MARINE INVERTEBRATES OF THE NORTHERN AND YORKE NRM REGION: RESULTS OF 2013-2014 FIELD WORK, INCLUDING RECORDS OF NEW SPECIES

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Dedication

This report is dedicated to marine naturalist and photographer Mr Leon Altoff, from the Marine Research Group of the Field Naturalists of Victoria, and an associate of SACReD. Leon's expert photography of small marine invertebrates in south-eastern Australia is a valuable resource, not only to aid taxonomic identifications by museum staff and associates, but also to show the general public many examples of unusual and rarely seen marine invertebrate life in southern waters. In 2014, Leon attended at field trip in NY NRM region, and photographed many of the species of taxonomic and biogeographic interest recorded by SACReD and MRG volunteers during that field trip, and subsequent field work through the year.

Acknowledgments

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- Dr Maite Teresa Aguado, Universidad Autónoma de Madrid, Spain
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- Mr Bob Burn, Honorary Associate, Museum Victoria
- Professor John Cann, University of South Australia
- Dr Allen Collins, Smithsonian National Museum of Natural History, Washington, USA
- Dr Andrea Crowther, South Australian Museum
- Mr John Chuk, research of Platyhelminthes and opisthobranchs, associated with Museum Victoria
- Dr Daniel Geiger, Santa Barbara Museum of Natural History
- Dr Yakko Hirano, Chibo University, Japan
- Mr Peter Hunt, Secretary of Malacological Society of South Australia
- Mr Thierry Laperousaz, South Australian Museum
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- Dr P. Mark O'Loughlin, Associate of Museum Victoria
- Dr Peter Schuchert, Muséum d'Histoire Naturelle, Genève, Switzerland
- Dr David Staples, Museum Victoria
- Dr Robin Wilson, Museum Victoria

The expertise of the aforementioned people has greatly assisted the project, and their time is also much appreciated. Particular thanks go to Bob Burn for attending one of the project field trips to Yorke Peninsula in April 2014, and identifying all nudibranchs and other sea slugs and gastropod molluscs. Sincere thanks also to Robin Wilson, John Chuk and Michela Mitchell for regular correspondence and identification of species in photographs, and for sharing their valuable knowledge of various marine invertebrate phyla in SE Australia. Thanks to Thierry Laperousaz and Dr Andrea Crowther from SA Museum for assisting with sample curation.

Particular thanks to Mr Leon Altoff, from Marine Research Group of the Fields Naturalists of Victoria. Thanks also to P. McPeake and R. Trigg from incorporated body Marine Life Society of South Australia. SACReD is an unincorporated community group, and chose MLSSA in 2013 to administer on a fee-for-service basis the NRM community grant funding which was awarded to SACReD at that time. We also thank Stephen Johnson for catering work, and A. Brown (member of SACReD) who generously provided accommodation on south-western Yorke Peninsula, which enabled the October 2014 field work to be undertaken.

MARINE INVERTEBRATES OF THE NORTHERN AND YORKE NRM REGION: RECORDS OF NEW SPECIES, AND RESULTS OF 2013-2014 FIELD WORK

SUMMARY

This project aims to improve scientific and public knowledge about coastal marine invertebrates in South Australia, a large group of fauna which has rarely been considered. Marine invertebrates have often been described in scientific terms as "the other 99%" - i.e. the vast majority of species in numerical terms, which are largely ignored in marine research and education. Current knowledge regarding the range, distribution and habitats of numerous marine invertebrate species in South Australia is inadequate. Some species are known only from a single specimen, from one locality. Many known species remain unnamed, and an additional unknown number are yet to be discovered. Learning more about the existence and distribution of these species can help to better determine their conservation needs. The project also provides opportunity for some results to be shared in marine education, through promotion of rarely seen South Australian marine species in school slideshows, public talks and freely available educational materials.

The work on rarely recorded marine invertebrates which members of South Australian Conservation Research Divers (SACReD) have been doing voluntarily since 2011, with some benefactor and/or community grant assistance to help cover field expenses and reporting of results, is the only current research in South Australia contributing to knowledge of the biodiversity and biogeography of marine invertebrates in this State. Via this project, we are also collaboratively working and sharing information with colleagues from the Marine Research Group of the Field Naturalists Club, and from Museum Victoria, who are working on the biogeography and taxonomy of marine invertebrates in Victoria.

The main objectives of the project are scientific discovery, which can contribute to public awareness, marine education and marine conservation. Through education comes understanding, and through understanding comes appreciation. The project hopes to help foster a broader, public conservation interest in marine invertebrates, particularly reef-associated species, which are a large and little known group. The project aims to encourage the general public, coastal school students, dive groups and associations, marine conservation managers, educators and other decision-makers, coastal and marine NGOs, and any other interested persons, to better understand the marine invertebrate biodiversity of SA waters. Some of these species may be threatened by coastal impacts and developments, declines in critical habitat (including host benthic species, in some cases) and, in the longer term, by the effects of ocean warming in southern Australia. By improving knowledge of the distribution and habitat of such species, their conservation needs can be better determined in a changing climate. It is also hoped that education about the extraordinary marine biodiversity of South Australia might inspire some students to choose a career in marine research, because there is much still to discover about marine species in South Australia, particularly invertebrates.

During the past 14 months, with assistance of a 2013-14 NY NRM Community Grant, from Natural Resources - Northern and Yorke, via the Department for Environment, Water & Natural Resources (DEWNR)'s NRM Investment Unit, field-based and lab-based project work has been undertaken by SACReD members and associates, to learn more about the distribution and habitats of rarely recorded marine invertebrates at various locations around Yorke Peninsula. Areas of study during the past year have included more than 20 sites at 12 locations around eastern, southern and western Yorke Peninsula. The project follows a detailed review of conservation status of marine invertebrates in the NY NRM regions, based on existing information (Baker 2011). This report outlines some of the results from the past 14 months of the field and lab work.

Our searches for 2014 included species in Staurozoa (stalked jellyfishes); Anthozoa (anemones and corals); Opisthobranchs/Heterobranchia (sea slugs / nudibranchs); Prosobranchia (sea snails); Platyhelminthes (flatworms); Nemertea (ribbon worms); Annelida (including Polychaeta - sea worms); Holothuroidea (Sea Cucumbers); some groups of Crustacea (isopods, shrimps and sand shrimps); and several other groups.

At 11 of the locations, divers, snorkellers and intertidal researchers collected 16 samples of seaweed (macroalgae) and seagrass for extraction of micro-invertebrates. Divers searched on SCUBA for invertebrates in the target taxonomic groups, at locations around eastern, southern and western Yorke Peninsula. Over the period, 19 dives were undertaken to search for uncommonly recorded marine invertebrates. Participants in the project took more than 2,800 photographs of invertebrates from September 2013 to October 2014, collectively comprising several hundred *in situ* photographs on SCUBA, and more than 2,000 photographs of micro-invertebrates, with the aid of microscope, digital microscope and macro-photography equipment. During the April 2014 field trip, colleagues from the Marine Research Group (MRG) of the Field Naturalists Club of Victoria attended SACReD's field trip, and managed the intertidal specimen collecting at several sites, and also the processing and curation of most samples collected during that field trip.

During the past year, 20 marine taxonomists and other specialists from Australia, North America and Europe have assisted SACReD's marine invertebrates' project on Yorke Peninsula, by offering advice, and identifying samples, and also photographs taken by divers from SACReD, MRG and SCUBA clubs during the 2013-2014 field work. A number of the specimens which have been collected will be loaned to various research institutions for taxonomic description of new species, such as Museum Victoria, and Smithsonian National Museum of Natural History (Washington USA). A number of specimens are also on loan for identification of species, at institutions such as the Santa Barbara Museum of Natural History (California USA).

Results of the project to date have included records of invertebrates not previously recorded anywhere else (i.e. "new", undescribed species); tropical and subtropical species not previously recorded in SA; range extensions for rarely recorded species, previously known from only one or two records; and range extensions for species previously known only from other southern States. Some examples from the 2013-14 project include records of the rare group staurozoa (stalked jellyfish), including a *Stenoscyphus* which will be described by taxonomists in the US, and a range extension of a south eastern Australian species; first records of 12 types of ribbon worm which represent new species and will be taxonomically described in future (and for which places on Yorke Peninsula will become the type localities); first records of several polychaete worms which will be described as new species; 6 species of sea slugs which represent first documented records in SA of eastern or SE species, and 9 other species of sea slug which are uncommonly recorded in SA. The marine invertebrate searches and photography of SACReD group members and associates from various SCUBA clubs in SA, coupled with seaweed collections under permit; extraction of micro-invertebrates from seaweed samples; micro-photography of samples; and assistance of numerous marine taxonomists from around Australia, have all helped to improve the state of knowledge about the distribution and habitat of a number of rarely recorded marine invertebrate species in South Australia, as well as rarely recorded tropical and south-eastern species, and several undescribed and previously unrecorded taxa.

Marine invertebrate have important ecological roles, including food sources for other animals, and the recycling of nutrients through ecosystems. Many of the species discussed in this report are associated with reef surfaces as habitat, and others are reliant up seagrass and seaweeds as habitat in which to live, feed and reproduce. Degradation of such habitats may result in a decline in the invertebrate species richness and diversity in NY NRM, and this may have flow-on effects to higher order animals. 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. Across South Australia, the majority of ranges for small, non-commercial marine invertebrates are opportunistically defined, based on few records from few locations, recorded incidentally during the past century. The research effort in the current project, in collaboration with researchers who undertake similar work in other States, will assist in better determining the invertebrate species richness and diversity across Yorke Peninsula, and in SA more generally.

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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 current survey efforts, to understand more about the marine invertebrate fauna in various coastal regions of South Australia, particularly marine species of conservation interest.

During the past 14 months, with the assistance of a 2013-14 NY NRM Community Grant, from Natural Resources - Northern and Yorke, via the Department for Environment, Water & Natural Resources (DEWNR)'s NRM Investment Unit, field-based and lab-based project work has been undertaken by the South Australian Conservation Research Divers (SACReD) and associates to learn more about the distribution and habitats of rarely recorded and endemic marine invertebrates at various locations along the central South Australian coast. SACReD is a group of marine citizen science volunteers founded by marine ecologist Janine Baker, and members and associates have participated in marine science projects managed by Janine since 2007. In 2014, divers from several dive clubs in South Australia - such as Adelaide University SCUBA Club, M.E. Dive Club and Wallaroo and Districts Dive Club - also assisted with SACReD's rarely recorded and endemic marine invertebrates project. Several members of the Marine Research Group (MRG) of the Field Naturalists of Victoria are also key participants in SACReD's field project in NY NRM Region, and attended a joint SACReD / MRG field trip to southern Yorke Peninsula in April 2014. Our current project is concentrating on various invertebrate groups, comprising species which may be rarely recorded (and thus poorly known); apparently rare; endemic or of narrow geographic range; and/or undescribed. Some of the groups for which we are currently searching include species in Anthozoa (anemones and corals); "Prosobranchs" (sea snails); Opisthobranchs/Heterobranchia (sea slugs / nudibranchs); Platyhelminthes (flatworms); Nemertea (ribbon worms); Annelida (including Polychaeta - sea worms); Crinoidea (Feather Stars), Holothuroidea (Sea Cucumbers), Ophiuroidea (Brittlestars), Asteroidea (sea stars), and several other groups. During 2013-14, 20 marine taxonomists and other specialists from around Australia and overseas assisted SACReD and associates' rarely recorded marine invertebrates' project, by offering advice, identifying macro-photographs of invertebrates taken by divers, and identifying specimens collected under permit. This report details some of the results so far - including several "new" species not previously recorded anywhere else; eastern and south-eastern Australian species not previously known from SA; tropical species, and uncommonly recorded southern relatives of tropical species; and range extensions for species previously recorded only from the type locality, or from very few locations.

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 rarely recorded and potentially threatened marine invertebrate fauna in two NRM regions (Baker 2011a, 2011b; Baker et al. 2013a, 2013b). The *No Species Loss* strategy in SA is currently being updated.

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. In future, previous Aquatic Reserves designated under the *Fisheries Management Act* will become Sanctuary Zones within Marine Parks, which have been designated under the *Marine Parks Act 2007*, and implemented in October 2014. 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).

For small and cryptic invertebrates, such as those living in seaweed, or under rocks, the concept of rarity is much hard to define, because the probability of finding such animals without extensive targetted searches is low. Some of these animals are undoubtedly much more abundant than records would indicate.

3. Characteristics that Determine Vulnerability of Marine Species

There are various recognised life history and population characteristics that can render marine invertebrate species populations vulnerable to decline. Examples include:

- restricted range - particularly apparent endemism within a small geographic area;
- apparent rarity (known from very few records); and
- apparently small populations.

The second of these points is hard to determine. Numerous small invertebrate species in South Australia which are rarely recorded are undoubtedly more abundant than records would indicate, but records are inadequate due to lack of targetted searches in the appropriate habitats, over many years.

Other characteristics which can increase vulnerability, 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 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 population decline and local extinctions. 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).

Although many invertebrates are short-lived and fast-growing, others (such as various gastropod groups) are relatively long-lived and slow-growing, and this is another life history characteristic which increases vulnerability to population decline.

Other characteristics which increase vulnerability of invertebrates to population decline include living in a readily accessible habitat (e.g. if collected for food or trade); close association with threatened habitat (such as nearshore seagrass beds), or with threatened species (as parasites or commensal organisms, or as food sources etc.); value in trade for collections / ornaments etc (promotes exploitation), or as a food species; high visibility (due to large size, bright colour / patterning, and/or presence in intertidal habitats); aggregation of adults, for feeding or reproduction (can increase the effects of localised impacts on populations); and being subject to large scale mass mortality events (Jones and Kaly 1995; Roberts and Hawkins 1999; Ponder et al. 2002).

4. Methods

The 2013-14 Yorke Peninsula project was an extension of previous work undertaken in coastal waters in other parts of South Australia, by South Australian Conservation Research Divers (SACReD). For previous dive surveys, a preliminary list of target species was made, based on reviews of uncommonly recorded marine invertebrates in the South Australian gulfs (e.g. Baker 2011a, 2011b). Prior to the first field trips in 2011-12, diver education included viewing photos of some of the target species, and provision of a written list of some of the target species and taxonomic groups. Some divers had also previously viewed a slideshow of common and broadly distributed species which they should not photograph during the field work. Between April and November 2014, 10 divers collectively spent approximately 60 hours searching for invertebrates, at 9 sites within the NY NRM region. Five divers searched specifically for this project during their dives, and another 5 divers assisted the project during their own independent dives, and provided records of species of interest to SACReD's project. Sites at which divers searched are shown in **Map 1**. Sites are listed in **Table 1** below, in alphabetical order of location, with dates and corresponding depths of dives. Several of the sites where divers searched, and where marine plant samples were taken under permit, are shown in **Figure 1**. For 10 of the dives corresponding to the sites labelled "D" under Survey Type in **Table 2**, 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. During some dives, such as several of those undertaken at Edithburgh Jetty, photos of invertebrates of interest were taken incidentally by divers during recreational diving for various other purposes, such as testing new macro lenses on underwater cameras.

