been documented in Australia (R. Wilson, Museum Victoria, pers. comm. 2013).

The Eunicidae (rock worms and blood worms) is another family of polychaetes for which there are numerous undescribed species in southern Australia, in addition to the ~ 36 named species (Hutchings and Yerman 2011). An example of an unidentified species in genus *Eunice* is shown in **Figure 7E**, photographed at Ballast Head on KI.

Also recorded during the Kangaroo Island field trip were several undescribed species in the Terebellidae, a large family of spaghetti worms. Terebellidae is one of several families of polychaete worms which build tubes in mud, sand or on reef surfaces. Terebellids have thin, papery tubes coated in sand, mud, shell debris and/or small stones (Gowlett-Holmes 2008). These worms are soft-bodied, and feed on organic particles which are caught by the numerous long tentacles near the mouth. There are currently over 100 named terebellid worms in Australia, plus various undescribed species (Baker 2013). About 40 of the described species are known to occur in SA. There are several unnamed reef terebellids in SA, and some are known to date from only a few locations, due to lack of targeted searches. Detailed examination of specimens is usually required for identification, and terebellid species are difficult to identify (R. Wilson, Museum Victoria, pers. comm. 2013). A very widely distributed terebellid in Australia, known as *Eupolymnia koorangia*, may be a group of related species. Terebellid specimens resembling *E. koorangia* were recorded at several locations during the Kangaroo Island field trip, including a mottled worm which resembled a terebellid out of its case. That species had no buccal tentacles, or dendritic gills, and cannot even be placed to family level, based on an image alone (R. Wilson, Museum Victoria, pers. comm. 2013). Several spaghetti worms, unidentifiable at this stage, were also recorded during the April 2013 field work (**Figure 7F**, **7G**, **7H**). The distribution of these unidentified (and possibly undescribed) terebellids is very difficult to determine, because there have been no systematic efforts to collect or describe reef terebellids in South Australia. The Terebellidae is now being split by taxonomists into several families (R. Wilson, Museum Victoria, pers. comm. 2013), and thus the current taxonomic assignments of numerous species in southern Australia are likely to change.

Tunicata (Sea Squirts / Ascidians)

This large group of sessile animals all have a characteristic outer coat of a cellulose-like substance called tunicin (Gowlett-Holmes 2008). There are two main groups of ascidians, the solitary ascidians (which often have visible siphons through which water can be squirted), and the colonial ascidians. The latter group includes some forms in which colony members are only joined at the base, and other forms which comprise many small colony members (zooids) embedded in a matrix. Many colonial ascidians resemble sponges in appearance. The ascidian fauna of South Australia is quite well documented, due to the taxonomic research of the late P. Kott over several decades, and the sporadic collecting efforts of several marine biologists in SA from the 1970s to 1990s, including K. Gowlett-Holmes and S. Shepherd. Of at least 220 ascidian species that occur in SA, about a quarter of these have been recorded from very few areas, some known only from the type locality, and currently considered to be endemic. Distributions are inadequately known, because previous collecting efforts have been concentrated in few areas, mainly Kangaroo Island, small offshore islands, and several jetties. During the past year, the known geographic range of several species has been expanded due to photographic records from SACReD divers in the SA gulfs region.

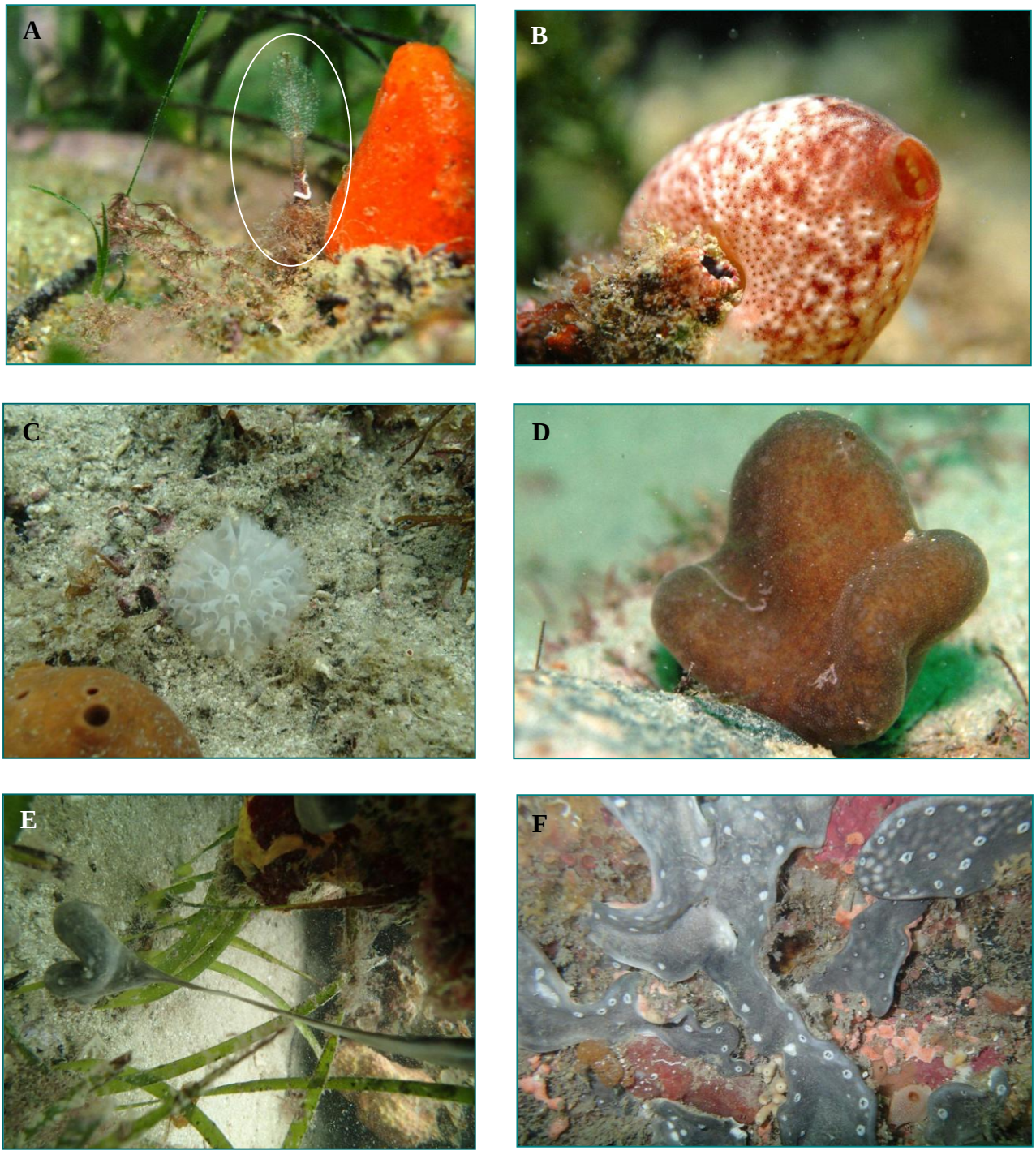

Figure 8: ***Euherdmania translucida*** **(A, ringed); unidentified compound ascidian, possibly** ***Polysyncraton montanum*** **(B);** ***Stomozoa australiensis*** **(C); unidentified compound ascidians in Didemnidae (D, E, F).**
Photos: © D. Muirhead (A, B, D); © H. Crawford (C, E, F).

Species identification of compound ascidians is a difficult and specialised task, and has traditionally required dissection of samples and examination of reproductive structures and/or other parts of the anatomy, such as zooids, brood pouch (if present), branchial sac, stomach and spicules. The papers by Kott (see **Bibliography** below) have described most of the southern Australian species. Rarely can ascidians be accurately identified from photographs, and therefore the species identifications for colonial ascidians in **Figure 8** are preliminary, pending later examination of identical specimens by a taxonomist expert.

Example of species for which the currently known geographic range is narrow (i.e. possibly endemic within South Australia) include:

- *Euherdmania translucida*, a delicate solitary ascidian with a spotted, transparent test (body) (**Figure 8A)**;
- *Polysyncraton montanum* (**Figure 8B**), a colonial ascidian which occurs on shaded reef, and is known to date only from South Australia (Kott 2010), in very few locations;
- A colonial species, possibly in *Polysyncraton* (**Figure 8D**). Several of the species in this genus are known to date only from South Australia, and there are very few records.
- The colonial species *Stomozoa australiensis*, known to date only from South Australia (Kott 2010) (**Figure 8C**);
- Various unidentified species in the family Didemnidae (**Figures 8E, F**). An example from Ironstone Hill is shown in **Figure 8F**, which may be the rarely recorded species *Diplosoma fecundum,* known to date only from South Australia. Also recorded, from Lavers Reef in Eastern Cove, was an unusually shaped, apparently dislodged colony of an unidentified didemnid ascidian, probably an uncommonly recorded species in genus *Leptoclinides* (**Figure 8E**).

'Opisthobranchs' / Heterobranchia: Sea Slugs

Opisthobranchs are sea slug gastropods with "rearward" gills. The sea slug fauna in South Australia is much less known than are the gastropod shells. Most members of this large group lack a shell, or have a reduced internal shell. Some have a fragile external shell. The shell-less nudibranchs are often brightly coloured and patterned, and have evolved bizarre body shapes. In most sea slugs, the head bears two pairs of sensory tentacles: a pair of tactile oral tentacles, and in nudibranchs, there is also a dorsal pair of rhinophores (chemo-sensory organs), which may be ornamented to increase their surface area (Burn 1989). Opisthobranchs are hermaphrodites, and can function as male and female at the same time. Eggs are usually laid in a gelatinous mass. Most species have planktonic larvae, but some hatch as crawling miniatures which resemble the adults (Gowlett-Holmes 2008).

Many sea slugs have a specialised diet, and their distribution thus reflects the presence of their preferred food type, such as sponges or bryozoans (Debelius and Kuiter 2007). Some of the larger sea slugs are predatory, feeding on polychaete worms, colonial ascidians, or even on other sea slugs. Some are seasonal in occurrence, and others may be locally abundant in some years, and absent from the same area in other years. The identity and distribution are uncertain, for a number of small, undescribed opisthobranchs found uncommonly in SA.

One group of opisthobranchs with several members in South Australian waters is the Aglajidae (head shield slugs). These species are usually found in sand, near reefs or seagrass beds, mainly on sheltered coasts. The broad head shield in these slugs is used to plow beneath the surface of sand, and prevents sand entering the mantle cavity. Some species have fleshy, wing-like parapodia on the sides of the body. Head shield slugs have well-developed sensory structures, used to detect prey.

An example in Aglajidae is the large head shield slug *Philinopsis troubridgensis* (**Figure 9A**), which grows to more than 10cm, and has been recorded over a narrow range, in South Australia, and also in the Great Australian Bight in WA (Wells and Bryce 2000). There are recent photographic records from as far west as Fremantle in WA. The taxonomy of southern Australian species of *Philinopsis* is confused, and a number of separately named species may be forms of the same species. For example, a tropical and subtropical species in *Philinopsis* has also been recorded in SA, which closely resembles the Indo-Pacific *P. cyanea*. That species may be the same as *P. speciosa* Pease 1860 (see Rudman 2006) and *Philinopsis taronga* (Allan 1933), both of which have been recorded as far south as Victoria, and have appeared more frequently during the past decade (J. Chuk, pers. comm. 2012). Records of *Philinopsis cyanea* / *speciosa* from South Australia are lacking, although it has previously been assumed that this species could extend into SA waters, by way of the Leeuwin current (Rudman 2006), and *P. taronga* has reportedly been recorded here (Rudman 2007).

It is also possible that the large *Philinopsis troubridgensis* is a form of *P. cyanea* / *P. speciosa* (see Rudman 2003). Due to its sand-dwelling habit, *P. troubridgensis* has been recorded at few locations in South Australia, and is known mostly from Edithburgh on Yorke Peninsula; Port Lincoln area in Spencer Gulf (Rudman 2001, 2003; SCUBA divers' records; OZCAM records), and metropolitan reefs and beaches in Gulf St Vincent (photographs by D. Muirhead; photographs by C. Rapson 2013). The example shown below was recorded in the Muston area of American River on KI during the April 2013 field work. In Norway, the taxonomy of the *Philinopsis* group is being revised using both anatomical and molecular studies (J. Chuk, pers. comm. 2012), and that project may also shed light on the identity of the eastern and southern Australian fauna.

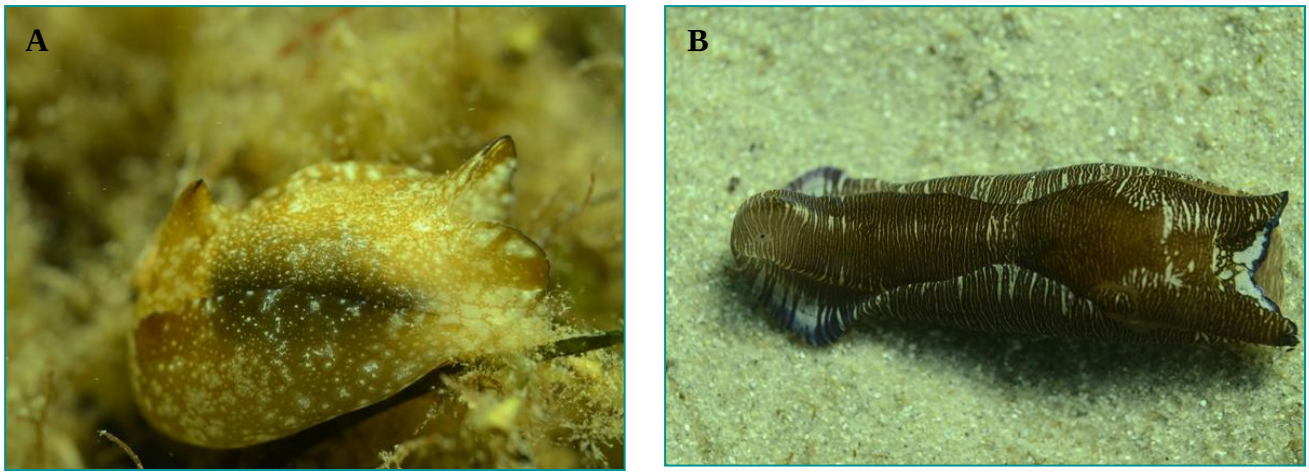

Figure 9: *Philinopsis troubridgensis*, uncommonly recorded in SA and WA, and possibly a form of a related species in the genus *Philinopsis* (A). *Philinopsis lineolata*, a tropical species which is rarely recorded in SA. (B). Photos: © L. Baade.

A widespread tropical Indo-Pacific species of head shield slug which has rarely been recorded in South Australia and Western Australia is *Philinopsis lineolata*. One example from the April field trip to Kangaroo Island is shown in **Figure 9B**. *P. lineolata* is found in sand on reefs, and feeds on polychaete worms (Gowlett-Holmes 2008). The individual shown above was recorded on shallow subtidal sand in Pelican Lagoon on KI, in the vicinity of sponges and turfing brown and red macroalgae. The recent sighting during the April 2013 field work is one of the very few records of this species from South Australia, other than a preserved specimen taken from a wharf at Port Lincoln in 1985 (Australian Museum record C.145121); another from sediments at Port Pirie in 1980 (Hutchins et al. 1993); and a sighting by J. Baker in Sturt Bay 2012 (specimen photographed by H. Crawford, SACReD). Two of the locations where this species has been recorded are ports, but it is not known if this species was introduced to South Australia by shipping. The rarity of records may relate to the sand-dwelling habitat of *P. lineolata*, and the lack of targetted searches.

Within the Order Nudibranchia, there are various undescribed species which are known from very few records. Some of these are in the Doridiidae and Discodorididae families (the "dorid" nudibranchs). Most dorids live on and feed on sponges, and are often very well camouflaged on their host sponge. Dorids lay brightly coloured rings of small eggs on sponges. One example of an uncommonly recorded species is the undescribed dorid shown **Figure 10A and B,** which has both yellow and orange forms. This species has not yet been described, and its taxonomic identity and relation to other dorid nudibranchs is uncertain (J. Chuk, pers. comm. 2013). The examples were found on reef at Ironstone Hill during the current survey, in April 2013. To date, there are no known records of this dorid, with in the orange or yellow form, outside of South Australia (B. Burn, unpubl. data; J. Chuk, pers. comm. 2013).