More than 2,000 photographs of marine invertebrates were taken by volunteer participants. 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. To date, 19 marine taxonomists and other specialists from around Australia, Europe and USA have assisted SACReD and associates' project on uncommonly recorded marine invertebrates in NY NRM region.

During 2013 and 2014, samples of seaweed and seagrass were collected on 16 occasions during several field trips, for extraction of micro-invertebrates. Subtidal seaweed and seagrass samples from sites listed in **Table 1** as Survey Type "C" and dated April, September and October 2014 were collected by J. Baker, A. Futterer, D. Kinasz, J. Baker-Johnson, H. Crawford and K. Puxley from 11 locations. Samples dated 2013 were collected from the intertidal and shallow subtidal by J. Baker and J. Baker-Johnson at Port Julia (on 3 occasions), Sultana Point, and Point Gilbert. Intertidal seaweed samples were also collected by A. Falconer and L. Altoff at Mozzie Flat in April 2014. Divers who collected seaweed and seagrass samples under permit were provided with photographic samples of species of interest for the project, and instructions were provided so that the collecting technique would be non-destructive of the entire plant, to allow the plant to regrow after the stems were cut. Samples were immediately placed in bags underwater, to ensure that the micro-fauna content would not swim or float out of the plant. Samples were floated out in clean seawater, and micro-fauna extracted, examined under microscope, photographed, and catalogued. During the April 2014 field work, micro-invertebrates of interest, such as potentially new species or range extensions of species known from other areas, were extracted and examined by A. Falconer and B. Burn, and photographed by L. Altoff. Samples of staurozoans, nemerteans, opisthobranchs and other fauna recorded during the April 2014 field work were curated by A. Falconer for lodgement at South Australian Museum, and for loan to taxonomic specialists in Victoria and overseas.

For the 2014 micro-invertebrate sampling at various Yorke Peninsula locations, 500g - 1kg samples of seagrass (mainly *Amphibolis*) and macroalgae (species of *Sargassum*, *Cystophora*, *Caulocystis*, and several species of multi-branched red algae) were collected using SACReD's permits, namely a Ministerial exemption under PIRSA's *Fisheries Management Act 2007*, and a permit by DEWNR to undertake scientific research, under the *Marine Parks Act 2007*.

Table 1: Sites where divers from SACReD, dive club members who are associated with this project, and other associates of SACReD's project on Yorke Peninsula (e.g. Marine Research Group of FNCV) searched for and photographed endemic and uncommonly recorded marine invertebrates from September 2013 to October 2014, and/or collected samples of seagrass and macroalgae for live examination of marine micro-invertebrates. Results from 5 dives in November 2014, and from 1 dive in each of December 2014, January 2015 and February 2015 are also included. D = dive-based search location; C = sample collecting location.

Site name	Date	Latitude	Longitude	Depth	Survey Type	No. Divers Searching
Ardrossan - adjacent to jetty	17/04/14	-34.425686°	137.925019°	3m	D, C	3
Ardrossan Jetty	30/10/14	-34.424981°	137.92564°	2.5 - 4m	D, C	
Port Julia (3 locations)	16/09/13; 27/10/13; 16/12/13	-34.665368°	137.879166°	0.2m 0.5m	C	
Edithburgh Pool	18/04/14	-35.081783°	137.748249°	0.75cm, 1m, 3m	C, D	2
Edithburgh Pool - deeper	19/04/14	-35.081483°	137.748543°	3m	C, D	3
Edithburgh Jetty (various locations around jetty)	01/11/13; 06/01/14; 26/01/14; 02/02/14; 06/02/14; 07/02/14; 12/02/14; 16/03/14; 17/04/14; 18/04/14; 26/04/14; 18/05/14; 26/06/14; 28/06/14; 16/08/14; 17/08/14; 14/09/14; 12/11/14; 21/11/14; 22/11/14; 23/11/14; 21/12/14; 17/01/15	-35.084940°	137.750283°	3-5m	C, D	10
Sultana Point	25/10/13	-35.114017°	137.760367°	0.5m	C	
Point Gilbert - shallow subtidal	26/10/13	-35.119710°	137.510182°	0.5m	C	
Point Gilbert - intertidal	16/04/14	-35.118962°	137.511766°	0m	C	
Mozzie Flat (Sturt Bay) - intertidal platform	17/04/14	-35.112489°	137.497588°	0m	C	
Mozzie Flat (Sturt Bay) - subtidal	17/04/14	-35.113061°	137.497067°	2m	C, D	2
Marion Bay	04/10/14	-35.237289°	136.982632°	0.75m	C	
Groper Bay	05/10/14	-35.235986°	136.831275°	1m	C	
Moonta Bay Jetty	31/05/14, 10/08/14, 07/02/15	-34.053974°	137.556770°	3.5m	C, D	2
Port Hughes - seaward of jetty	29/12/13; 10/08/14	-34.074786°	137.539799°	6m	D	3
Port Hughes Jetty	17/02/14; 08/03/14; 21/09/14	-34.074803°	137.540848°	3m	C, D	3
Port Victoria	25/01/14; 27/08/14	-34.494736°	137.479957°		D	2

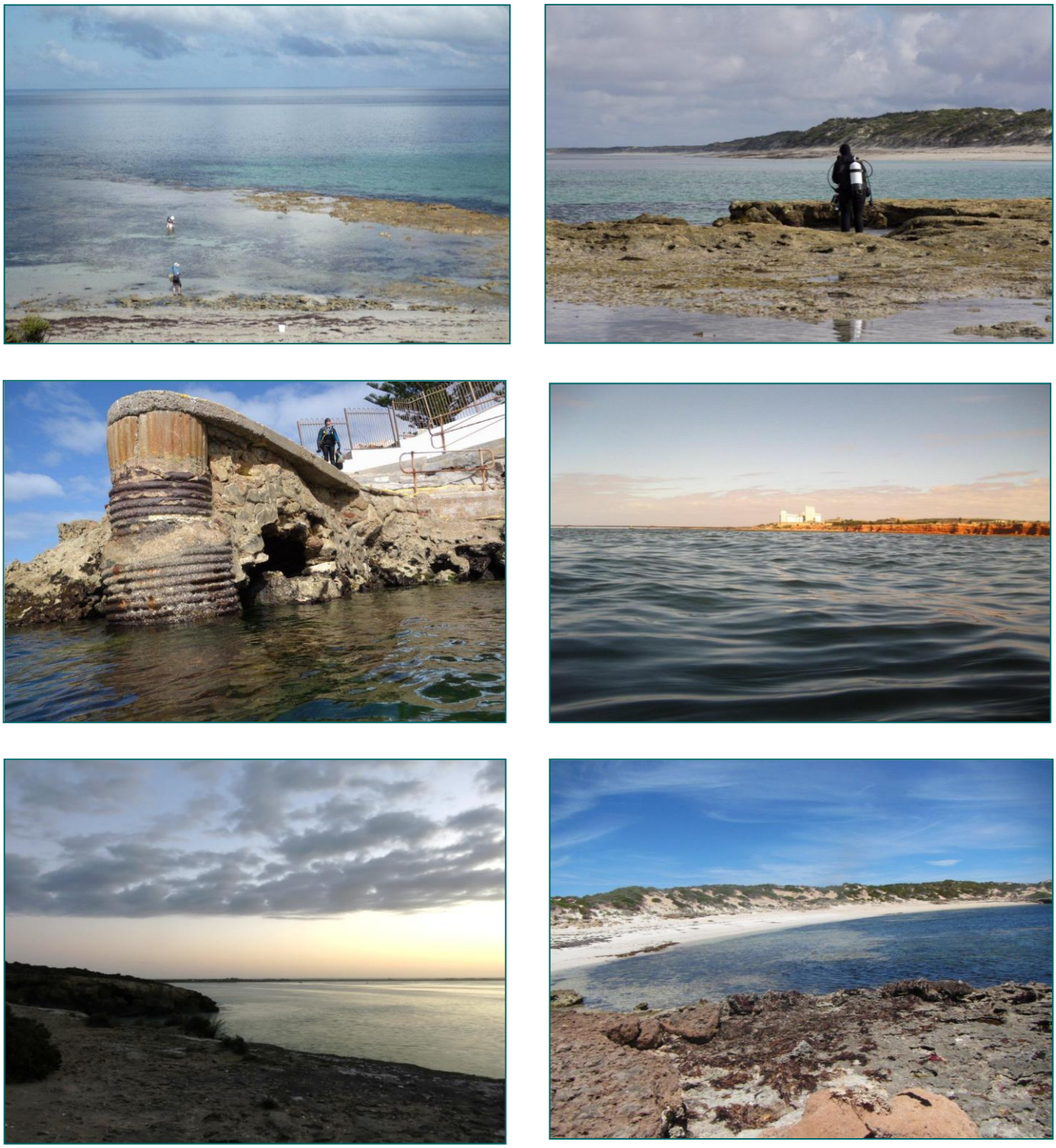
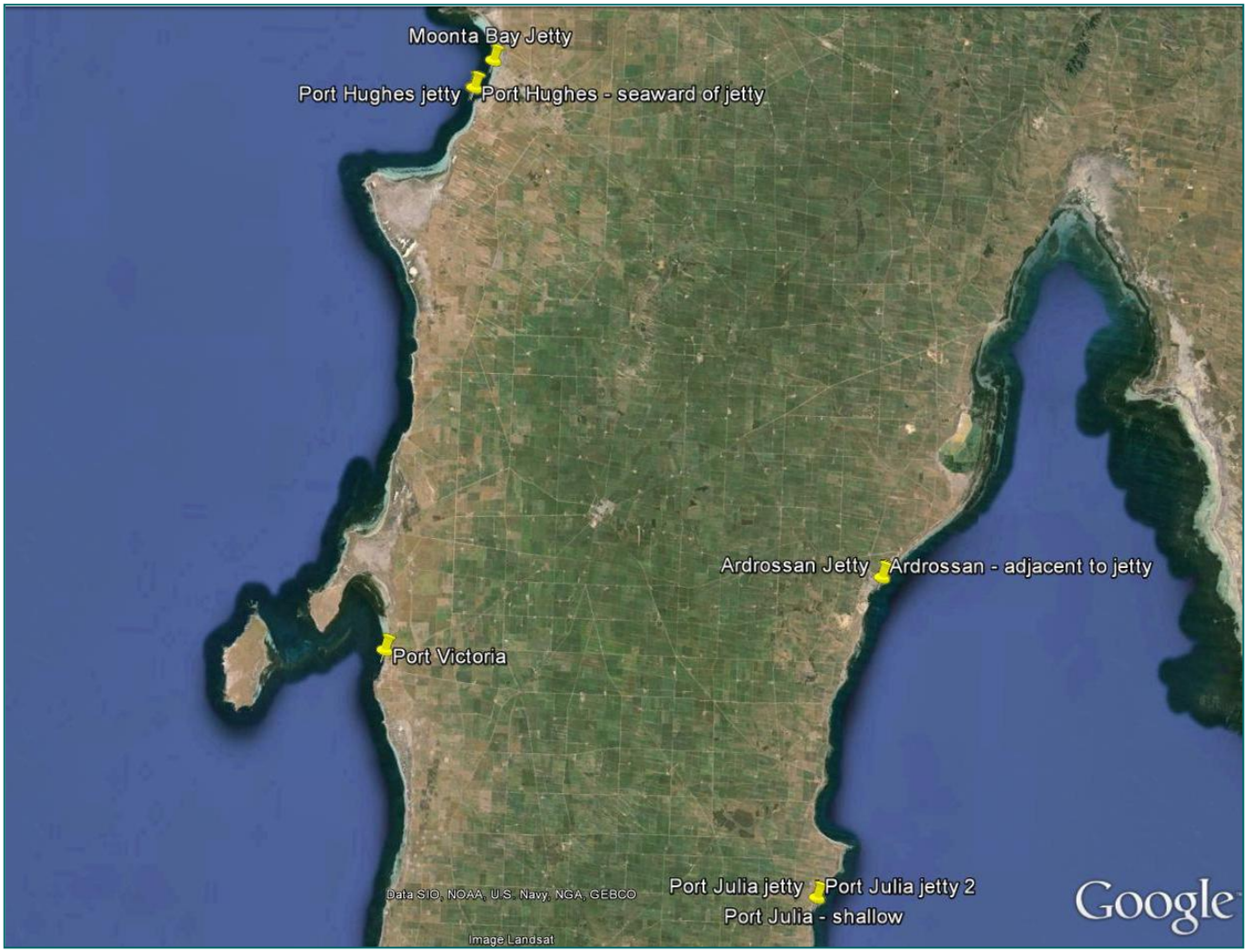
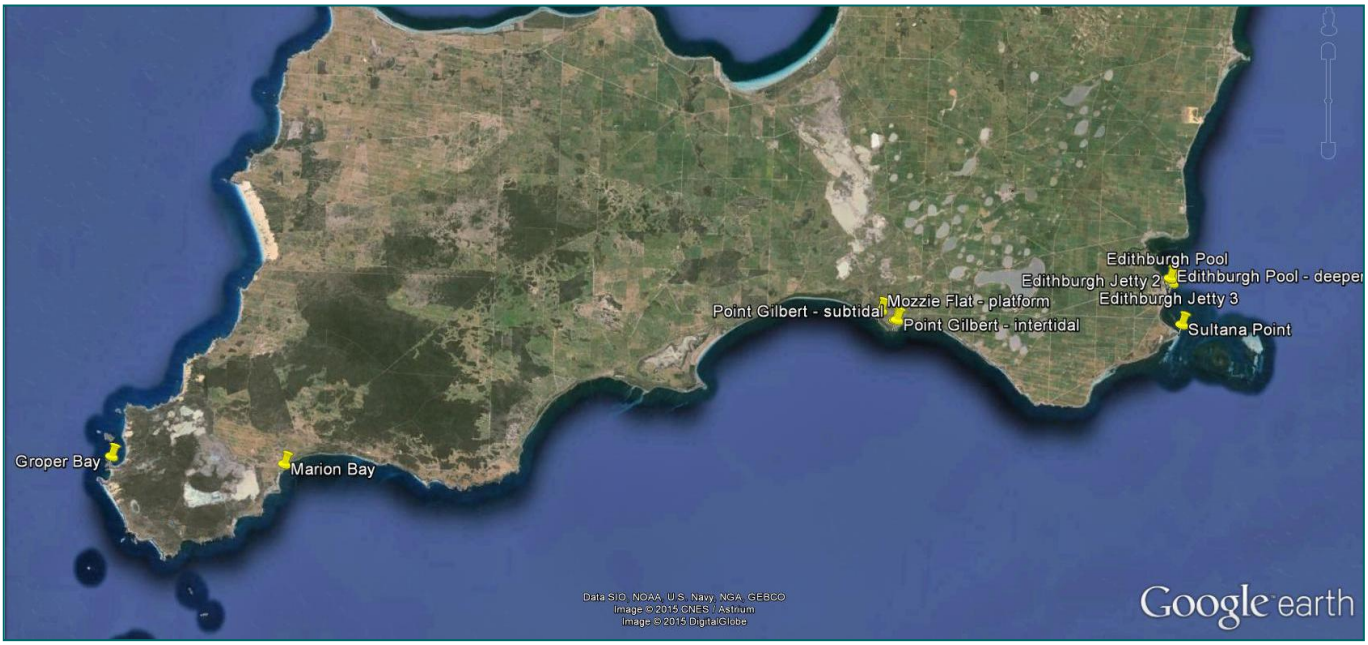


Figure 1: Some examples of sites around Yorke Peninsula where SACReD divers and volunteers from the MRG searched for rarely recorded marine invertebrate species in 2013-14, and where marine plant samples were taken under permit. Point Gilbert (A); Mozzie Flat (B); Edithburgh Pool (C); Ardrossan (D); Marion Bay (E); Groper Bay (south Pondalowie) (F). Photos: © J. Baker (A); ©L. Altoff, MRG (B); © K. Puxley (C); © H. Crawford (D); © D. Kinasz (E); ©L. McLean (F).





Map 1: Sites along eastern, southern and western Yorke Peninsula, in which divers and other project volunteers searched for and/or recorded marine invertebrate species of interest during the project period. These locations are listed in Table 1. A = eastern and western Yorke Peninsula; B = southern Yorke Peninsula. Map © Google Earth.

5. Results

Staurozoa (Stalked Jellyfish)

Staurozoa, also known as stauromedusae, are small animals related to jellyfishes, but instead of swimming freely though the water column, they remain adhered to rocks, seagrass or seaweed (Mills 2011). Globally, the staurozoa is a rare group, with less than 60 species known, and most of these are from the northern hemisphere, reflecting greater study effort on staurozoans in that part of the world. There are a few species in southern Australia (e.g. Zagal et al. 2011). During SACReD and MRG field work in April 2014, several colour forms of undescribed species in genus *Stenoscyphus* (related to *S. inabai*) were found by A. Falconer and J. Baker in samples from several southern Yorke Peninsula locations (**Figure 2A, 1B and 1C**). These included a *Posidonia sinuosa* seagrass sample from Mozzie Flat (Sturt Bay); a brown seaweed samples at Point Gilbert, and *Sargassicola* brown seaweed and filamentous red seaweed sample from Edithburgh Pool. The undescribed species has previously been recorded in Port Phillip Bay in Victoria. Several specimens (3-4mm, 7-9mm and 1cm) of the undescribed *Stenoscyphus* species were also recorded in a *Sargassum linearifolium* sample collected from Groper Bay in October 2014 (**Figure 2D**), and these were preserved, for deposition at the South Australian Museum.

Figure 2: Various colour forms of an undescribed stalked jellyfish species in *Stenoscyphus* (A,B,C,D), recorded at 4 locations across southern Yorke Peninsula in 2014; stalked jellyfish *Lucernariopsis tasmaniensis* (E), recorded at Groper Bay in October 2014. Photos: © L. Altoff, MRG (A, B, C); © J. Baker (E, F).

Also recorded during the 2014 field work was the recently described staurozoan *Lucernariopsis tasmaniensis* (Zagal et al. 2011). This species was previously known from a small number of locations in Tasmania, Victoria and the lower South East of SA, the latter based on samples collected by Y. Hirano from Chiba University in 1997-98. The 2014 specimen (**Figure 2E**), collected by J. Baker in a *Sargassum* sample from a wave- and swell-exposed location in Groper Bay, represents a westward extension of the known range. Previous examples in SE Australia have been reported mainly from seagrass, red seaweed, and green seaweeds such as *Codium fragile*, and species in *Caulerpa* and *Ulva* (data by Hirano, in Zagal et al. 2011).
Staurozoans from the 2014 Yorke Peninsula field work are being examined by A. Collins and colleagues at the Smithsonian National Museum of Natural History in Washington USA, as part of a worldwide study of the morphology and DNA of staurozoans. The Yorke Peninsula specimens will contribute to the description of a new species in the genus *Stenoscyphus*.

Hydrozoa (Hydroids and Hydromedusae)

The Class Hydrozoa includes the hydroids (small colonial animals attached to hard substrates), hydromedusae (the swimming stage of hydroids), and siphonophores (colonial, mostly pelagic animals, including stinging species such as *Physalia physalis*, the blue bottle). Most members of the Hydrozoa have both an attached polyp stage, and a floating medusa stage, and some have a "crawling medusa" which can move across sediment, rocks or marine plants. One of the hydroid families which have crawling medusae is the Cladonematidae, for which there are very few records in Australia, mostly from New South Wales. An example of the attached stage of one of the hydroids in Cladonematidae is shown in **Figure 3A**. A crawling medusa in the family Cladonematidae and genus *Staurocladia* (**Figure 3B** and **3C**) was found in a mixed sample of brown *Sargassicola* and red filamentous algae collected at Edithburgh Pool (0.75m deep) by J. Baker. The specimen has two branching radial canals on the oral side, and six prominent nematocyst clusters at the rim of the mouth (Y. Hirano, pers. comm. 2015).

In Australia, although a large body of taxonomic work has been done on the polyp stages of hydroids (e.g. papers by J. Watson), the identity and distribution of crawling medusae are not well known, and little is documented for Australian representatives of the genus *Staurocladia*, of which the animal recorded at Edithburgh is a member. Globally, there are 14 species in the genus *Staurocladia*, every few of these recorded to date in Australia (Schuchert 2014). It is not possible to identify the crawling medusa from Edithburgh Pool to species level without examination of the specimen, which was damaged and therefore not retained. Some of the visible features in the photographs of the Edithburgh animal resemble those of the New Zealand species *Staurocladia wellingtoni* (Schuchert 1996; Y. Hirano, pers. comm. 2015; P. Schuchert, pers. comm. 2015), a crawling medusa which is unable to swim, and has previously been recorded in *Cystophora* seaweed in New Zealand. Parts of the Edithburgh animal are also similar to those seen in *Staurocladia haswelli*, an Australian endemic known from New South Wales (Briggs 1920; Anonymous, in Australian Faunal Directory 2012; P. Schuchert, pers. comm. 2015).

Staurocladia medusae are extremely variable, even within a single population of a species (P. Schuchert, pers. comm. 2015). Furthermore, newly released medusae which are budded off from the polyp stage of the hydroid differ in structure from the adult medusae, which further complicates taxonomic identifications. Molecular sequencing of specimens is being undertaken by P. Schuchert in Geneva Switzerland, to better determine the distribution and taxonomy of crawling medusae in the global fauna. In future, when crawling medusae of hydrozoans are found during SACReD and MRG's field project work in South Australia, the collected specimens will contribute to that process.

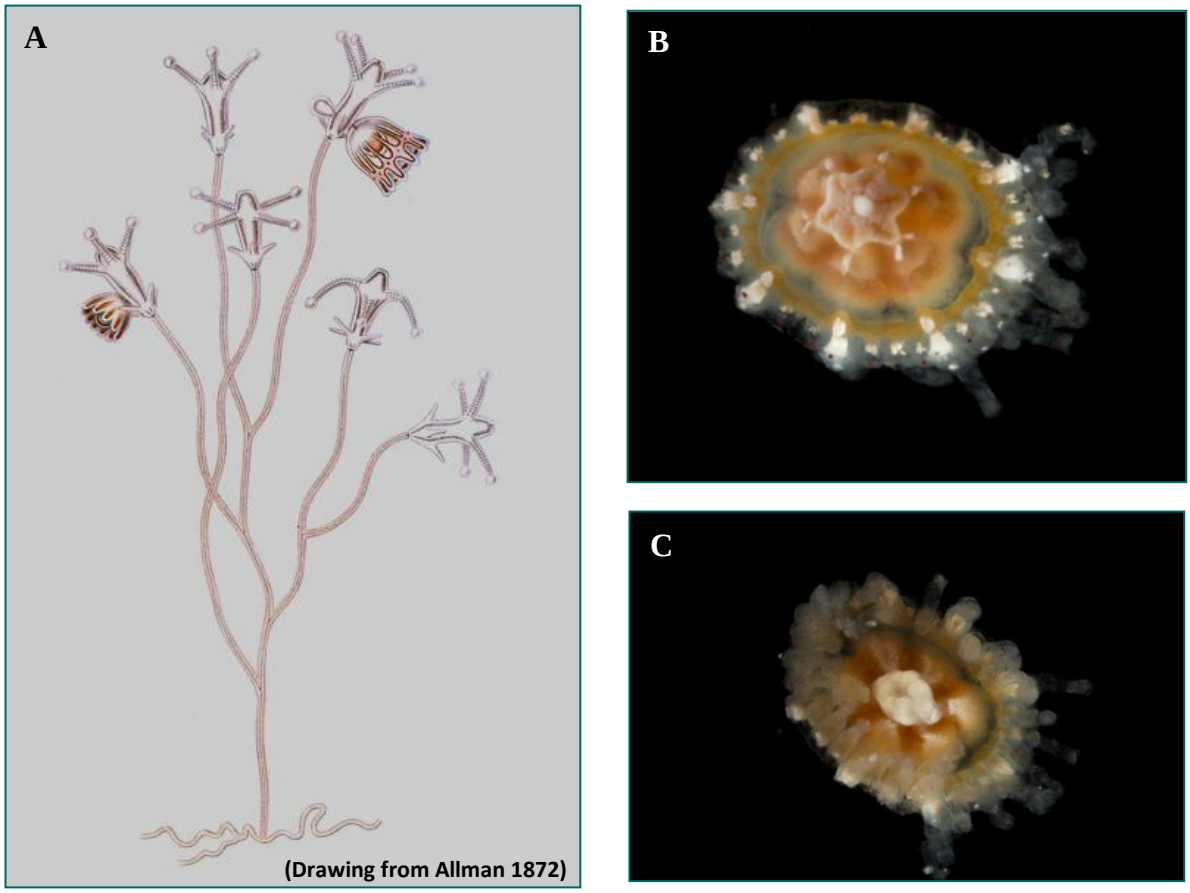


Figure 3: Drawing of a magnified colony of *Cladonema radiatum*, in the same family as the *Staurocladia*, which produce crawling medusae (A). Crawling medusa in genus *Staurocladia*, from Edithburgh Pool. Aboral surface (B) and oral surface (C). Images: Drawing from Allman 1872, in Wikimedia Commons (CC Licence); © L. Altoff, MRG (B).

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, University of Kansas, pers. comm. 2009). 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 group in southern Australian waters.

A number of undescribed anemones were recorded in the NY NRM during the 2013-14 field surveys, and at other times throughout 2014 by SACReD divers, and by our associates from dive clubs in South Australia. Photographed animals cannot be positively identified without examination of internal structures such as the stinging cells (nematocysts). A number of specimens of small anemones which were extracted from seaweed samples during the NY NRM field work in 2014 have been lodged at South Australian Museum, and will be identified in future.

Of the species photographed by divers in the field, several are of note. **Figure 4A** shows a pink anemone with swollen tentacle tips, photographed at Edithburgh on a night dive in November 2014. This species likely belongs to the tropical genus *Telmatactis* (M. Mitchell, pers. comm. 2014), in the largely tropical 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 been recorded in the gulfs area of South Australia, and on Kangaroo Island (Gowlett-Holmes 2008; Baker et al. 2013c).

Several juvenile anemones with broad tentacles retracted were also recorded in *Sargassicola* samples from Edithburgh Pool. These ranged from 2mm to 5mm long, and were coloured pink, white and fawn (**Figure 4B** and **4C**). The identity of these anemones has not yet been determined, but the preserved specimens may be examined in future.

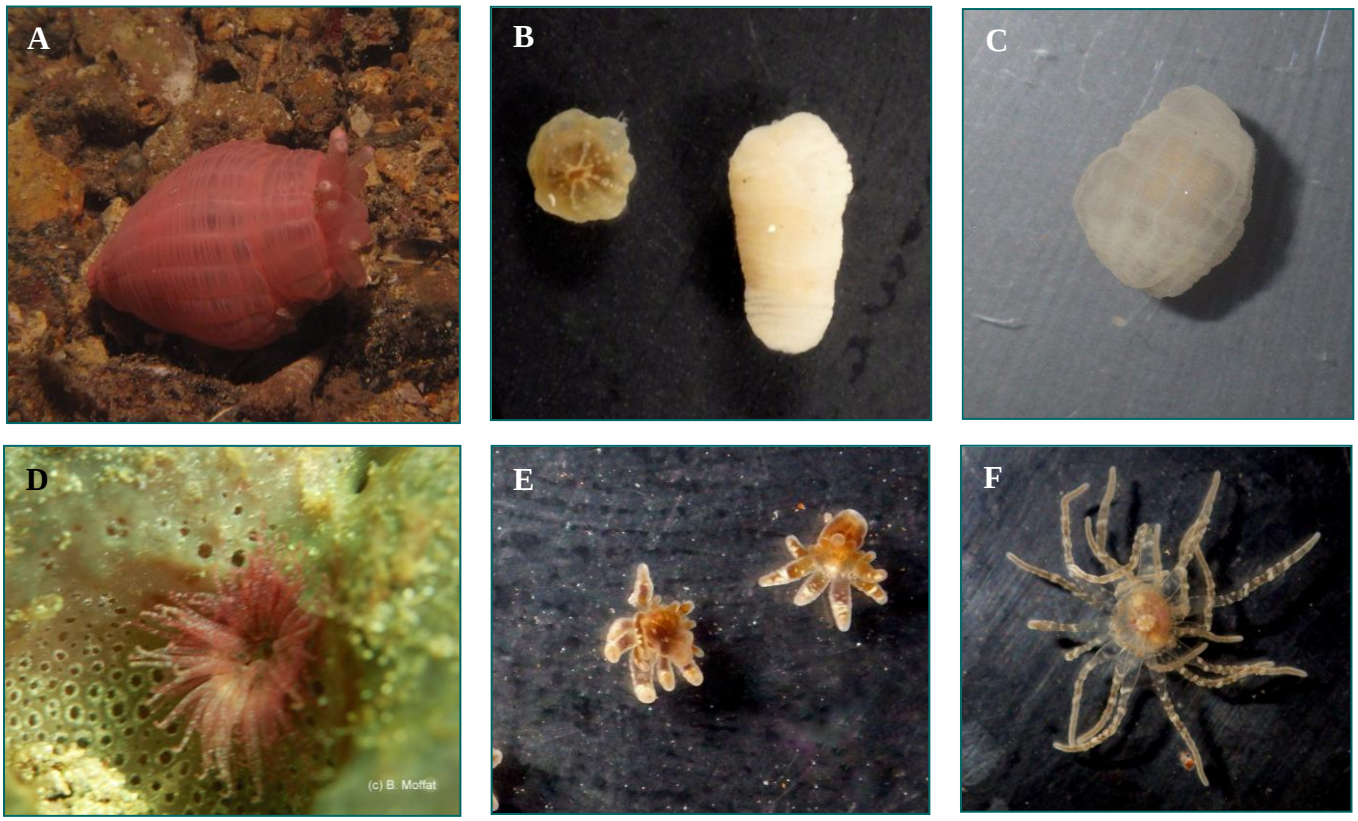


Figure 4: Undescribed anemone species in tropical genus *Telmatactis* (A); juvenile anemones, unidentified (B and C); multi-tentacled anemone or zoanthid anemone embedded in sponge, probably undescribed species (D); juvenile anemones with symbiotic algae, unidentified and possibly undescribed species, which has also been recorded in Victoria (E and F). Photos: © J. Santiago (A); © J. Baker (B, C, E. F); © B. Moffat (D).