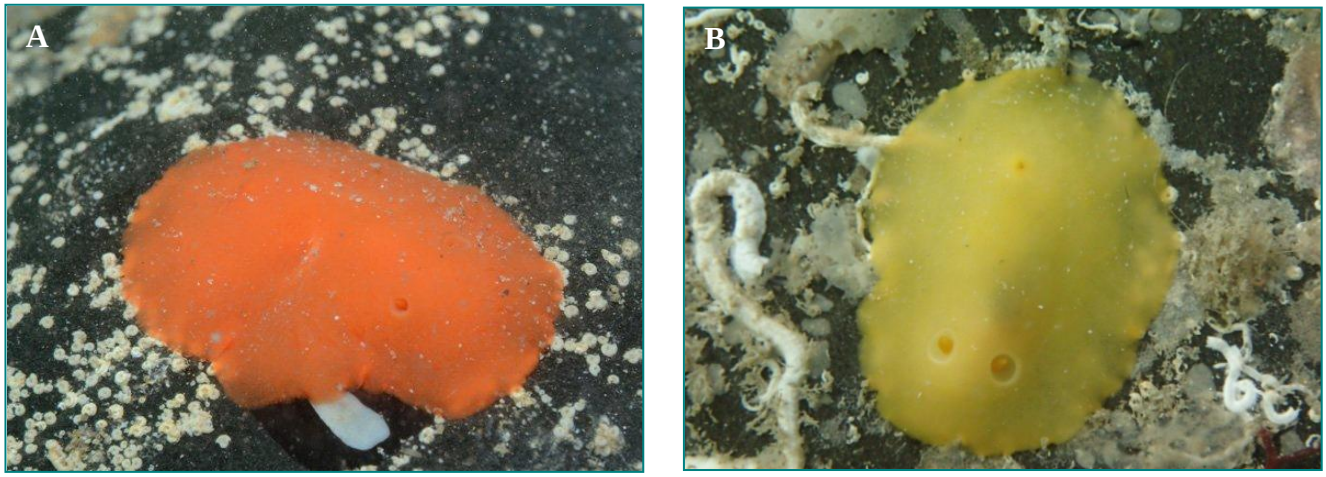

Figure 10: Undescribed dorid nudibranch, in orange and yellow forms (J. Chuk, pers. comm. 2013). Photos: © L. Baade (A); H. Crawford (B).

There are numerous small nudibranchs in the Aeolidina order, many of which are rarely recorded in SA. Members of the group are typically 1 to 4cm long (depending on the species), with a tapering body and elongate cerata (outgrowth of the mantles) on the dorsal side. Many species in the group feed on cnidarians such as sea anemones, hydroids and soft corals, and use the stinging cells of their prey for their own protection (Gowlett-Holmes 2008). The rising popularity of macro-photography amongst the SCUBA diving community has resulted in new records of aeolid species in the genera *Facelina*, *Flabellina* and *Trinchesia* in recent years, and extensions of known range. One example of a rarely recorded aeolid nudibranch is the unnamed *Facelina* sp. 3 (in Burn 2006), known from Victoria and SA. This species was first seen in SA and Victoria during the late 1990s (J. Chuk, pers. comm. 2013). As at 2013, records were known from northern Kangaroo Island (photographed by SACReD associate K. Smith at Muston in American River, in 2008: **Figure 11**), one from Edithburgh in 1998 (recorded by J. Chuk): one from Carrickalinga (photographed by SACReD associate P. Mercurio in 2011); one from Rapid Bay in GSV (photographed by A. Sutandio in 2013), and one from Island Point on Yorke Peninsula (from a *Caulocystis* sample collected by SACReD member J. Baker in 2013). Published records are from the intertidal (Burn 2006), but this species also extends to at least the shallow subtidal, with SA records to at least 6m deep.

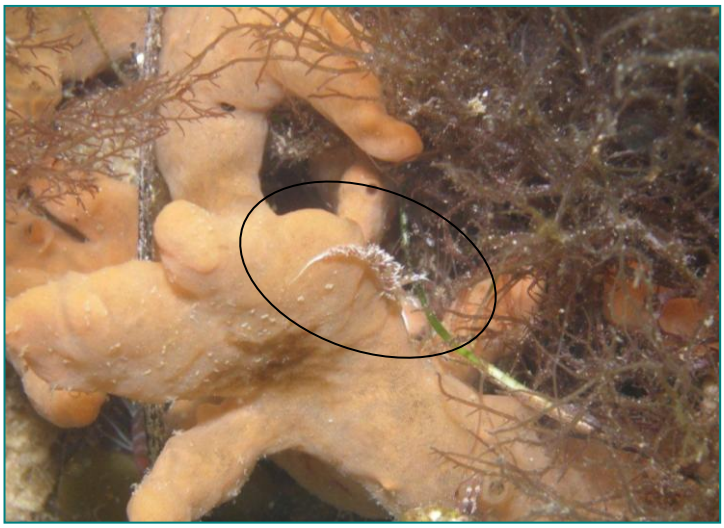

Figure 11: *Facelina* sp. 3 (J. Chuk, pers. comm. 2013) from Muston in American River. Photo: © K. Smith, SACReD associate.

A summary of more commonly recorded and geographically widespread sea slugs (nudibranchs and opisthobranchs) which were recorded during the Kangaroo Island surveys in 2013 are listed in **Appendix 1**. Sea slugs recorded during previous surveys, and during collection dives for museums over the years, are listed in **Appendix 2**. Together with the records from the April 2013 survey, at least 76 species of sea slug have been recorded from searches in few areas of Kangaroo Island, mainly the northern coast, and north-eastern bays. A number of these species are rarely recorded in South Australia, including:

- the tropical species *Phyllodesmium poindimiei* and *Marianina rosea*;
- the Indo-West Pacific species *Berthellina citrina*;
- the sub-tropical *Tritoniopsis alba*, a white nudibranch which has numerous lace-like gills;
- the Western Australian species *Pattyclaya brycei*;
- the south-eastern Australian species *Doto ostenta,* which feeds on hydroids;
- a species in *Paratritonia* which lives on *Mopsella* coral, and resembles the Japanese *P. lutea;* and
- an unidentified species in the genus *Kaloplocamus*, which is possibly an imported species from Europe.

Some of the less commonly recorded nudibranchs live under rocks, which would explain the lack of records, since targetted searches must be made for records to be found.

Prosobranchs (Sea Snails, Gastropod Shells)

The Prosobranchia was for many decades considered one of three large subclasses of gastropod shells, along with Pulmonata and Opisthobranchia. A substantial revision of this classification (e.g. Ponder and Lindberg 1997, cited by Ponder et al. 2002; Bouchet et al. 2005) now recognises the following groups:

- Patellogastropoda (true limpets);
- Vetigastropoda (top shells, abalones, turban shells, keyhole limpets, slit shells etc.);
- Neritopsina or Neritimorpha (nerites);
- Caenogastropoda (many of the marine snails, including periwinkles, whelks, cowries, cones, moon snails, balers, etc.) and
- Heterobranchia or Euthyneura (land snails and slugs, sea slugs etc.).

Most prosobranchs have external shells that can completely contain and protect the soft animal within, but a few species have reduced internal shells. Another characteristic of prosobranchs is the presence of gills in a mantle cavity under the edge of the shell. There is often a horny or shelly operculum on the back of the foot, which is used to block the aperture of the shell when the animal retreats inside (Gowlett-Holmes 2008).

The prosobranch gastropod mollusc fauna in SA is rich and diverse, with hundreds of species occurring from the intertidal, shallow subtidal and upper shelf waters combined (e.g. Appendix 4 in Baker 2004). During the 2013 marine field work, various common prosobranch gastropods were recorded in the RLS monitoring transects by KI Friends of the Sea and NRM divers. These species included the trumpet shell *Cabestana tabulata*, the helmet shell *Cassis fimbriata*, the top shell *Clanculus undatus*, the whelk *Cominella lineolata*, the cone shell *Conus anemone*, the dog whelk *Dicathais orbita*, abalone species (*Haliotis cyclobates, H. laevigata*, *H. rubra*), the volute *Lyria mitraeformis*, the pheasant shells *Phasianella australis* and *P. ventricosa*, the kelp shell *Phasianotrochus eximius*, the tulip shell *Pleuroploca australasia,* the top shell *Prothalotia lehmani,* the false limpet *Siphonaria zelandica,* the top shell *Thalotia conica,* and the turban snails *Turbo torquatus* and *T. undulatus.*

Many of the above found during RLS transects were also recorded by SACReD divers, and one shell species of interest recorded by SACReD divers during the 2013 field work was Compton's Cowrie *Notocypraea comptoni* (Pelican Lagoon). Cowries are of conservation interest due to limited dispersal and production of benthic eggs, which are brooded in some species; narrow geographic distribution of some morphologically distinct populations; narrow depth range of some species, and/or value for trade, because these shells are sought after by both commercial and recreational collectors. SACReD divers also recorded the Southern Ear Cowrie / Velutinid *Lamellaria australis* (at Pelican Lagoon), an unusual shell which is permanently covered in life with the orange body of the animal. *Lamellaria australis* is known mostly from south-eastern Australia.

Kangaroo Island is rich in rarely recorded shells, and other shells of conservation interest, including commercially valued specimen shells. Examples of such species are listed in **Appendix 3**, along with approximate locations where they have been recorded, mainly by collectors during the 20th century. The species in **Appendix 3** include groups such as the cowrie and volutes, whose members have potentially vulnerable population characteristics, such as direct development (i.e. brooding of young, and thus limited dispersal); narrow geographic distribution; narrow depth range, and/or high value for trade, because the shells are sought after by collectors.