A rarely recorded and apparently unnamed species, for which family and genus are uncertain (M. Mitchell, pers. comm. 2014; A. Crowther, pers. comm. 2015), was recorded by SCUBA diver B. Moffat at Port Victoria in January 2014 (**Figure 4D**). This may be either an undescribed anemone or an undescribed zooanthid anemone. It had more than 50 long tentacles, which were pink with white speckles, and was embedded in sponge. A similar, long-tentacled anemone embedded in the same species of sponge was recorded by P. Mercurio at Wallaroo in 2008, but the long tentacles on the previously photographed animal were bright red. The taxonomic identity of these long-tentacled, sponge-dwelling anemones cannot be determined without examination of specimens, but it is highly likely that both are undescribed species, and divers have recorded very few examples of such anemones in South Australia. The two mentioned here are the only ones to be recorded by divers who have been assisting SACReD's marine invertebrate projects along the central SA coast since 2011, and no other examples could be found for this report.

Numerous juvenile anemones were also recorded (e.g. **Figure 4E** and **4F)** on red filamentous seaweed from 4m deep, in a sample collected by D. Kinasz at Ardrossan in October 2014. These small (2mm) anemones had semi-transparent tentacles to 4mm when extended, with bright yellowish-white spots. The anemones were partly coloured with fine brown dots and golden brown markings, perhaps indicative of the presence of zooxanthellae algae (A. Crowther, pers. comm. 2015), which photosynthesise and make sugars that the anemone can use and an additional energy source. Similar small specimens have been recorded by A. Falconer in Victoria, in shallow subtidal seaweed from muddy areas. Juvenile anemones lack many of the distinguishing features that might be present in older specimens (A. Crowther, pers. comm. 2015), and are therefore difficult to identify. These anemones might be members of one of the anemone families which have mostly tropical representatives (e.g. Aiptasiidae, Boloceroididae or Aliciidae), but the identity of these juveniles cannot be determined until the stinging cells in the tentacles of the specimens are examined microscopically (A. Crowther, pers. comm. 2015).

Nemertea (Ribbon Worms)

Nemerteans are unsegmented, extendible worms, found in all marine environments. They range in size from less than 1mm, to a very large species of around 50m long in the Atlantic, and individuals of some species easily break into pieces. Nemerteans have a smooth, muscular body coated in mucus, and most species are carnivorous. The nemertean fauna of south-eastern and South Australia has not previously been studied prior to the recent work of Audrey Falconer, associate of Museum Victoria, and member of the Marine Research Group of the Field Naturalists of Victoria, and associate of SACReD. There are many undescribed species in south-eastern and southern Australia (Falconer and Altoff 2014). Most named species in Australia come from collections taken in WA and QLD, and were described by Gibson and Sundberg (e.g. Gibson 1990, 1997, 1999; Sundberg and Gibson 1995). Some southern Australian nemerteans have been recorded only in one locality to date, and others may have cosmopolitan distributions. Description has traditionally relied on correct preservation techniques of intact animals, and observation of live specimens. DNA studies are now also used. Consequently, traditional classifications and current assignments are now uncertain, and the nomenclature of nemerteans is currently in revision. In late 2012, SACReD began working with the MRG to provide photographic records of undescribed subtidal species from South Australian reefs, and from mixed reef and seagrass habitats, so that the combined efforts of the two groups can eventually contribute towards documenting the nemertean diversity in SE Australia.

At least 75 different nemertean types, thought to be separate species, have been recorded from the intertidal in Victoria and the intertidal and subtidal in South Australia (Falconer and Altoff 2013, 2014), and there are likely to be well over 100 species in south-eastern Australia, many still undescribed. **Table 2** below documents the nemerteans recorded from seagrass and seaweed collections in NY NRM region during 2013 and 2014. Twelve of these may represent new species, not previously recorded before at any site in southern Australia, and will be described in due course by A. Falconer. Locations in NY NRM region where these specimens were recorded will become the type localities when the new species are taxonomically described. The new species are illustrated below in **Figure 5**.

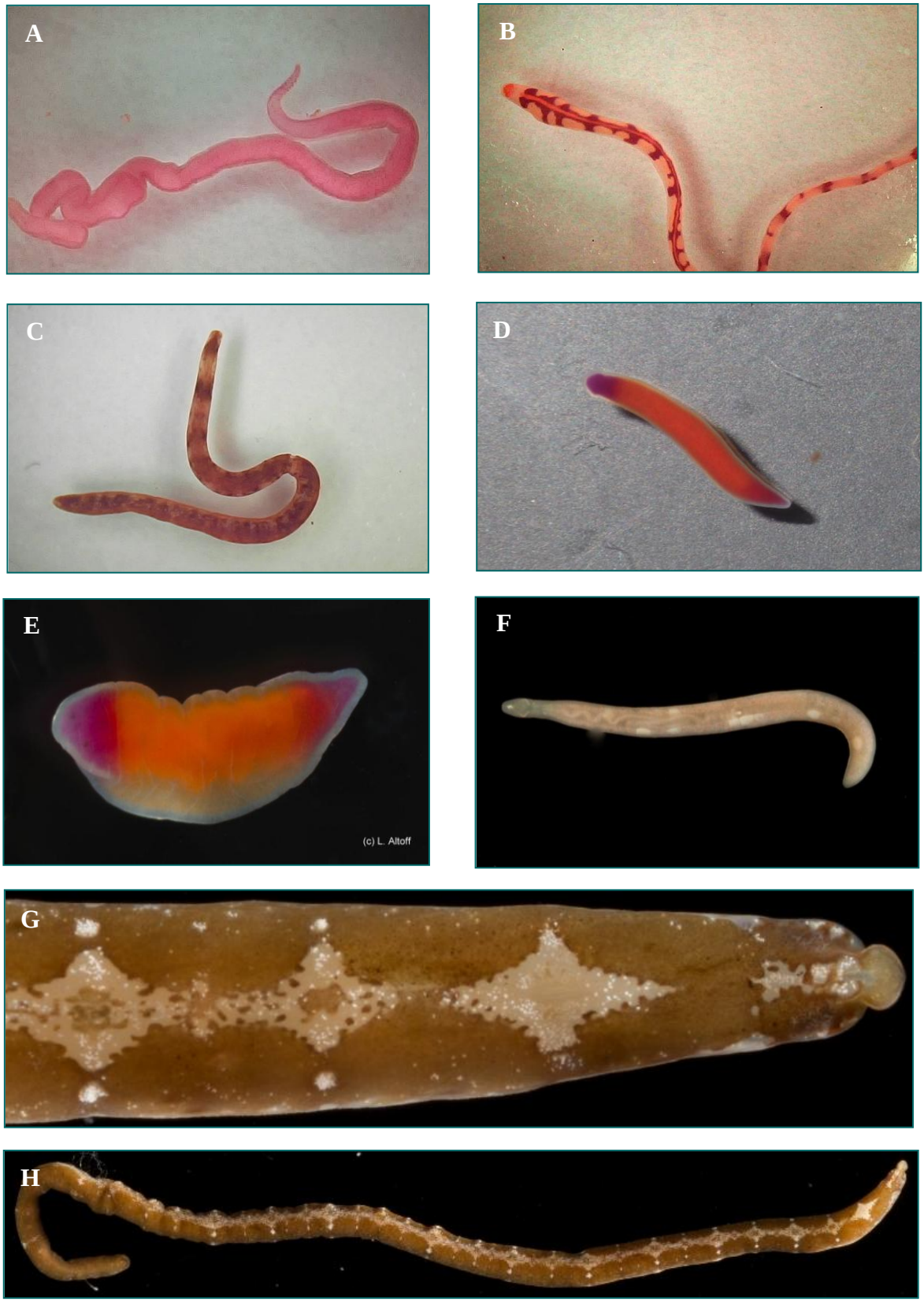


Figure 5: Undescribed ribbon worms from Yorke Peninsula, first records of new species not previously recorded in southern Australia. Bright purple ribbon worm 4-6cm (A); 4cm long, cream coloured ribbon worm with brown-black bands across body, and bright red-orange mid-line and head (B); 1.2cm brown ribbon worm with blotches and white "frosting" pattern (C), which may be same as new species recorded in Victoria in 2014; orange ribbon worm with purple head and tail (D and E); MoV 6819: mushroom pink-coloured body, clear head with white streak between first pair of eyes (F); ribbon worm with eyes in clusters on both dorsal and ventral sides, and brown colour with white diamond pattern on ventral side. Registered as MoV 6822 (G and H).
Photos: © J. Baker-Johnson (A and B); © J. Baker (C and D); © L. Altoff, MRG (E, F, G, H).

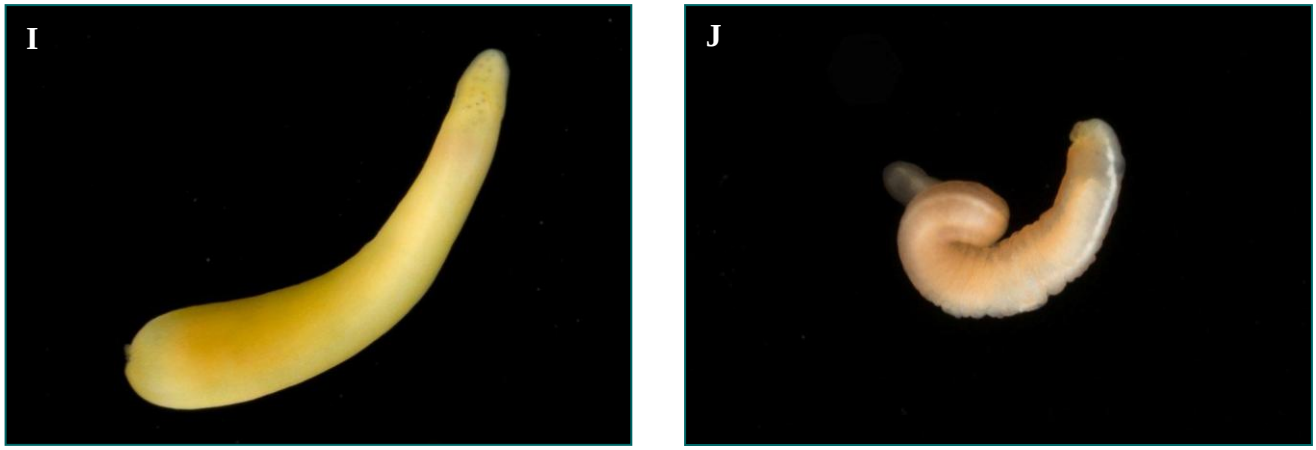


Figure 5 (continued): Undescribed ribbon worms from Yorke Peninsula NRM region, first records representing new species not previously recorded in southern Australia. Lemon yellow ribbon worm with pink brain, and 4 lines of minute eyes. Registered as MoV 6824 (I); apricot-gold and brown ribbon worm with wide paler centre stripe, and 4 eyes (J). Photos: © L. Altoff, MRG (I, J).

Table 2: Examples of nemerteans (ribbon worms) recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Probable new species (i.e. first records ever documented) are shaded in grey.

Label	Name / Preliminary Identity	Locations	Habitat
SACReD18-01	Translucent cream nemertean with 4 eyes	Port Julia	filamentous red seaweed attached to floating grey sponge 75cm deep
SACReD18-02	Nemertean - MoV 6766	Port Julia	filamentous red seaweed attached to floating grey sponge 75cm deep
SACReD18-08	Bright purple nemertean with small head, and multiple eyes. 4+cm long.	Port Julia	inside dislodged grey sponge, found at 75cm deep.
SACReD18-15	*Baseodiscus delineatus* 1 x 10cm, and 1 x 8cm	Port Julia	filamentous red seaweed attached to floating grey sponge at 75cm deep.
SACReD18-09	Cream coloured nemertean with orange-red mid-line and brown-black bands across body. Bright orange-red head. 4cm long	Port Julia	filamentous red seaweed attached to floating grey sponge 75cm deep
SACReD19	Brown nemertean with tan blotches and white "frosting" pattern on dorsal side. 1.2cm long. Possibly same as mottled yellow, brown and white nemertean (MoV 6807) found in VIC in 2014	Sultana Point (2013)	red *Wrangelia* and *Wollastoniella* epiphytes on Posidonia segrass
SACReD20	Nemertean with translucent head and body perimeter, and beige-pink innards; 4 large eyes, in square shape. 3mm	Point Gilbert	mixed sample: *Cystophora* and *Caulocystis* plus red epiphytes (e.g. *Gelidium* and *Laurencia*)
SACReD64-12	Nemertean - MoV 6760	Marion Bay'	*Amphibolis with Dilophus gunnianus* and *Laurencia filiformis* epiphytes, and some coralline algae on stems

Table 2 (cont.): Examples of nemerteans (ribbon worms) recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Probable new species (i.e. first records ever documented) are shaded in grey.