Discussion

A summary of studies within the KI NRM region in which the macro-invertebrate fauna has previously been investigated include:

- A study of the intertidal reef platform species composition at 5 sites on Kangaroo Island (Benkendorff et al 2007). Species recorded during the intertidal surveys were common and/or had broad geographic ranges across southern Australia;
- A study of the fauna in seagrass meadows at selected sites around north-eastern Kangaroo Island, in which both fish and invertebrate fauna were documented (Kinloch et al. 2007). Species lists indicate that common and/or geographically widespread invertebrate species were found;
- During the late 1970s, the late Neville Coleman, naturalist and marine photographer dived at a number of locations around KI, and collected specimens for museums in south-eastern Australia;
- During the 1980s and 1990s, the late P. Clarkson, marine naturalist and shell collector, dived periodically at a number of locations around north-eastern Kangaroo Island, and collected numerous species of specimen shells.

A summary of other subtidal invertebrate studies from 1990s to mid 2000s on Kangaroo Island was detailed in Kinloch (2005):

- From 1999 to early 2000s - biological surveys of subtidal reef fauna at depths from 5 - 20 m between Western River Cove and Snug Cove were undertaken by J. Thistleton (KI Diving Charters) and Dr K. Gowlett-Holmes (CSIRO Marine Research), assisted by T. Laperousaz (SA Museum) and D. Muirhead (marine photographer). Specimens of marine benthic invertebrates (sponges, ascidians, molluscs, bryozoans) were photographed (in situ) and collected, and around 20 hours of underwater video footage was shot. More than 1,000 specimens (over 500 species), were curated and archived in the Marine Invertebrates Collection at the SA Museum, with data on their location (depth, substrate type and habitat) and taxonomy. Images are contained in the Museum's slide library and catalogued in a hardcopy photo index. Dr Gowlett-Holmes also photographed and collected marine organisms from jetties at Kingscote, Penneshaw and Vivonne Bay.
- The former Department for Environment and Heritage Coast and Marine Branch carried out sporadic benchmarking surveys of invertebrate and fish assemblages at selected sites within the Encounter Marine Protected Area (MPA) between Point Marsden and Cape Willoughby. Abundance and size composition data for scallops, as well as sessile invertebrate populations (sponges, ascidians, echinoderms, molluscs, crustaceans), were collected from Pelican Lagoon and Nepean Bay.

The following summary of previous (20th century) intertidal invertebrate studies on Kangaroo Island was detailed in Kinloch (2005):

- In 1927, H. Hale published a treatise on the Crustaceans of Kangaroo Island in the *Transactions of the Royal Society of South Australia*, based upon specimens collected during several expeditions to the island by members of the SA Museum and the Flora and Fauna Board, as well as others dredged up earlier by the Endeavour and by Sir Joseph Verco. Specimens were collected both subtidally (to a depth of 60 metres) and intertidally at locations including beaches, seagrass meadows, limestone reefs, rock pools, beneath boulders, on mudflats and in shallow bays on both the south and north coasts. The majority were collected in the Bay of Shoals, Investigator Straight, Backstairs Passage and Vivonne Bay, off Beare's Point (Kingscote), and Pt Marsden and on Sanders Bank; others came from Emu Bay, Smith's Bay, American Beach and American River.

- From 1944 to 1947, S. J. Edmonds made a detailed study of the occurrence and distribution of the intertidal rock platform fauna at Pennington Bay (Edmonds 1948). This included a list of all the species of sponges, corals, worms, crustaceans, molluscs, ascidians and echinoderms he collected, together with notes on relative abundance and vertical zonation. He also determined the density of populations of 10 species of mollusc and starfish by counting their numbers in 100 randomly placed 0.5 m^2 quadrats.
- In the 1951 PhD thesis of H.B.S. Womersley on the intertidal algae of KI, also included some brief notes on the associated mollusc fauna at Pennington Bay and American River;
- In 1976 A short layman's guide to 25 sea shells of KI was published by Osterstock, containing some information on distribution and habitats (Osterstock 1976, cited by Kinloch 2005).

Despite previous survey efforts, little is known of the current distribution and local abundance of many apparently uncommon or rare marine invertebrates, 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 invertebrate species in SA are known from few specimen records, some of which date back to the early or mid 20th century;
(iv) many possibly rare and/or endemic invertebrate species live in cryptic and under-surveyed habitats, such as the underside of boulders, or in macroalgae.

As indicated in **Appendix 2**, marine invertebrate searches on Kangaroo Island have been concentrated in few areas to date, mainly the coves and bays of the northern and north-eastern coast. For many parts of the KI NRM region, little is known of the rare and endemic invertebrate fauna, other than areas between Western River Cove and Snug Cove, and parts of the north-eastern bays, where intensive collecting and photography occurred over several years. Examples of areas which are under-surveyed in terms of rare and endemic species include the entire west coast, north-west coast, much of Eastern Cove, and Western Cove (other than Kingscote Jetty), Dudley Peninsula (other than Penneshaw jetty area), and most of the southern coast.

The marine invertebrate fauna of Kangaroo Island is likely to be rich, given the diversity of habitats around the island (Baker 2004), and its biogeographical position in southern Australia, between the warm to cool temperate waters of the Flindersian Province, and the cool to cold temperate waters of the Maugean sub-province (Womersley 1990). The nudibranch and opisthobranch fauna is one example. Around 76 species, ranging from tropical to cold temperate south-eastern Australian species, have been recorded from few surveys (**Appendices 1** and **2**, and section of this report on **Opisthobranchia**), in few areas of the north and north-east coast. The species richness is likely to be greater than is currently known.

Current field searches as discussed in this report, complemented by discussions with marine taxonomists, have helped to improve (and correct) the state of knowledge about the distribution and habitat of a number of rarely recorded and endemic marine invertebrates in South Australia, as well as several undescribed and previously unrecorded taxa. Although specimen collecting is required to determine unequivocally the species identity of many marine invertebrates, it is clear from some of the examples provided in this report, that photographs with location and depth information can also provide very useful information, in the endeavour to document the marine invertebrate biodiversity of South Australian nearshore waters, including rarely recorded and endemic species in the KI NRM region.

A number of SACReD's marine photographs have been useful to taxonomic workers in Victoria, who specialise in Anthozoa (corals and anemones), Opisthobranchs/Heterobranchia (sea slugs, nudibranchs); Platyhelminthes (flatworms); and several other groups. A number of undescribed invertebrate species from South Australia are in the process of being named, and the taxonomy of some described species is being revised. Location records, macro-photographs (which show morphological detail and also habitat) and specimens from SACReD's field surveys, are useful as part of that process.

Additionally, recent collaboration with the Marine Research Group (MRG) of the Field Naturalists Club of Victoria (FNCV) has expanded the scope of SACReD's current field work. The consequent collection and the processing of both intertidal and subtidal samples for later taxonomic identification is proving to be valuable in terms of rare and endemic species finds, and biodiversity studies on a broader scale.

Collectively, SACReD records from the SA gulfs have included some "new" undescribed species (previously unknown to science), as well as records of existing undescribed and narrow range species; new records of tropical species not previously recorded in SA, and range extensions of several known species which are assumed to be endemic within SA. Due to various technical and logistic circumstances, few specimens were collected during the Kangaroo island field trips in March and April 2013. One specimen in Eunicidae which may be an undescribed species is yet to be examined.

Taxonomic colleagues are keen for more samples to be provided from our field work, for both traditional taxonomic investigations (based on anatomy and morphology) and molecular work. SACReD is collaborating with several taxonomists, who have provided advice about preferred fixing and preserving techniques for each phylum of invertebrates. It is hoped the SACReD and the Marine Research Group of the FCNV will have the opportunity in future to undertake a collaborative marine survey of sites around Kangaroo Island, particularly locations which have not yet been surveyed.

Of interest are records of various species of tropical affinity (such as two of the undescribed anemones recorded in April 2013 and discussed above, and also nudibranchs previously recorded on Kangaroo island during other surveys, such as *Phyllodesmium poindimiei*). Records of tropical species require further investigation. It is not known whether some of these species have existed for a long period in South Australia, or are recent arrivals. In other cases, apparent tropical species may be undescribed temperate relatives, and further taxonomic work is required, and this is currently progressing. One example is the current taxonomic description of two anemones from South Australia, based on voucher specimens collected by SACReD divers in January 2013, under SA Museum permit. Over time, another use for data from this project may include the lodgement of records of tropical species that are found in South Australia, in national databases that monitor distributions and range extensions. Such databases have been set up to monitor marine fauna and flora in light of the multiple changes that are occurring to marine environments due to global warming (e.g. McInnes et al. 2003; Hobday and Matear 2005, Hobday et al. 2006, Suppiah et al. 2006; IPCC 2007). Location- and date-specific records of tropical species in South Australia are also useful for tracking the distribution and spread of invasive species.