SACReD50-04 SACReD53-18 SACReD53-22 SACReD54-12 SACReD55-01 SACReD55-04 SACReD64-06	*Ammonemertes erseusi*	Point Gilbert Edithburgh Pool Ardrossan Marion Bay	• *Amphibolis griffithii* • *Posidonia* • red filamentous seaweed • *Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems
SACReD55-02	Nemertean - MoV 6766	Ardrossan	*Amphibolis*, with red filamentous epiphytes
SACReD50-05 SACReD50-15 SACReD64-01 SACReD64-04 SACReD65-04	Nemerteans - MoV 6767 5mm and 7mm	Point Gilbert Marion Bay Groper Bay	• *Amphibolis antarctica* • *Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems • *Sargassum* ?*linearifolium*
SACReD51-06	Nemertean - MoV 6769	Mozzie Flat	*Amphibolis antarctica*
SACReD65-10	1 x cream with black head, possibly MoV 6774	Groper Bay	mixed *Amphibolis* + *Sargassum* sample
SACReD64-05	1 x MoV 6776	Marion Bay	*Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems
SACReD51-10 SACReD65-03	Nemerteans - MoV 6778	Edithburgh Pool Groper Bay	• *Amphibolis antarctica* • *Sargassum* ?*linearifolium*
SACReD53-07 SACReD53-15	Nemertean - MoV 6786	Edithburgh Pool	red filamentous seaweed
SACReD53-17 SACReD53-21 SACReD53-24 SACReD53-27	Nemertean - MoV 6787	Edithburgh Pool	*Posidonia*
SACReD51-05 SACReD53-25	*Zygonemertes* sp. MoV 6788	Mozzie Flat Edithburgh Pool	*Amphibolis antarctia* *Posidonia*
SACReD51-09 SACReD51-11 SACReD55-05 to 07 SACReD55-09 SACReD65-09	Nemerteans - MoV 6794	Mozzie Flat Ardrossan Groper Bay	• *Amphibolis antarctia* • mixed *Sargassum* and *Amphibolis antarctica*
SACReD51-01 SACReD51-08 SACReD53-13 SACReD65-09	*Zygonemertes* sp. MoV 6795	Mozzie Flat Edithburgh Pool Groper Bay	• *Amphibolis antarctia* • *Posidonia* • *Sargassicola* • red filamentous • mixed *Sargassum* and *Amphibolis antarctica*

Table 2 (cont.): Examples of nemerteans (ribbon worms) recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Probable new species (i.e. first records ever documented) are shaded in grey.

SACReD51-02 SACReD51-12	Nemertean - MoV 6800	Mozzie Flat	*Amphibolis antarctia*
SACReD53-26	Nemertean - MoV 6801	Edithburgh Pool	*Posidonia*
SACReD51-03 SACReD55-10 SACReD66	*Tetrastemma tristribruna* (Several colour forms - pink, gold and cream; some with white splotches and fine spots; others plain.	Mozzie Flat Ardrossan	*Amphibolis antarctica* with red filamentous epiphytes
SACReD53-19 SACReD54-02 & 03 SACReD54-05 SACReD54-07 to 10 SACReD54-13 SACReD55-03 SACReD63-10 SACReD64-02 & 03	Nemerteans - MoV 6815 4mm to 12mm	Ardrossan Edithburgh Pool Marion Bay Port Hughes	• filamentous red seaweed *Posidonia* • *Heterozostera nigricaulis* • *Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems • *Amphibolis antarctica* with filamentous red epiphytes
SACReD50-06 SACReD51-30 SACReD53-06 SACReD53-12	Nemertean - MoV 6819 Mushroom pink coloured body, clear head with white streak between first pair of eyes.	Pt Gilbert Edithburgh Pool	*Posidonia*
SACReD51-04 SACReD54-01	Nemertean - MoV 6820 Orange with purple head and tail	Mozzie Flat Edithburgh Pool	*Amphibolis antarctia*
SACReD51-07 SACReD53-08 SACReD54-04 SACReD64-10	Nemertean - MoV 6821 White with 4 maroon eyes in a square; no other distinguishing characteristics	Mozzie Flat Edithburgh Pool Marion Bay	• *Amphibolis antarctia* • *Posidonia* • filamentous red seaweed • *Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems
SACReD51-18	MoV 6822 Eyes in clusters each side, dorsal and ventral; ventral colour pattern brown white diamonds	Mozzie Flat	*Amphibolis antarctia*
SACReD51-31	Nemertea - *Zygonemertes* sp. MoV 6823. Possibly same species as MoV 6788.	Mozzie Flat	intertidal; in scum scraped from side of rock
SACReD53-01 SACReD65-06	Nemertea - MoV 6824 Lemon or yellow with pink brain; 4 lines of minute eyes ; outer two forming semi-circular shape around edge of head	Edithburgh Pool Groper Bay	• *Posidonia* • *Sargassum* ?*linearifolium*
SACReD54-16	Nemertea - *Zygonemertes* sp. MoV 6825. Cream with brown brain.	Edithburgh Pool	*Posidonia*

Table 2 (cont.): Examples of nemerteans (ribbon worms) recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Probable new species (i.e. first records ever documented) are shaded in grey.

SACReD63-05	1 x 5mm pale mauve nemertean with black head. Unidentified.	Port Hughes	*Amphibolis antarctica* with many red seaweed epiphytes
SACReD64-11	1 x 1.5cm pale pink nemertean; faint broken lines along body; eye clusters. Unidentified	Marion Bay	*Amphibolis antarctica* with brown *Dilophus gunnianus* epiphyte and red *Laurencia filiformis* epiphyte, and some coralline algae on stems
SACReD65-05	2 x pale beige nemerteans with small head. 5mm and 1cm.	Groper Bay	*Sargassum* ?*linearifolium*
SACReD65-08	1 x apricot-gold and brown nemertean; wide paler centre stripe; 4 eyes.	Groper Bay	mixed *Sargassum* + *Amphibolis antarctica* sample
SACReD65-10	1 x white nemertean with pink innards; no obvious head. Unidentified.	Groper Bay	mixed *Sargassum* + *Amphibolis antarctica* sample
SACReD65-11	1 x 2mm white nemertean with 4 eyes. Unidentified.	Groper Bay	mixed *Sargassum* + *Amphibolis antarctica* sample

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 more than 10,000 flatworm species described, 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; J. Chuk, pers. comm. 2013). In recent years, the Marine Research Group (MRG) of the Field Naturalists Club of Victoria has been collecting specimens for identification by museum taxonomists in future, 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, 2014).

Some examples of undescribed species from Yorke Peninsula are shown below. **Figure 6A**, photo taken at Edithburgh by S. Ruxton depicts a flatworm with prominent pseudo-tentacles and a raised, anterior pharynx, likely to be an undescribed species in the family Euryleptidae. Family assignment of flatworms is difficult to determine without examination of the pharynx and eyes, and these are rarely visible in photographs. Euryleptid flatworms have two long clusters of eyes anterior to the pharynx, and those in the related family Pseudocerotidae have marginal eyes near the pseudo-tentacles (Newman and Canon 2003). Another small (less than 2cm) unnamed species in Euryleptidae is shown in **Figure 6B**, photographed by A. Newton at Edithburgh. This tan and white speckled species, probably in genus *Cycloporus*, has been recorded on and under rocks in the SA gulfs region and Kangaroo Island, but the full distribution is not known. A more geographically widespread species in *Cycloporus* is shown in **Figure 6C** and **6D**, a blue flatworm known from SA, Victoria and Tasmania. The south-eastern Australian species was previously misidentified (Prudhoe 1982) when the species was named from the type, collected on Kangaroo Island in SA by N. Coleman in 1978. A blue flatworm of very similar appearance also occurs in NSW, and another in WA. The relationship is not known between these blue flatworms, and the South Australian one which is regularly recorded but remains as *Cycloporus* sp. until it is redescribed in future. Sectioning of the reproductive organs is usually required to determine the taxonomic identity of flatworms, even to family level (Dr L. Newman, pers. comm. 2015). Southern Australian species of flatworm require much taxonomic work.

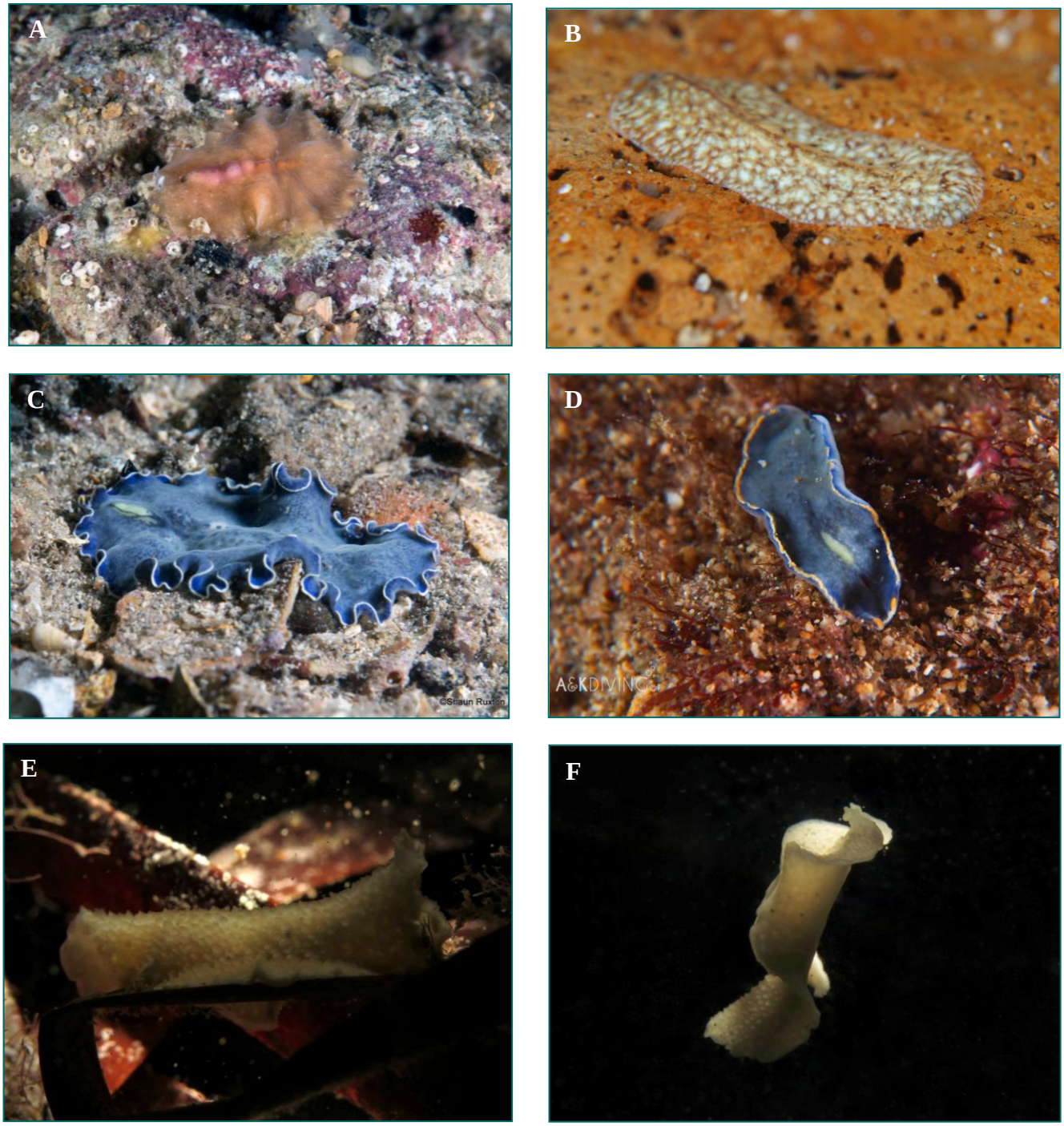


Figure 6: Undescribed flatworms in family Euryleptidae, genus undetermined (A) and in genus *Cycloporus* (B, C and D). Undescribed flatworm in family Pseudocerotidae, genus *Thysanozoon* (E and F).
Photos: © S. Ruxton (A and C); © A. Newton, A&K Diving (B and D); © M. Sutcliffe (E and F).

One of the most unusual flatworms found on Yorke Peninsula during the project reporting period was a white species in *Thysanozoon*, recorded by D. Kinasz and M. Sutcliffe during a night dive at Moonta Bay. Two animals of about 3.5cm long were observed at 3m deep, and these flatworms are capable of undulating the body margin and swimming through the water column. There are few species of swimming flatworm known in southern Australia. Examples of a Yorke Peninsula individual at rest on dead seagrass and then swimming through the water are shown in **Figures 6E** and **6F** respectively. When at rest, the body of this flatworm is curved downwards over in convex shape, and the pseudo-tentacles on the head are raised, hence the animal mimics a nudibranch in appearance.

This undescribed white species in *Thysanozoon* has been recorded occasionally in Victoria (J. Chuk, pers. comm. 2013), and there are also photographs from turf in Pelican Lagoon, on northern Kangaroo Island, during a SACReD field work project. The Pelican Lagoon example was the first recorded in SA during SACReD's marine invertebrate species searches since 2011 (see photograph by H. Crawford, in Baker et al. 2013c). 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.

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). The descriptions for many polychaete 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 some 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.

The Phyllodocidae is a species-rich polychaete group for which there are numerous undescribed species in southern Australia, including SA. The phyllodocids are long, slender, multi-segmented worms, which have enlarged and flattened, leaf-like dorsal (and sometimes ventral) cirri projecting from the segments (Wilson et al. 2003; Read 2004). They live in numerous types of marine habitat from the shore to deep water, including attached growths on the sea floor, in rock crevices, and some on soft substrates. There are 15 named genera in the family in Australian waters, with *Phyllodoce* being the most speciose to date. **Table 3** below lists several of the phyllodocid species which were recorded during the 2013-14 field work in NY NRM region. Of particular note is a spectacular undescribed worm in genus *Notophyllum* (R. Wilson, Museum Victoria, pers. comm. 2014), with flat overlapping gold and grey-black scales; bright purple head; short white head tentacles; purple rear end, and many parapodia under the body **(Figure 7A** and **7B**). Following cataloguing at South Australian Museum, any specimens which represent new species will be loaned to Museum Victoria and various institutions overseas, to assist taxonomic description of new species.

One of the better known families of polychaete in southern Australia is the Syllidae, a diverse family with around 240 described species in Australian waters, along with numerous unnamed species, including some from SA. Syllid worms commonly occur in estuarine soft sediments, but are also found on reefs, in marine vegetation, and on structures such as jetty piles.

Syllid worms often have long and sometimes curly extensions (cirri) on each body segment. In some syllids, the end of the body becomes swollen with eggs or sperm, and then detaches to reproduce. In others, most of the body fills with eggs or sperm, and after rising into the water to release those cells, the worm dies (Wilson et al. 2003). Some syllid worms feed on detritus, or on diatom plankton, but many of the larger syllids are carnivores. They have a toothed pharynx which punctures prey, and a muscular cylinder in the digestive tract which "pumps out" the internal fluids of bryozoans, sponges, hydrozoans and other invertebrates (Wilson et al. 2003).