Future work by SACReD on the rare and endemic invertebrates project will entail searches in more locations within the KI NRM region, including deeper waters, and in the shallow subtidal and intertidal, at locations where divers have not yet searched. Divers also plan to search within sanctuary zones of marine parks, and in comparable habitats outside of sanctuaries. The project will also entail further collection of type specimens (to be lodged at the S.A. Museum), so that some of the potentially new species can eventually be described by taxonomic associates of the project from around Australia. There are still many gaps in the knowledge of marine invertebrate species distributions, habitats, life history (e.g. reproductive mode, which provides an indication of resilience or vulnerability to environmental impacts) and ecology. More field research is required, based on careful observation, macro-photography and collection. Additionally, further conservation status assessment is required over time, including a Statewide assessment. Many invertebrate species 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. For example, many of the opisthobranchs and nudibranchs (sea slugs) and specimen shell gastropods, are found under rocks, and are not likely to be seen unless targetted searches are made. Without substantial survey and collecting effort, it is not possible to determine true "rarity" over any spatial scale, or to produce reliable systematic maps of the range of various invertebrate species.

A comprehensive description of the true biodiversity, biogeography and value of marine invertebrates in South Australia cannot be undertaken without considering the rare, endemic and other potentially threatened invertebrates. These species deserve more emphasis, because most invertebrate studies to date have focussed on the common intertidal and shallow subtidal invertebrates, or on commercially valuable species.

6. Summary of Recommendations

- Undertake further surveys to better determine the composition, distribution and abundance of South Australian rare and endemic species from key invertebrate groups, particularly in and adjacent to Marine Park sanctuary zones; also in data-poor areas, and in port areas and boat harbours (and other highly modified areas where threatening processes exist).

- Further studies to determine the current distribution of species known only from very few records (particularly old records from the late 19th and early 20th century). In some cases only a single specimen has ever been collected. Many of these species are small and inconspicuous, and require trained taxonomists for their precise identification.

- Specialised training of divers, to identify rare, endemic and other invertebrates of conservation interest, at sites across the KI NRM region. Training should also include sample preparation techniques so that, once collected, specimens are properly preserved for expert taxonomic analysis at museums.

- Where possible, particular protection of existing Aquatic Reserves and 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 invertebrates.

- Establishment of a reliable and sensitive monitoring program for Aquatic Reserves and sanctuary zones of Marine Parks, to determine the composition of invertebrate fauna (including rare and endemic species), and provide baseline data to assist in detecting change over time due to local and global stressors. This could be done by trained volunteers from Kangaroo Island Friends of the Sea, utilising Reef Life survey methods, and assisted by members of SACReD.

- Protect calcareous macro-invertebrates (such as corals and molluscs) that currently exists in and around KI NRM, from additional anthropogenic stresses such as physical damage (e.g. from boats, anchors, dredging etc), sediment smothering, and nutrient enrichment. Such protection may help calcareous organisms to persist longer in the face of ongoing stresses which are harder to control, such as ocean acidification from climate change.

- Further investigation and assessment of the conservation status of marine invertebrates in South Australia, particularly a Statewide status assessment (as recommended in DEH's 2007 *No Species Loss* nature conservation strategy, which was being revised in 2012-13). Following a Statewide assessment (see above), consideration of listings under the schedules of the *SA National Parks and Wildlife Act* or other suitable legislation. Complimentary 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 such as specimen shells.

References

Australian Biological Resources Study (ABRS) (2013) *Australian Faunal Directory*. Department of the Environment and Water Resources, Canberra. (URL accessed July and August 2013).

Australian Biological Resources Study (ABRS) (2010) Phylum Bryozoa. http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/BRYOZOA

Australian Biological Resources Study (ABRS) (2013) Family Dorvilleidae. Compiled in 2003 and updated in 2011 by P. Hutchings and M. Yerman, Australian Museum. http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/DORVILLEIDAE/complete

Australian Museum (2012) Segmented worms - The Polychaetes. http://australianmuseum.net.au/Segmented-worms-the-polychaetes

Baker, J.L. (2004) *Towards a System of Ecologically Representative Marine Protected Areas in South Australian Marine Bioregions - Technical Report*. Report (Parts 1 - 4) for Coast and Marine Conservation Branch, Department for Environment and Heritage, South Australia. 1250p.

Baker, J.L. (2011a) Marine invertebrates of potential conservation concern in the Adelaide & Mt Lofty Ranges Natural Resources Management Region - a review. Report for Adelaide and Mt Lofty Ranges NRM Board. 130p. http://www.amlrnrm.sa.gov.au/Portals/2/Coast/Reports/FINAL%20AMLRNRM%20marine%20invertebrates%20review%20101012.pdf

Baker, J.L. (2011b) Conservation status of marine invertebrates in the Northern and Yorke NRM Region - a review. Report for Northern and Yorke Natural Resources Management Board. October 2011. Updated Version: October 2012. http://www.nynrm.sa.gov.au/Portals/7/pdf/publications/NYNRM-MarineInvertebrates.pdf

Baker, J.L. (2013) *Marine Invertebrates of South Australia –examples of rarely seen, endemic and potentially threatened species*. Booklet produced with support from the Nature Foundation of South Australia. http://www.naturefoundation.org.au/documents/Projects-Marine-Invertebrates.pdf

Baker, J.L., Muirhead, D., Mercurio, P., Crawford, H., Lewis, J., Baade, L., Manna, J., Velzeboer, R. & Shepherd, S.A, (2013a) *Rarely recorded, endemic and potentially threatened marine invertebrates in the Adelaide and Mt Lofty NRM Region - results of 2011-2012 surveys*. Report for Adelaide and Mt Lofty Ranges Natural Resources Management Board, South Australia. March, 2013.

Baker, J.L., Mercurio, P., Crawford, H., Lewis, J., Falconer, A., Muirhead, D., Velzeboer, R., Smith, K. Brook, J., Kutyna, D. and Shepherd, S. (2013b) *Rarely recorded and endemic marine invertebrates in the Northern & Yorke NRM Region - results of 2012 surveys.* Report for NRM Investment Unit of the S.A. Department for Environment, Water & Natural Resources and Natural Resources - Northern and Yorke (Northern and Yorke NRM Board). April 2013.

Benkendorff, K., Kinloch, M. A. and Brock, D. J. (2007) *Intertidal Reef Biodiversity on Kangaroo Island*. KI NRM Board Coast and Marine Program Report No. CMP07/003.

Bock, P.E. (1982) Bryozoans. Chapter 9 in: Shepherd, S. and (the late) Thomas, I. (Eds) *Marine Invertebrates of Southern Australia, Part 1*. Handbook of South Australian Flora and Fauna, Government Printer, Adelaide, South Australia.

Burgess, S.N., McCulloch, M.T. and Mortimer, G.E. (2004) Geochemical ecology of a high latitude coral, Gulf St Vincent, South Australia. Report from Australian National University, Canberra.

Burgess, S.N., McCulloch, M.T. and Mortimer, G.E., and Ward, T.M. (2009) Structure and growth rates of the high-latitude coral: *Plesiastrea versipora. Coral Reefs* DOI 10.1007/s00338-009-0533-5.

Burn, R. (1966) Notes on opisthobranchs mainly from South Australia. *Records of the South Australian Museum* **15**: 329-352.

Burn, R. (1989) Opisthobranchs (Subclass Opisthobranchia). In: Shepherd, S.A. and Thomas, I.M. (Eds) *Marine Invertebrates of Southern Australia. Part II.* South Australian Government Printing Division: Adelaide, South Australia. pp. 725-788.

Burn, R. (2006) A checklist and bibliography of the Opisthobranchia (Mollusca: Gastropoda) of Victoria and the Bass Strait area, south-eastern Australia. *Museum Victoria Science Reports* **10**: 1–42.

Carpenter, K.E., Abrar, M., Aeby, G., Aronson, R.B., Banks, S., Bruckner, A., Chiriboga, A., Cortés, J., Delbeek, J.C., DeVantier, L., Edgar, G.J., Edwards, A.J., Fenner, D., Guzmán, H.M., Hoeksema, B.W., Hodgson, G., Johan, O., Licuanan, W.Y., Livingstone, S.R., Lovell, E.R., Moore, J.A., Obura, D.O., Ochavillo, D., Polidoro, B.A., Precht, W.F., Quibilan, M.C., Reboton, C., Richards, Z.T., Rogers, A.D., Sanciangco, J., Sheppard, A., Sheppard, C., Smith, J., Stuart, S., Turak, E., Veron, J.E.N., Wallace, C., Weil, E. and Wood, E. (2008) One-third of reef-building corals face elevated extinction risk from climate change and local impacts. *Science* **321**(5888): 560-563.

Coleman, N. (2008) *Nudibranchs Encyclopedia. Catalogue of Asia / Indo-Pacific Sea Slugs*. Neville Coleman's Underwater Geographic Pty Ltd.