One example of an unusual and taxonomically unidentified syllid worm was found by J. Baker in a sample of *Sargassum* collected by her at 1m deep in a wave- and swell-exposed location in Groper Bay, Innes National Park in October 2014 (**Figure 7C** and **7D**). This has been preliminarily identified as an undescribed species in the genus *Odontosyllis* (M. Aguado, Universidad Autónoma de Madrid, pers. comm. to R. Wilson, Museum Victoria, 2014). There are around 10 named species in *Odontosyllis* in Australia and so far, most records are from Western Australia, New South Wales and Queensland (Australian Museum and Museum of Victoria records, in Atlas of Living Australia 2014; San Martin and Hutchings 2006). There are two species in *Odontosyllis* fauna recorded so far from South Australia (Hutchings and Yerman, in ABRS 2011). The specimen found on southern Yorke Peninsula is on loan to researchers in Spain, and may lead to a new species description.

One of the most unusual syllid worms re.corded on Yorke Peninsula in 2014 was a likely example of *Myrianida* (**Figure 7E**), photographed by A. Futterer at Edithburgh. The white worm with god bands and long white cirri was recorded on a reef rubble surface. There are two named species in *Myrianida* in Australia (Hutchings and Yerman 2011, in ABRS 2015) and neither of these has been recorded in South Australia to date. The syllid from Edithburgh does not resemble either species in appearance. Superficially, the Edithburgh worm resembles the European species *M. pinnigera*. It is possible that the animal illustrated in **Figure 7E** is an undescribed species.

Another species-rich polychaete family in Australia is the scaleworms, Polynoidae, with around 30 genera and at least 70 named species in Australia (Australian Faunal Directory 2015). There are more than two dozen unnamed species awaiting description. Polynoids have flattened bodies, with paired, overlapping and sometimes ornamented scales on the most of the body segments. Scale worms have a well developed head with numerous sensory appendages. These worms occur in a variety of habitats, and are often seen on (or under) rocks on reefs, or crawling over shell substrates, or amongst marine vegetation. Some species share the tubes of other worm species and others live in association with echinoderms, sponges, stony corals, or soft corals. Scale worms are predatory, and feed on various small invertebrates, particularly crustaceans. 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). Some examples of unidentified and possibly undescribed scaleworms (R. Wilson, Museum Victoria, pers. comm. 2014) from Yorke Peninsula are shown in **Figures 7F, 7G and 7H.** One of these, a 3.5cm cream-coloured worm with brown dorsal patterning (**Figure 7F**), and had clear scales (elytra) on each segment, and likely belongs to the genus *Lepidasthenia*. There are very few named species in this genus in Australia. There are several described species from deeper continental slope waters, and a shallow waters species from WA, *L. michaelseni*, named in the early 20th century (Augener 1913). There are various undescribed *Lepidasthenia* scaleworms in southern Australia, and the animal from Edithburgh will be examined to determine its taxonomic identity. Another smaller (3mm) scaleworm from Port Hughes had pink, gold and brown mottled markings, broad flat scales, and gold setae. This may also be an undescribed species. Another unusual purple and grey scaleworm was found by J. Baker in a sample of *Amphibolis* collected by D. Kinasz at Ardrossan. This animal was 1cm long, and covered with keel-less scales, each of which had a white spot made up of fine, white pustulose dots; there were also fine black pustulose dots on each scale. Scales were translucent dark grey / black with a translucent violet purple margin. This may represent an undescribed species in *Lepidonotus*, and the specimen will be examined in due course.

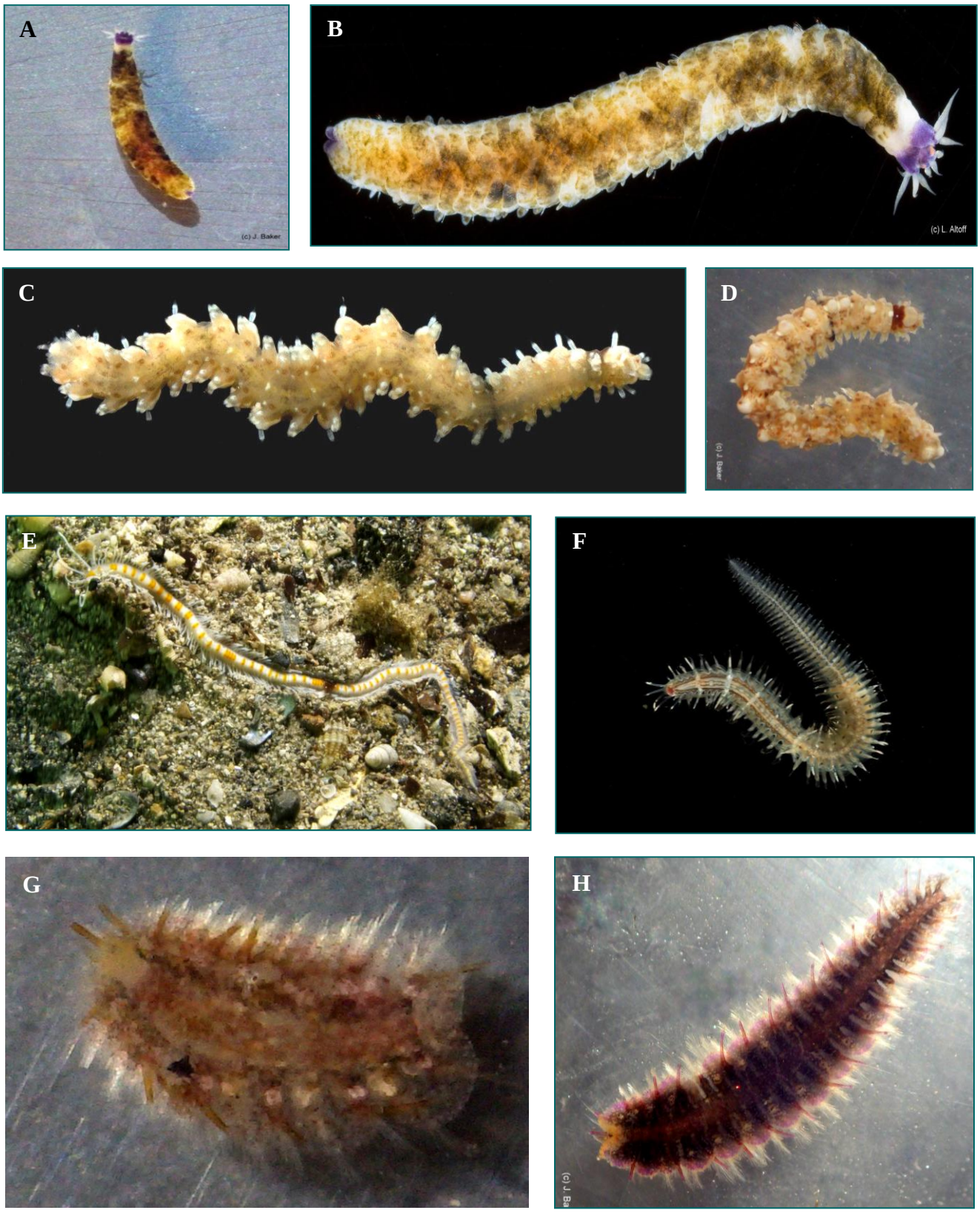


Figure 7: Probable undescribed species in *Odontosyllis* (A and B); probable undescribed species in *Notophyllum* (C and D); probably undescribed species in *Myrianida* (C); probable undescribed species in scaleworm genus *Lepidasthenia* (F); probable undescrbied species in scaleworm family Polynoidae (G and H). Photos: © L. Altoff, MRG. (B, C, F); © J. Baker (A, D, G, H); © A. Futterer (E).

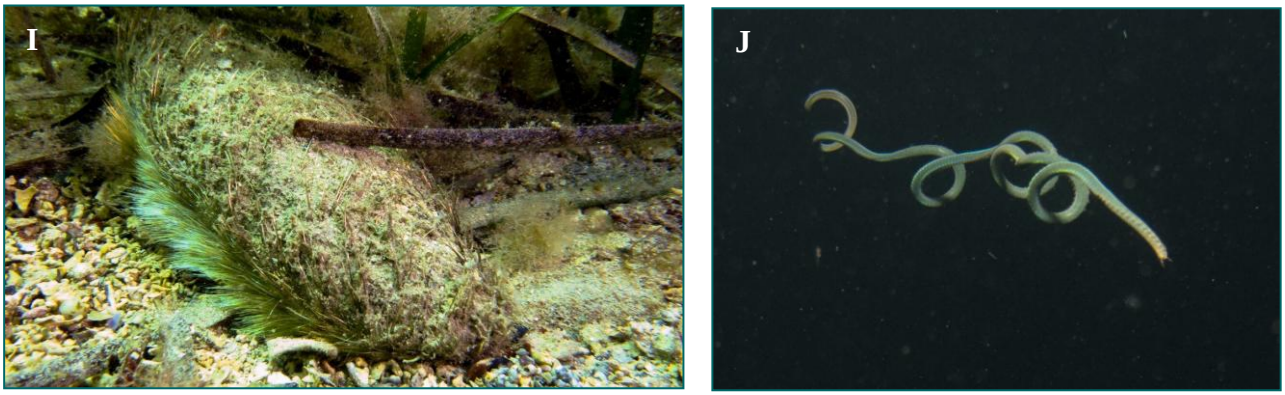


Figure 7 (continued): 'Sea mouse' in genus *Aphrodita* (I); swimming polychaete, possibly Eunicidae epitoke (J). Photos: © K. Hart, A&K Diving (I); © A. Strous

A "sea mouse" polychaete in family Aphroditidae was recorded at Port Hughes (**Figure 7I**, by K. Hart). Members of Aphroditidae are unusually structured types of scale worm which have distinctive iridescent and "furry" setae, and this can form a dense, felt-like cover over the body in some genera, such as the "sea mice" in *Aphrodita* (Hutchings and McRae 1993; Wilson et al. 2003). These worms also have spines, which can be used in defence. The iridescent colours produced by a photonic (light-splitting) process in both the spines and the fibres may be a potential warning to predators (Parker et al. 2001). Sea mice live in sandy and muddy environments, and are active scavengers. In Australian waters, there are 5 genera in the family, of which the "sea mice" genus *Aphrodita* is the best known. There are 8 named species in the genus *Aphrodita* (CSIRO 2014), at least three of which have been recorded in South Australia. These are the Southern Sea Mouse *A. australis*, along with *A. bamarookis*, and *A. talpa*, the latter of which in known mainly from trawl samples in south-eastern Australia.

Also photographed on night dives were the swimming polychaetes. In some families of worms, during the reproductive period, segments of the worm metamorphose into a stage filled with masses of sperms and eggs (gametes), and become swimming forms called heteronereids (NIWA 2004). In other groups, such as the Nereididae (= Nereidae) and the Eunicidae, the entire worm becomes an epitoke. At night, often on moonless nights, the worms swarm in the water column. During the swimming stage, when the adults die, they disintegrate and release eggs and sperm into the water column. An unidentified swimming polychaete, possibly an epitoke phase in Eunicidae, is shown in **Figure 7J**, photographed at Edithburgh by A. Strous during a night dive.

Table 3: Examples of polychaete worms recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Uncommonly recorded species and/or probable new records for South Australia are shaded in grey. NB: Not included in the table below is the common species in Nereidae found at numerous locations in NY NRM Region and frequently recorded during the 2013-14 invertebrate searches.

Taxonomic Name and Description	Location	Habitat
Cirratulidae. Olive green and orange body, paler tentacles.	Edithburgh	reef surface with sponge and filamentous red seaweeds.
Cirratulidae. 1 x 5mm; orange body. 1 x 12mm; red body.	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.
Eunicidae. *Eunice* (to be determined - *E. bassensis* or *E. laticeps*). Several sizes: e.g. 5cm, 13cm.	Port Julia Edithburgh Pool Ardrossan	filamentous red seaweed (e.g. *Wrangelia*, *Polysiphonia*, *Wollastoniella* etc) on rock on rock
Eunicidae. *Eunice* sp.; 5 head tentacles; olive green, gold and pink body	Edithburgh Pool	red seaweed
Eunicidae. 3 x ~ 30cm long; green body.	Edithburgh	in water column

Table 3 (continued): Examples of polychaete worms recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Uncommonly recorded species and/or probable new records for South Australia are shaded in grey.

Maldanidae. 1 x 3cm long, tangled red and white worm; smooth body, no setae visible under low power magnification.	Port Hughes	*Amphibolis antarctica* with many red epiphytes, such as *Jeannerettia*, *Wrangelia*, *Mychodia*, *Laurencia* etc
Nereidae. 4 x *Nereis* species, possibly including *Nereis bifida*.	Port Julia Point Gilbert	*Amphibolis,* and red filamentous seaweed
Nereidae. Common maroon-spotted pale species	Marion Bay	*Amphibolis antarctica*
Nereidae. 1 x 3.5cm, maroon body with white frosting (common).	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.
Oenonidae. Iridescent green.	Edithburgh Pool	on *Scaberia* plant
Phyllodocidae. 4 x cream and tan body with blue iridescence, and rounded, white head. 1.5cm, 3cm, 4cm, 4.5cm 1 x 2.5cm, as above.	Point Gilbert Mozzie Flat	*Amphibolis* and mixed red and brown seaweed *Amphibolis antarctica*
Phyllodocidae. 4mm; translucent beige and white.	Mozzie Flat	*Amphibolis antarctica*
Phyllodocidae. 1cm. Translucent cream with white head. Maroon lower half (internal colour).	Mozzie Flat	*Amphibolis antarctica*
Phyllodocidae. 1.2cm. Maroon and white speckled with gold bands	Mozzie Flat	*Amphibolis antarctica*
Phyllodocidae. 1 x 5mm, longitudinal maroon stripes, both whole striped at body edges and broken strip along mid-line.	Edithburgh	in sponge
Phyllodocidae. 2 x 4 - 5cm pale brown and cream worms. More than 80 pairs of leaf-like cirri on largest animal.	Edithburgh Pool	*Posidonia*
Phyllodocidae, possibly *Phyllodoce*. Translucent, with olive-coloured dots and large dark eyes.	Port Hughes	*Amphibolis antarctica* with many red epiphytes, such as *Jeannerettia*, *Wrangelia*, *Mychodia*, *Laurencia* etc
Phyllodocidae. 1 x 1cm *Notophyllum* sp., with flat overlapping gold and grey-black scales; bright purple head; short white head tentacles; purple rear end; many parapodia under body.	Port Hughes	*Rhabdonia clavigera* red seaweed
Phyllodocidae, 1 x 8mm red brown, with eggs; short head tentacles.	Marion Bay	*Amphibolis antarctica* with *Dilophus gunnianus* epiphyte & *Laurencia filiformis* epiphyte; some coralline algae on stems
Phyllodocidae. Brown and white	Ardrossan	
Polynoidae. 1 x 3mm pink, gold and brown mottled scaleworm with clear patches; broad flat scales; gold setae with clear ends.	Port Hughes	*Amphibolis antarctica* with many red epiphytes, such as *Jeannerettia*, *Wrangelia*, *Mychodia*, *Laurencia* etc

Table 3 (continued): Examples of polychaete worms recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Uncommonly recorded species and/or probable new records for South Australia are shaded in grey.