Conservation SA (2005) Feral or In Peril Program. Information brochure. http://www.conservationsa.org.au/PDF/Feral%20or%20In%20Peril%20Brochure%20v4.pdf

Currie, D.R., Sorokin, S.J. A and Ward, T.M. (2007) *Infaunal assemblages of the eastern Great Australian Bight: Effectiveness of a Benthic Protection Zone in representing regional biodiversity*. Final report to the South Australian Department for Environment and Heritage and the Commonwealth Department of the Environment and Water Resources. SARDI Research Report Series No. 250. SARDI Aquatic Sciences, South Australia.

CSIRO Marine Research (2012, 2013) *Codes for Australian Aquatic Biota* (CAAB). (Database – version 2). http://www.marine.csiro.au/caab/

Davey, B. (1993) The specimen shell trade in Australia. Status, export and legislation. Unpublished report. University of Canberra.

Debelius, H. and Kuiter, R. (2007) *Nudibranchs of the World*. IKAN-Unterwasserarchiv, Germany.

Department for Environment and Heritage (2004) *Living Coast Strategy for South Australia 2004*. Government of South Australia.

Department for Environment and Heritage (2007) *No Species Loss: A Nature Conservation Strategy for South Australia 2007–2017.* Government of South Australia.

DeVantier, L., Hodgson, G., Huang, D., Johan, O., Licuanan, A., Obura, D., Sheppard, C., Syahrir, M. and Turak, E. (2008) *Plesiastrea versipora*. In: IUCN (2012) *IUCN Red List of Threatened Species*. Version 2010.4. www.iucnredlist.org.

Edgar, G. (2000, 2008) *Australian Marine Life. The Plants and Animals of Temperate Waters*. Reed New Holland, Australia. Second edition. 544p.

Edmonds, S. J. (1948). The commoner species of animals and their distribution on an intertidal platform at Pennington Bay, Kangaroo Island, South Australia. *Trans. R. Soc. South Aust*. **72**(1): 167-177.

McKinnon, L.J., Parry, G.D., Leporati, S.C., Heislers, S., Werner, G.F., Gason, A.S.H., Fabris, G. and O'Mahony, N. (2003) The environmental effects of Blue Mussel (*Mytilus edulis*) aquaculture in Port Phillip Bay. Fisheries Victoria Research Report Series No.1.

Fahey, S.J. and Gosliner, T.M. (2003) Redescription of *Halgerda graphica* Basedow and Hedley, 1905, with observations on external morphological variation within selected species of *Halgerda* (Mollusca: Nudibranchia). *Proceedings of the California Academy of Sciences* **54**(23): 393–406.

Falconer, A. and Altoff, L. (2012) *Oddments: other intertidal marine invertebrates of Victoria*. Unpublished report by A. Falconer and L. Altoff, Marine Research Group of the Field Naturalists Club of Victoria.

Fautin, D.G. (2010) *Hexacorallians of the World*. A database component of Biogeoinformatics of Hexacorals. Kansas University, USA.

Fautin, D.G., Zelenchuk, T. and Raveendran, D. (2007) Genera of orders Actiniaria and Corallimorpharia (Cnidaria, Anthozoa, Hexacorallia), and their type species. *Zootaxa* **1668**: 183–244.

Gowlett-Holmes, K. (2008) *A Field Guide to the Marine Invertebrates of South Australia.* Notomares, Sandy Bay, Tasmania.

Hobday, A.J. and Matear, R. (Eds) (2005) *Review of the Climate Impacts on Australian Fisheries and Aquaculture: Implications for the Effects of Change.* Report to the Australian Greenhouse Office, Canberra, Australia. December 2005.

Hobday, A.J., Okey, T.A., Poloczanska, E.S., Kunz, T.J. and Richardson, A.J. (Eds) (2006) *Impacts of climate change on Australian marine life:* Part B. Technical Report and Part C: Literature Review. Report to the Australian Greenhouse Office, Canberra, Australia. September 2006.

Hutchings, P.A. Ward, T.J., Waterhouse, J.H. and Walker, L. (1993) Infauna of marine sediments and seagrass beds of Upper Spencer Gulf near Port Pirie, South Australia. *Transactions of the Royal Society of South Australia* **117**: 1-14.

Hutchings, P.A. and Yerman, M. (2011) Class Polychaeta Claparède, 1864. *Australian Faunal Directory.* Australian Museum, Sydney, NSW. (URL accessed April and August 2013).

IPCC (International Panel on Climate Change (2007) Climate Change 2007: Synthesis Report. IPCC Fourth Assessment Report. IPCC, Geneva , Switzerland.

IUCN (1994) *1994 Categories & Criteria (version 2.3).* IUCN, Gland, Switzerland and Cambridge, UK. http://www.iucnredlist.org/apps/redlist/static/categories_criteria_2_3.

IUCN (2001) *IUCN Red List Categories and Criteria: Version 3.1.* IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN Standards and Petitions Subcommittee (2011) *Guidelines for using the IUCN Red List Categories and Criteria.* Version 9. Prepared by the Standards and Petitions Subcommittee of IUCN.

Jones, G.P and Kaly, U.L. (1995) Conservation of rare, threatened and endemic marine species in Australia. In: Zann, L.P. and Kailola, P.K. (Eds) State of *the marine environment report for Australia, Technical Annex 1: The marine environment*. Ocean Rescue 2000 Program, Department of the Environment, Sport and Territories, Canberra.

Kinloch, M. A. (2005). *Review of Kangaroo Island Marine, Coastal and Estuarine Biodiversity Monitoring and Research Programs.* Kangaroo Island Natural Resources Board, Kingscote.

Kott, P. (1952) Ascidians of Australia. 1. Stolidobranchiata and Phlebobranchiata. *Aust. J. Mar. Freshwat. Res.* **3**(3): 206-333.

Kott, P. (1954) Tunicata, Ascidians. Rep. B.A.N.Z. *Antarct. Res. Exped.* **1**(4): 121-182.

Kott, P. (1957) Ascidians of Australia II. Aplousobranchiata Lahille; Clavelinidae Forbes and Hanley and Polyclinidae Verrill. *Aust. J. Mar. Freshwat. Res*. **8**(1): 64-110.

Kott, P. (1962) The ascidians of Australia III. Aplousobranchiata Lahille: Didemnidae Giard. *Australian Journal of Marine and Freshwater Research* **13**(3): 265-334.

Kott, P. (1963) The ascidians of Australia IV. Aplousobranchiata Lahille; Polyclinidae Verrill (continued). *Aust. J. Mar. Freshwat. Res.* **14**(1): 70-118.

Kott, P. (1972) The ascidians of South Australia I. Spencer Gulf, St Vincent Gulf and Encounter Bay. *Transactions of the Royal Society of South Australia* **96**(1): 1-52.

Kott, P. (1985) The Australian Ascidiacea Pt 1: Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum* **23**: 1-440.

Kott, P. (1990) The Australian Ascidiacea Pt 2: Aplousobranchia (1). *Memoirs of the Queensland Museum* **29**(1): 1-266.

Kott, P. (1990) The Australian Ascidiacea, Phlebobranchia and Stolidobranchia: supplement. *Memoirs of the Queensland Museum* **29**(1): 267-298.

Kott, P. (1992) The Australian Ascidiacea Pt 3: Aplousobranchia (2). *Memoirs of the Queensland Museum* **32**(2): 377-620.

Kott, P. (1992) The Australian Ascidiacea, supplement 2. *Memoirs of the Queensland Museum* **32**(2): 621-655.

Kott, P. (1997) Tunicates (Sub-Phylum Tunicata) In: Shepherd, S.A. and Davies, M. (Eds) *Marine Invertebrates of Southern Australia Part III*. SARDI Aquatic Sciences, South Australia, and the Flora and Fauna of South Australia Handbooks Committee, Adelaide, South Australia.

Kott, P. (1998) Tunicata. In: Wells, A. and Houston, W.W. (Eds) *Zoological Catalogue of Australia*. Hemichordata, Tunicata, Cephalochordata. Melbourne: CSIRO Publishing, Australia Vol. 34. 298p.

Kott, P. (2001) The Australian Ascidiacea, part 4: Aplousobranchia (3), Didemnidae. *Memoirs of the Queensland Museum* **47**(1): 1-410.

Kott, P. (2001) The Australian Ascidiacea Pt 4, Didemnidae. *Memoirs of the Queensland Museum* **47**(1): 1-410.

Kott, P. (2003) New syntheses and new species in the Australian Ascidiacea. *Journal of Natural History* **37**: 1611-1653.

Kott, P. (2004) New and little known species of Didemnidae (Ascidiacea, Tunicata) from Australia. Part 1: *Journal of Natural History* **38**(6): 731-774. Part 2: *Journal of Natural History* **38**(19): 2455-2526.

Kott, P. (2005a) New and little known species of Didemnidae (Ascidiacea, Tunicata) from Australia (Part 3). *Journal of Natural History* **39**(26): 2409-2479.

Kott, P. (2005b) Novel Australian Polyzoinae (Styelidae, Tunicata). *Journal of Natural History* **39**(32): 2997-3011.

Kott, P. (2005c) Catalogue of Tunicata in Australian Waters. Australian Biological Resources Study, Department of the Environment and Heritage, Canberra.

Kott, P. (2006) Observations on non-didemnid ascidians from Australian waters (1). *Journal of Natural History* **40**(3-4): 169-234.

Kott, P. (2007) New and little known species of Didemnidae (Ascidiacea, Tunicata) from Australia (Part 4). Journal *of Natural History* **41**(17-20): 1163-1211.

Kott, P. (2010) (i) Class Ascidiacea. (ii) Didemnidae. In: Australian Faunal Directory.
(i) http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/ASCIDIACEA;
(ii) http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/DIDEMNIDAE

Loo, M. G. K. (2001) Effects of wastewater effluent on macrobenthic infaunal communities at Christies Beach, South Australia. Ph.D. thesis. (Department of Environmental Biology, University of Adelaide).

Martin, D. and Britayev, T.A. (1998) Symbiotic polychaetes: review of known species. *Oceanogr. Mar. Biol. Ann. Rev*. **36**: 217-340.

McDonald, G.R. (2006) *Nudibranch Systematic Index*. Institute of Marine Sciences, University of California, Santa Cruz.

McInnes, K.L., Suppiah, R., Whetton, P.H., Hennessy, K.J. and Jones, R.N. (2003) Climate change in South Australia. Chapter in report on: Assessment of climate change, impacts and possible adaptation strategies relevant to South Australia. CSIRO Atmospheric Research.

Newman, l. and Cannon, L. (2003) *Marine Flatworms: the World of Polyclads*. CSIRO Publishing, Victoria.

O'Hara, T. Gledhill, D., Butler, A., Wilson, R., Poore, G., McCallum, A., Last, P. England, P. and Andreakis, N. (2011) *Report on application of evolutionary history to inform how species and/or communities might respond to changes in climate.* CERF Marine Biodiversity Research Hub report, March 2011. CSIRO, Hobart.

Osterstock, A. (1976). *Sea shells of Kangaroo Island*. Alan Osterstock, Austaprint, Adelaide. 56 pp.

OZCAM (2012, 2013) *Online Zoological Collections of Australian Museums* http://www.ozcam.gov.au/index.php.

Ponder, W., Hutchings, P. and Chapman, R. (2002) *Overview of the Conservation of Australian Marine Invertebrates*. Report for Environment Australia. July, 2002.

Roberts, C. M. and Hawkins, J. (1999) Extinction risk in the sea. *Trends in Ecology and Evolution* **14**: 241-246.

Read, G. and Fauchald, K. (Ed.) (2013) *World Polychaeta database*. http://www.marinespecies.org/polychaeta on 2013-04-09. (URL accessed August 2013).

Rudman, W. B. (1983) The Chromodorididae (Opisthobranchia: Mollusca) of the Indo-West Pacific: *Chromodoris splendida*, *C. aspersa* and *Hypselodoris placida* colour groups. *Zoological Journal of the Linnean Society* **78**: 105-173.

Rudman, W.B., 2001 (Aug 1). Comment on Philinopsis troubridgensis from South Australia by Nigel Holmes. In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/find/4898 (URL accessed August 2013).

Rudman, W.B. (2003) (i) Comment on *Philinopsis cyanea* from Lizard Is by Nils Anthes. In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/find/9063 (URL accessed July 2013). (ii) *Philinopsis troubridgensis* from South Australia (1). In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/message/9902 ; (iii) *Philinopsis troubridgensis* from South Australia by Nigel Holmes. In: Sea Slug Forum. Australian Museum. http://www.seaslugforum.net/find/4898 (URLs accessed July 2013).

Rudman, W.B. (2006) *Philinopsis speciosa* Pease, 1860. In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/factsheet/philspec (URL accessed July 2013).

Rudman, W.B. (2006) Comment on *Philinopsis cyanea*? from Victoria, Australia by Trevor McMurrich. In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/find/16141 (URL accessed July 2013).

Rudman, W.B. (2007) Comment on *Philinopsis taronga*? from Tasmania by Patrick N Lewis. In: Sea Slug Forum. Australian Museum, Sydney. http://www.seaslugforum.net/find/19478 (URL accessed July 2013).

Shepherd, S.A. and Sprigg, R. (1976) Substrate, sediments and subtidal ecology of Gulf St Vincent and Investigator Strait. In: Twidale, C., Tyler, M., and Webb, B. (Eds) (1976). *Natural History of the Adelaide Region*. RSSA, South Australia.

Shepherd, S.A. and Thomas, I.M. (1989) (Eds) *Marine Invertebrates of Southern Australia Part 2.* South Australian Government Printing Division, Adelaide, South Australia.

Sheppard, C., Turak, E. and Wood, E. (2008) *Coscinaraea mcneilli*. In: IUCN (2013) *IUCN Red List of Threatened Species*. Version 2010.4. www.iucnredlist.org.

Sorokin, S.J. and Currie, D.R. (2009) The distribution and diversity of sponges in Spencer Gulf. Report to Nature Foundation SA Inc. SARDI Aquatic Sciences Publication No.F2008/001153-1. SARDI Research Report Series No. 334. South Australian Research and Development Institute (Aquatic Sciences), Adelaide, SA.

Suppiah, R., Preston, B., Whetton, P.H., McInnes, K.L., Jones, R.N., Macadam, I., Bathols, J. and Kirono, D. (2006) Climate change under enhanced greenhouse conditions in South Australia – An updated report on: Assessment of climate change, impacts and risk management strategies relevant to South Australia. Report for South Australian Government by the Climate Impacts and Risk Group, CSIRO Marine and Atmospheric Research.

Tanner, J.E., Fairhead, A. Marsh, R. and Miller, D. (2003) *Environmental assessment of the dredge site at Outer harbor: Berth 8 option*. SARDI Aquatic Sciences report, for GHD Pty Ltd.

Thomas, I.M. and Shepherd, S.A. (1982) Sea anemones. In: Shepherd, S.A. and Thomas, I.M. (Eds) *Marine Invertebrates of Southern Australia.* Part 1. Handbook of the Flora and Fauna of South Australia. Government Printer, SA.

Turak, E., Sheppard, C. and Wood, E. (2008) *Scolymia australis*. In: IUCN (2010) *IUCN Red List of Threatened Species*. Version 2010.4. www.iucnredlist.org.

Wells, F.E. and Bryce, C.W. (2000). *Sea Slugs of Western Australia*. Western Australian Museum. 184pp.

Wilkinson, C. (2004) *Status of the Coral Reefs of the World: 2004*. AIMS, Townsville, QLD.

Wilson, R.S, Hutchings, P.A. and Glasby, C.J. (2003) *Polychaetes - An Interactive Identification Guide*. CD-ROM. CSIRO Publishing. ISBN: 9780643067028.

Womersley, H.B.S. (1990). Biogeography of Australasian marine macroalgae. In: Clayton, M. and King, R. (eds.) Biology of Marine Plants. Longman Cheshire, Melbourne.

Appendices

Appendix 1: A summary of relatively common and geographically widespread opisthobranchs (including nudibranchs) which were recorded during the Kangaroo Island field work in 2013. Species are listed in alphabetical order.

Species Name	Location(s)
Baeolidia australis (= *Spurilla australis*)	American River (NB Previously record housed at SA Museum, was from a site between Snug Cove and Western River Cove)
Ceratosoma brevicaudatum	Stokes Bay West; Western River Cove; Frenchman's; Lavers Reef; American River; White Point (near Emu Bay); Kangaroo Head (NB Previous records including Kingscote; Penneshaw; Brown Beach; American Beach; D'Estrees Bay; and Osmanli Reef off Point Tinline)
Chromodoris epicuria	Frenchmans (NB Also previous record from W side of Cape D'Estaing, at SA Museum)
Doriopsilla carneola	Kingscote; American River (NB Other locations include a previous record from Snug Cove, at SA Museum)
Doriopsilla peculiaris	American River
Elysia expansa	American River
Hypselodoris saintvincentius (*H. infucata*)	Kangaroo Head (NB Previous records housed at SA Museum and Australian Museum, including "The Arch" (between Snug Cove and Western River cove): a site E of Snug Cove; Knob Point and Kingscote Jetty
Mexichromis macropus	Ironstone Hill; Western River Cove
Oxynoe viridis	American River (NB Also previously recorded at this location in 1978: Museum Victoria record, collected by N. Coleman)
Paradoris dubia	American River
Stiliger smaragdinus	American River
Tylodina corticalis	Frenchman's; Lavers Reef

Appendix 2: Examples of records of other opisthobranchs and nudibranchs which have been found on Kangaroo Island, in addition to those listed in Appendix 1 and in the body of this report.