Polynoidae. Scales with no keel; white spot on each scale, made up of fine white pustulose dots; fine black pustulose dots on each scale; each scale translucent dark grey / black with a translucent violet purple margin.	Ardrossan	*Amphibolis* with coralline epiphyte.
Polynoidae 2 x 4mm scaleworms, with silver setae on scales, dark mid-stripe on dorsal side; body brown on ventral side.	Port Hughes	*Amphibolis antarctica* with red epiphytic seaweed
Polynoidae. *Lepidonotus melanogrammus*	Edithburgh Pool	red filamentous seaweed
Polynoidae. *Thormora argus*	Edithburgh	in sponge
Polynoidae. *Lepidasthenia* sp. 1 x 4.5cm, cream with brown longitudinal patterns; transparent scales (elytra)	Edithburgh	in sponge
Polynoidae. 1 x 8mm; dark, orange-brown body.	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.
Syllidae. *Amblyosyllis* sp. 1 x 5mm, maroon-brown and cream; long (1mm), thin, "curly" cirri.	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.
Syllidae. *Megasyllis corruscans*: white mark on head, orange body.	Port Julia	
Syllidae. 1 x 1cm, yellow-brown body; long translucent white cirri. 2 red eyes.	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.
Syllidae. 1 x 5mm; 1 x 3mm; golden body, white cirri.	Edithburgh Pool	filamentous red seaweed.
Syllidae - *Odonotosyllis* sp.	Groper Bay	*Sargassum* + *Amphibolis*
Terebellidae. 1 x 5cm, red and white; 1 x 1cm, orange	Port Julia	-
Terebellidae. Common speckled terebellid	Ardrossan	on rock
Terebellidae. Gold and white speckled species. Swimming with tentacles extended. *NB Unusual behaviour for a terebellid.*	Moonta	in water column
Unidentified polychaetes. 2 x pink, 7mm long	Edithburgh Pool	red seaweed
Unidentified polychaete. 1 x 2cm long; translucent body with broken dark bands; long setae; pointed rear end.	Port Julia	filamentous red seaweed on dislodged grey sponge in sand.

"Opisthobranchs" / Heterobranchia: Sea Slugs

Traditionally, opisthobranchs have been defined as sea slug gastropods with "rearward" gills, which includes the bubble shells, sea hares, side-gilled sea slugs and the nudibranchs. In recent years, the classification of this large group has been revised (e.g. Bouchet et al. 2005; Knudsen et al. 2006; Jörger et al. 2010), and Opisthobranchia is no longer generally accepted as taxonomically valid. Sea slugs are currently considered to be part of a large group (Heterobranchia or Euthyneura) which also includes the land snails and slugs (Bouchet et al. 2005). The term "sea slug" will be used in this report, for simplicity.

The sea slug fauna in South Australia is much less known than are the shelled molluscs. Most sea slugs formerly known as opisthobranchs lack a shell, or have a reduced internal shell. Some have a fragile external shell. Many of the shell-less sea slugs (nudibranchs) are brightly coloured and patterned, and have evolved a variety of bizarre body shapes. In most sea slugs, the head bears two pairs of sensory tentacles, these being a pair of tactile oral tentacles, and (in nudibranchs) 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), or various seaweeds. 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.

Table 4 lists 42 of the 43 species of sea slugs with were either recorded *in situ* by divers, or found in seaweed samples collected by divers and snorkellers during the 2013-14 survey period. Six of these species may represent new records for South Australia, some of which are south-eastern or eastern Australian species, and others of tropical distribution. New species records are discussed below. Some of the less commonly recorded nudibranchs live under rocks, or are small, and live within the blades of seagrasses and seaweeds, which would explain the lack of previous records, since targetted searches must be made for records to be found.

A number of sea slugs in the Order Cephalaspidea (head shield slugs and bubble shells) were recorded during the field work in 2014. Cephalaspideans have a shell (internal in some species), a blunt head shield, and a chemo-sensory organ between the head and the foot. Examples from the 2014 sampling include:

- the first South Australian records of the purple, white and yellow shell-less sea slug *Ilbia ilbi* (**Figure 8A**), previously known from NSW and Victoria;
- *Philine* sp. 1, a pale, orange-bodied sea slug with an internal shell (**Figure 8B**), previously known from NSW, Victoria and Tasmania (Burn 2014);
- Two undescribed species in genus *Siphopteron*. One of these, orange and black with pale yellow spotting, was previously recorded at Barker Rocks during SACReD and MRG's field trip to western Yorke Peninsula in January 2013 (**Figure 8C**), and more recently found at Point Gilbert during the 2014 sampling (**Figure 8D**). The South Australian specimens may be the first examples of this unnamed species. The other *Siphopteron*, with irregular blue and orange mosaic patterns (**Figure 8E**), was recorded at Mozzie flat on southern Yorke Peninsula during the April 2-014 field trip, and resembles an undescribed species known from Victoria and southern WA; and
- a small, maroon-brown sea slug in the genus *Colpodaspis*, with a thin, fragile shell (**Figure 8F**). This has been identified as *Colpodaspis* sp. 1, previously known only from Victoria (R. Burn, pers. comm. 2014).

Table 4: Nudibranchs, opisthobranchs and related sea slugs recorded in NY NRM region during the 2013-14 project period, including species photographed by divers, and species occurring in seaweed or seagrass samples. Uncommonly recorded species and/or probable new records for South Australia are shaded in grey. Identifications by B. Burn (2014), J. Chuk (2013) and J. Baker (2013-14). NB: Not included in the table below is the common species *Ceratosoma brevicaudatum* - found at numerous locations in NY NRM Region and frequently recorded during the 2013-14 invertebrate searches.

Species Name	Location
Aegires villosus	Edithburgh
Aeolidiella cf. *foulisi* (undescribed)	Edithburgh
Aphelodoris lawsae	Edithburgh
Austraeolis ornata	Ardrossan; Edithburgh; Edithburgh Pool; Mozzie Flat
Berthella medietas	Edithburgh
Burnaia helicochorda	Mozzie Flat
Chromodoris epicuria	Edithburgh; Edithburgh Pool; Moonta Bay
Colpodaspis sp.	Mozzie Flat
Cratena lineata	Edithburgh
Dendrodoris albopurpurea	Edithburgh
Dendrodoris fumata (*" nigra"*)	Edithburgh
Doriopsilla carneola	Mozzie Flat, Edithburgh
Doridídae - undescribed red species	Edithburgh
Doto ostenta	Edithburgh Pool
Elysia coodgeensis	Point Gilbert; Mozzie Flat; Edithburgh Pool
Elysia furvacauda	Point Gilbert
Elysia sp. (undescribed)	Edithburgh
Flabellina sp. 2	Edithburgh
Facelina sp. 3	Edithburgh
Haminoea maugeansis	Mozzie Flat
Haminoea sp. 1	Point Gilbert, Mozzie Flat, Ardrossan
Hermaea sp. 6	Mozzie Flat
Hoplodoris nodulosa	Edithburgh
Hypselodoris saintvincentius (cf. *H. infucata*)	Ardrossan; Edithburgh
Ilbia ilbi	Mozzie Flat; Edithburgh Pool
Melibe sp.	Edithburgh
Noumea spencerensis (unconfirmed)	Edithburgh
Okenia sp.	Ardrossan; Port Hughes
Paradoris dubia	Mozzie Flat; Edithburgh
Philine sp. 1	Mozzie Flat
Philidiella pustulosa	Edithburgh
Polycera sp.	Edithburgh
Runcina australis	Ardrossan; Edithburgh Pool; Point Gilbert; Port Hughes
Sclerodoris sp. 1 (undescribed)	Edithburgh
Siphopteron sp. (also found on YP in 2013)	Point Gilbert
Siphopteron sp. 2	Mozzie Flat
Spurilla macleayi	Port Julia
Trapania brunnea	Edithburgh
Trinchesia sp. 5	Point Gilbert
Tularia bractea	Edithburgh
Volvulella rostrata	Edithburgh Pool
Verconia verconis	Edithburgh; Port Hughes

Figure 8: Cephalaspideans (head shield slugs and bubble shells) recorded during the 2014 field work on Yorke Peninsula. All of these may be first records for SA. One was also recorded in 2013 during the SACReD and MRG field trip to western Yorke Peninsula. A: *Ilbia ilbi*; B: *Philine* sp. 1; C and D: two examples of orange and black *Siphopteron* sp.; E: *Siphopteron*, possibly species 2 from Burn (2006, and in prep.); F: *Colpodaspis* sp. Photos: © L. Altoff, MRG.

Members of the sea slug Order Sacoglossa were also recorded during the 2014 field work, including new records for South Australia. Sacoglossans are known as "sap-suckers", because they have knife-like radula teeth which enable them to pierce green and red seaweeds and suck out the contents of the plant cells (Burn, in prep.). Of interest during the 2013-14 sampling period was the recording from Point Gilbert in April 2014 of a juvenile (2mm) sap-sucking sea slug *Elysia furvacauda* (**Figure 9A**) which grows to around 25mm (Burn, in prep.). This small, brightly speckled sea slug is found in the intertidal and shallow subtidal, associated with seagrass and green macroalgae. The Point Gilbert animal was found in a sample of *Amphibolis antarctica*, collected under permit by A. Futterer and J. Baker. A sample of *Amphibolis* collected at Rapid Bay in Gulf St Vincent in June 2014 by L. Baade and A. Malkowska also contained this species (identified by B. Burn, MRG and Museum Victoria honorary associate) (Baker et al. 2015). The 2014 specimens in marine samples collected by SACReD divers apparently represent the first records of this species in South Australia, which was previously confirmed only from central and western Victoria (B. Burn, pers. comm. 2014; Burn, in prep.).

An unnamed species from Victoria and South Australia, *Elysia* sp. 1, has previously been misidentified as *E. furvacauda* (e.g. photo in Gowlett-Holmes 2008, p. 153), and this species was also recorded during invertebrate searches on Yorke Peninsula (photograph from Edithburgh by S. Ruxton, January 2015). An *Elysia* which may be sp. 1 has also been recorded in abundance on western Yorke Peninsula (C. Harmer, pers. comm. 2014).

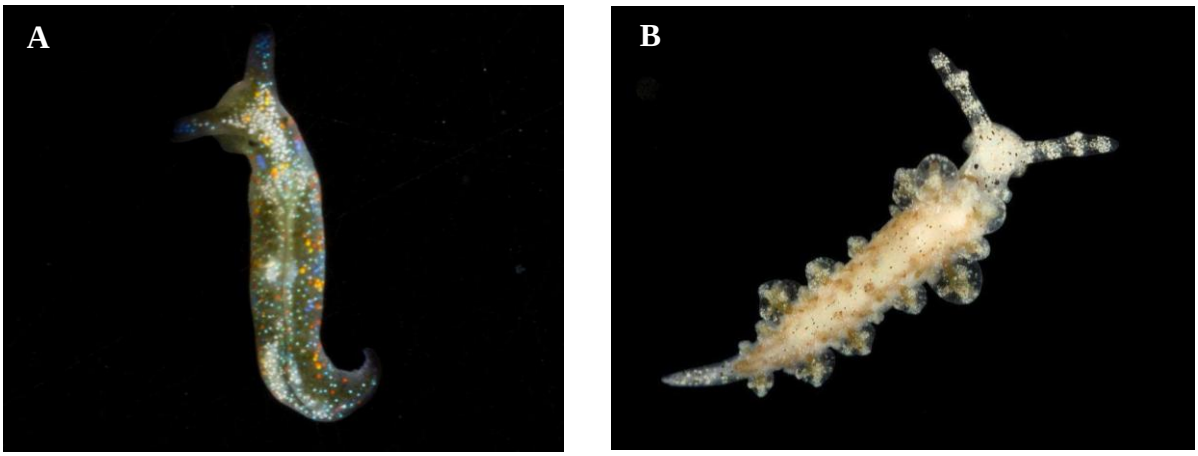


Figure 9: *Elysia furvacauda* (A) and *Hermaea* sp. 6 (B). Photos: © L. Altoff, MRG.

In the same family (Plakobranchidae) as *Elysia furvacauda* is the more widespread sap-sucking sea slug *Elysia coodgeensis*, found across southern Australia. Numbers of this species were also found on Yorke Peninsula, some infected with the parasitic copepod *Splanchnotrophus elysiae* (Burn 2014). Also a sap-sucker, but in a different family than the *Elysia* species, is *Hermaea* sp 6 (**Figure 9B**), which has speckled rhinophores and transparent, leaf-shaped cerata. There are at least 6 unnamed species of *Hermaea* in south-eastern Australia (Burn, in prep.), and the example from Mozzie Flat on southern Yorke Peninsula is the first record of "species 6" from South Australia (R. Burn, pers. comm. 2014).

In addition to sea slugs such as those described above, numerous kinds of shell-less slugs were recorded (**Table 4**). In what was formerly known as Order Nudibranchia, one of the major groups is the "dorid" nudibranchs, in the Doridiidae, Discodoridiidae and Dendrodoridiidae families. 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. Thirteen dorid species were recorded during the 2013-14 field work; some of which are very common and geographically widespread (such as *Ceratosoma brevicaudatum*, and *Doriopsilla carneola*) and others which are not often recorded, and are of apparently limited range. Examples of species of interest include:

- An undescribed species in *Sclerodoris* which is pale amber, pale yellow or cream with white papillae (**Figure 10A** and **10B**). Examples in 2014 were photographed at Edithburgh by A. Futterer and S. Ruxton. It is not known if this species is the same as an unnamed *Sclerodoris* which has been recorded in Victoria (e.g. Burn 2006, Burn, in prep.), and specimens are required for comparison. This *Sclerodoris* also resembles the little known *Sclerodoris trenberthi* (B. Burn, pers. comm. 2014). A similar unnamed *Sclerodoris* species has been illustrated from Fremantle in Western Australia ("Scalloped Sclerodoris", p. 240 in Coleman 2008);
- an unnamed red dorid nudibranch, and known to date only from a few records in South Australia. An example is shown in **Figure 10C**, photographed by S. Ruxton at Edithburgh. There may be more than one unnamed red dorid nudibranch in South Australia (J. Chuk, pers. comm. 2014), and the spotted one is easily confused with *Doriopsilla peculiaris*; and

- *Aphelodoris* "*lawsae*" (**Figure 10D**), one of several very similar *Aphelodoris* species, this one currently being known from very few locations, mainly in South Australia. The distribution of what was previously known as *A. lawsae* is under review, and several undescribed species have been recorded from Western Australia in recent years. It is also noted that there are two museum specimens previously identified as *A. lawsae*, one collected by R. Kuiter from Victoria in 1981, and one from Tasmania. The species within genus *Aphelodoris* are being taxonomically revised, with a number of cryptic species likely to be present in southern Australia (e.g. Australian Faunal Directory 2011).