Species Name	Location(s)	Source(s)
Aegires villosus	"The Amphitheatre" and "Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Aphelodoris lawsae	"The Amphitheatre", "The Arch" and a site E of "The Arch" (b/w Snug Cove and Western River Cove); Knob Point; Penneshaw	Australian museum record; Museum Victoria record; SA Museum record; Kuiter 2007; Coleman 2008
Aphelodoris greeni	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Aplysia parvula	Western River Cove	SA Museum record
Austraeolis ornata	"The Arch" and "Pissy Boy Rock" (b/w Snug Cove and Western River Cove); American River; Penneshaw	Museum Victoria record, collected by N. Coleman, 1978; SA Museum record
Berthellina citrina	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Bulla quoyi	Western Cove, Eastern Cove, American River	Australian Museum records; J. Baker, pers. obs.
Caldukia affinis	Penneshaw	SA Museum record
Ceratosoma amoenum / amoena	Snug Cove, and E of Snug Cove; Snellings Beach	SA Museum records; photo by H. Crawford
Chromodoris ambigua	W of "The Arch" (b/w Snug Cove and Western River Cove)	SA Museum record
Chromodoris alternata	"The Amphitheatre" (b/w Snug Cove and Western River Cove)	SA Museum record
Chromodoris tinctoria	"The Amphitheatre" (b/w Snug Cove and Western River Cove)	SA Museum record
Cratena sp.	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Dendrodoris albopurpurea	"The Arch" (b/w Snug Cove and Western River Cove)	SA Museum records
Dendrodoris fumata	American River and other locations	SA Museum record; Kuiter 2007
Dendrodoris nigra	Pelican Lagoon; Kingscote Jetty	Museum Victoria record; Kinloch et al. 2007
Digidentis arbuta (= *Thorunna arbuta)*	"The Arch" (b/w Snug Cove and Western River Cove)	SA Museum record
Digidentis kulonba (previously *Glossodoris kulonba*)	Western River Cove	Kuiter 2007; SA Museum record
Digidentis perplexa	Knob Point; "Pissy Boy Rock" (b/w Snug Cove and Western River Cove) and surrounds	Australian Museum record, 1978; Kuiter 2007; SA Museum records
Doriopsilla peculiaris	Kingscote jetty	SA Museum record
Doto ostenta	E of Snug Cove	SA Museum record

Appendix 2 (cont.): Examples of records of other opisthobranchs and nudibranchs which have been found on Kangaroo Island, in addition to those listed in Appendix 1 and in the body of this report.

Species Name	Location	Source
Eubranchus sp.	Kangaroo Island	Coleman 2008
Flabellina rubrolineata	"The Amphitheatre" (b/w Snug Cove and Western River Cove)	SA Museum records
Flabellina sp. 1	Kangaroo Island	Kuiter 2007
Glossodoris angasi	Kangaroo Island	Kuiter 2007
Halgerda graphica	Antechamber Bay	Fahey and Gosliner 2003
Haminoea maugeansis	Bay of Shoals	Australian Museum record
Hoplodoris nodulosa	Kangaroo Island	SA Museum record
Kaloplocamus sp.	"The Amphitheatre" and "Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Liloa brevis	Kangaroo Island	Coleman 2008
Marianina rosea	Knob Point	Australian Museum record
Melibe australis	W of "Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Mexichromis macropus	Western River Cove (type locality); "The Amphitheatre" (b/w Snug Cove and Western River Cove) and other locations	Burn 2006; Kuiter 2007; SA Museum record
Neodoris chrysoderma	W of Cape Cassini; "The Amphitheatre" (b/w Snug Cove and Western River Cove)	SA Museum records; Kuiter 2007
Noumea closeorum / closei	"Pissy Boy Rock" and a site W of "The Arch" (b/w Snug Cove and Western River Cove)	SA Museum records
Okenia mija	Kingscote	Australian Museum record
Paliolla cooki	"The Amphitheatre" (b/w Snug Cove and Western River Cove)	SA Museum record
Paratritonia cf *lutea*	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record; Coleman 2008
Phidiana militaris	Knob Point	Museum Victoria record
Phidiana cf. *newcombi* (= *Facelina newcombi*)	"The Castles" (b/w Snug Cove and Western River Cove)	SA Museum record
Philine angasi	Kingscote	SA Museum record
Phyllodesmium poindimiei	West of "The Arch" (b/w Snug Cove and Western River Cove)	SA Museum record
Pattyclaya brycei	Kangaroo Island	Coleman 2008
Polybranchia pallens	Western River Cove; The Arch" (b/w Snug Cove and Western River Cove)	SA Museum record
Pleurobranchaea maculata	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record

Appendix 2 (cont.): Examples of records of other opisthobranchs and nudibranchs which have been found on Kangaroo Island, in addition to those listed in Appendix 1 and in the body of this report.

Species Name	Location	Source
Pteraeolidia ianthina	E of Snug Cove	SA Museum record
Roburnella wilsoni	American River	Australian Museum record; Coleman 2008; photo by R. Kuiter
Rostanga sp. *("Discodoris paroa" / "Rostanga calumnus")*	Browns Beach (Eastern Cove) and other locations	Benkendorff et al. 2007; photograph by N. Coleman; SA Museum record
Rostanga crawfordi (= *Rostanga australis*)	Kingscote	photo by D. Muirhead
Rostanga calumus	Penneshaw; Kingscote and other locations	SA Museum; photograph by N. Coleman
Sagaminopteron ornatum	Stokes Bay; Cape Marsden	Museum Victoria record, collected by N. Coleman, 1978; photo by A. Brown 2008
Sclerodoris tarka	Kingscote Jetty	Museum Victoria record; SA Museum record
Scyllaea pelagica	Eastern Cove, Western Cove	photo by R. Kuiter; Kinloch et al. 2007; Coleman 2008
Siphopteron sp.	Snug Cove	SA Museum record
Spurilla macleayi	"Pissy Boy Rock" (b/w Snug Cove and Western River Cove)	SA Museum record
Tambja verconis	"The Amphitheatre" (b/w Snug Cove and Western River Cove); Penneshaw jetty	Australian Museum record, collected by I. Loch, 1978; SA Museum records
Taringa merria (previously *Aporodoris merria*)	Kingscote jetty	SA Museum record
Trapania aureopunctata	Kingscote jetty	SA Museum record
Trapania brunnea	Kingscote and other locations	Australian Museum record, collected by R. Kuiter, 1978; SA Museum record
Trinchesia sp.	Kangaroo Island	Coleman 2008
Tritoniopsis alba	Kangaroo Island	Kuiter 2007
Verconia verconis	Antechamber Bay (type locality) Brown Beach, Eastern Cove, Kingscote and other locations	Australian Museum record; Burn 2006; Kuiter 2007; photo by J. Baker 2007

Appendix 3: Examples of prosobranch gastropod shells of conservation interest which are found around Kangaroo Island (adapted from Baker 2011a and references therein, and data by the late P. Clarkson). Species which may be endemic within South Australia (if they are distinct species) are marked "E".

Genus & Species	Examples of locations around Kangaroo Island and vicinity
Amoria undulata	Dudley Peninsula
Argalista roseopunctata **E**	Cape Borda
Austrodrillia (Austrodrillia) agrestis **E**	Backstairs Passage
Austrodrillia (Austrodrillia) dimidiata **E**	Backstairs Passage
Austrocypraea reevei	Backstairs Passage; Dudley Peninsula (including Penneshaw area) I
Austroharpa (Palamharpa) punctata	S Kangaroo Island
Conus klemae	N coast of Kangaroo Island; Dudley Peninsula; S Kangaroo Island
Daphnella (Daphnella) diluta **E**	Backstairs Passage, and Cape Borda
Lyria mitraeformis	eastern Kangaroo Island
Nannamoria johnclarki / johnclarkei	Backstairs Passage
Notocypraea angustata	Backstairs Passage; Eastern Cove
Notocypraea piperita	Backstairs Passage; Eastern Cove; Dudley Peninsula
Notocypraea comptoni comptoni	Backstairs Passage ; S coast of Kangaroo Island
Notopeplum translucidum	Backstairs Passage
Turbo (Dinassovica) jourdani	Kangaroo Island
Umbilia armeniaca	N Kangaroo Island
Vasum (Altivasum) flindersi	Dudley Peninsula
Zoila friendii thersites (including form *contraria*)	Dudley Peninsula and other Kangaroo Island locations; Backstairs Passage
Zoila marginata orientalis	Dudley Peninsula (incl. Penneshaw area) and other areas
Zoila marginata marginata	Kangaroo Island