Related to the dorids are members of the tropical family Phyllidiidae, and one unusual record on Yorke Peninsula was the tropical Indo-Pacific nudibranch *Phyllidiella pustulosa*, recorded at Edithburgh in June 2013 by W. Butvila. There are two other records known for South Australia, one from Corny Point during the late 1970s (R. Burn, pers. comm. 2014) and one from Chinaman's Hat in Innes National Park in 2012 (photograph by A. Futterer). Most Australian records of this species are from Queensland and northern WA, and there are several related members of Phyllidiella which share the same reef environments. The lack of records in southern Australia may indicate only occasional presence of this tropical species in southern waters, perhaps depending on transport of larvae according to current strength and timing from south-western WA, another southern Australian location where *P. pustulosa* has occasionally been recorded. The tropical nudibranch *Aegires vilosus* was also recorded in 2014 at Edithburgh (photo by D. Aston 2014), and is another example of a tropical species which is occasionally present in gulf waters of SA.

Some of the more unusually-structured nudibranchs belong to the Tethydidae. Members of the family have a broad cowl (circular, veil-like structure) which forms the head, and can be used to catch food. An example recorded from Edithburgh on Yorke Peninsula by A. Strous is shown in **Figure 10E**. This swimming nudibranch had the body shape and long, pointed, spindle-shaped cerata characteristic of *Melibe maugeana*. That species is known from Victoria (Burn, in prep.) but previously thought to have a wider distribution (Rudman 2002). There are several undescribed species of Melibe, one of which has previously been recorded in SA and Victoria (Burn, in prep.), but the identity of the Yorke Peninsula animal remains uncertain until a specimen can be examined.

One of the nudibranch families which contain mostly small species is the Goniodorididae, and within that group, at least one species in *Okenia* has been recorded in South Australia. *Okenia* in South Australia is known mainly from Yorke Peninsula, such as Point Turton (Rudman 2004) and port areas such as Wallaroo (photos by P. Mercurio, 2013) and Ardrossan (photo by J. Baker, **Figure 10F**). The latter example was found in an *Amphibolis* seagrass sample with filamentous red seaweed epiphytes, collected under permit by D. Kinasz during the 2013-14 NY NRM project work. Specimens need to be examined to determine whether the South Australian animals are the introduced species from the Caribbean, *O. zoobotryon*, or a closely related undescribed species. Rudman (2004) reported that the specimens from Point Turton lacked the secondary dorsal papillae which are characteristic of *O. zoobotryon*. It is noted that specimens with both pointed and rounded papillae on the body have been recorded in SA. The specimen from Ardrossan shown in **Figure 10F** has rounded papillae. It is noted that several named and several unnamed species in *Okenia* have been recorded in Victoria (Burn, in prep.), and it is likely that a greater number of *Okenia* species exist in South Australia than have been recorded to date.

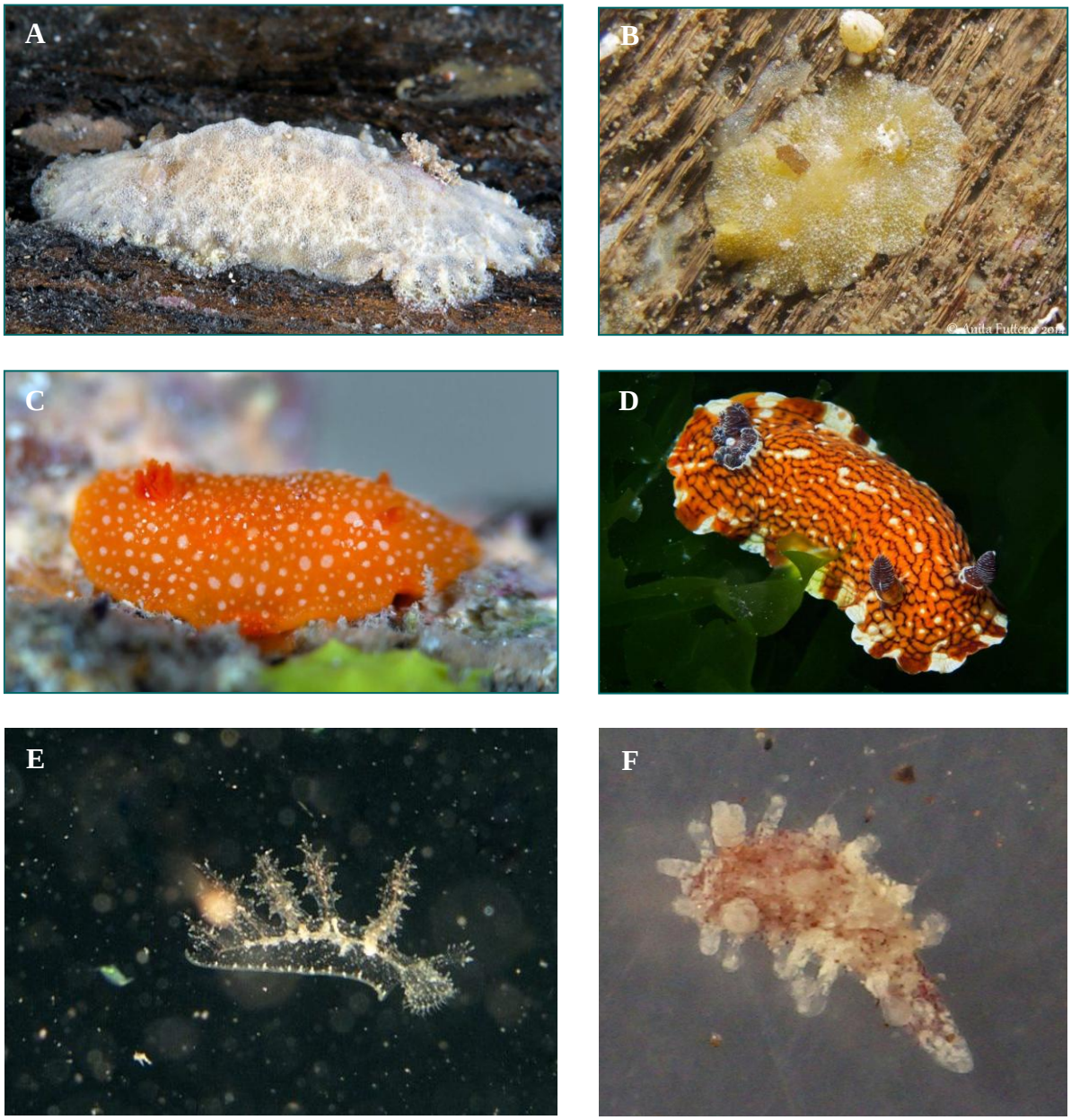


Figure 10: *Sclerodoris* sp. (A and B); undescribed red dorid (C); *Aphelodoris* "*lawsae*" (D); *Melibe* sp. (E); *Okenia* sp. (F). Photos: © S. Ruxton (A and C); © A. Futterer (B); © A. Newton, A&K Diving (D); © A. Strous (E); J. Baker (F).

In southern Australia, there are many nudibranch species in the sub-order Aeolidina, and eight species were recorded in NY NRM region in 2013-14. Members of the group are typically 1 to 4cm long (depending on the species), with a tapering body and elongate cerata on the dorsal side. The cerata are outgrowths of the mantle, and contain digestive glands. 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; Burn, in prep.). Many undescribed species have been recorded from intertidal sampling of seagrass and macroalgae (e.g. Burn 2006; Burn in prep.), and the rising popularity of macro-photography amongst the SCUBA diving community has also resulted in new records of aeolid species in the genera *Facelina*, *Flabellina*, *Trinchesia* and *Eubranchus* in recent years, and extensions of known range. Surprisingly, not species in the aeolid family Flabellinidae were found during the 2013-14 invertebrate searches in NY NRM, yet members of the group were regularly sighted in similar habitats in the adjacent AMLR NRM during the same period (see Baker et al. 2015).

One example is *Trinchesia* sp. 5, found at Point Gilbert during our 2014 field work (**Figure 11A**). This species was also photographed at Port Hughes by SACReD associate P. Mercurio in 2013, the first South Australian record (R. Burn, pers. comm. 2013). Prior to records from SACReD and MRG's field trips to Yorke Peninsula in 2013 and 2014, this species was previously known only from Victoria, where it has been recorded on occasion in association with hydroids. In Victoria, *Trinchesia* sp. 5 has been recorded living on and eating the hydroids *Obelia dichotoma* and *Monotheca flexuosa*, and laying a coil of white eggs in the vicinity (Burn 2006).

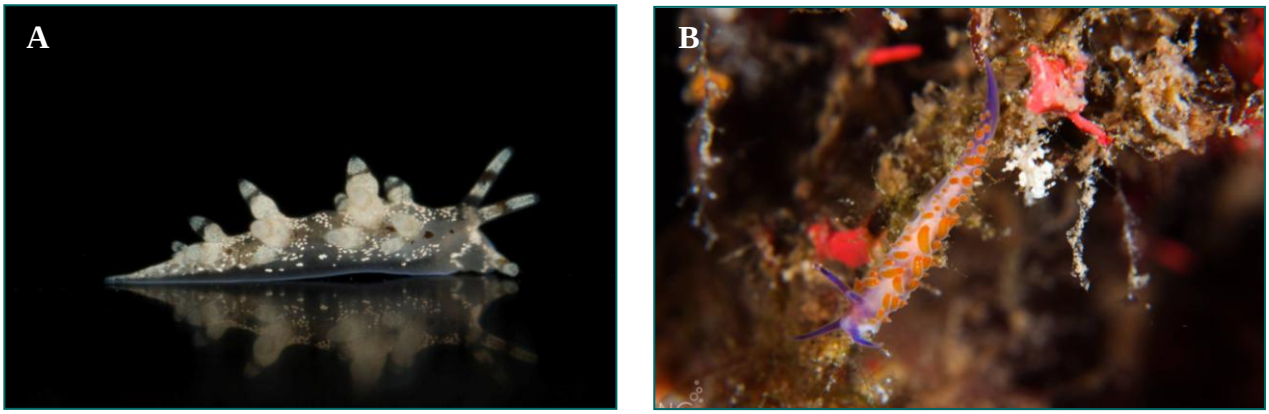


Figure 11: *Trinchesia* sp. 5 (identification by B. Burn) from Point Gilbert, April 2014 (A); *Flabellina* sp. 2 (B). Photo: © L. Altoff, MRG (A); © A. Newton, A&K Diving (B).

Another family of aeolid nudibranchs with various undescribed species is the Flabellinidae, whose members are usually slender and brightly coloured, and often have long oral tentacles. Flabellinids eat hydroids, and are often found on seaweeds which support colonies of small hydroids. Like other aeolids, *Flabellina* nudibranchs store the stinging cells from their food in cnidosacs at the tip of their cerata. There are several named and unnamed species in South Australia. Several undescribed species previously known only from Victoria (Burn 2006) have now been found in South Australia, due to searches by divers here over the past couple of years. One uncommonly recorded flabellinid nudibranch found in NY NRM region in 2014 was the bright purple undescribed *Flabellina* sp. 2, distinguished by the short, round corners of the foot (Burn, in prep.). This small species rarely grows to 25mm, and is mostly known from smaller specimens, of 10-15mm long. During the project reporting period, *Flabellina* sp. 2 was found and photographed at Edithburgh by A&K Diving (**Figure 11B**, photo by A. Newton). Several examples were recorded earlier in 2014 in the adjacent AMLR NRM region, on seaweeds and on sponge (see Baker et al. 2015).

"Prosobranchs" (Sea Snails, Gastropod Shells)

Previously, 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 currently recognises the following groups (e.g. Ponder and Lindberg 1997, cited by Ponder et al. 2002; Bouchet and Rocoi 2005), and this classification may be further revised in light of recent DNA and RNA studies:

- 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 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; Hunt 2011; ABRS 2014). During the 2013-14 marine field work, various common gastropods were recorded, and some were abundant in seaweed samples, including small species which feed on epiphytic algae. Some of the common gastropod shell species which were recorded during the survey period, either by divers, or in seagrass and seaweed samples, include the dog whelk *Dicathais orbita*, the net lepsiella *Phycothais* (prev. *Lepsiella*) *reticulata*, abalone species (*Haliotis cyclobates, H. laevigata*, *H. rubra*), pheasant shells (*Phasianella*), tulip shell *Pleuroploca australasia,* top shells such as *Thalotia conica,* the turban snails *Turbo torquatus* and *T. undulatus,* the False Ear Shell *Stomatella impertusa* (light and dark forms), the anemone cone *Conus anemone,* wing shell *Electroma georgiana*, razorfish shell *Pinna bicolor* and Doughboy Scallop *Mimachlamys asperrima*. A number of small trochid shells were also found (Burn 2014), including species in *Herpetopoma, Clanculus* and *Phasianotrochus.* Less commonly seen shells which were recorded either by divers or in seaweed samples collected under permit, are listed in **Table 5**.

Of the larger shell species, two species of cowrie[1] were recorded during the 2013-14 invertebrate searches, these being two relatively common species Black Cowrie *Zoila thersites* (formerly *Zoila friendii thersites*), and Compton's Cowrie *Notocypraea comptoni*. Both are included here due to the potentially vulnerable population characteristics of cowries, which include brooding of eggs (and thus limited dispersal); narrow geographic distribution of some cowrie species (and of separate morphologically distinct populations); narrow depth range of some species, and/or value for trade, because cowrie shells are sought after by both commercial and recreational collectors. Black Cowrie ranges from approximately Apollo Bay in western Victoria through to Point Fowler in western South Australia. *Zoila thersites* - with 2 subspecies or forms - was recognised as a distinct species by Lorenz (2001), an assignment supported by genetic work undertaken at the Florida Museum of Natural History (FMNH 2005). This cowrie grows to about 11 or 12cm, but is rarely seen at that large size. There are records of *Z. thersites* from across South Australia (see table in Baker 2012). It occurs on limestone, granite and other reefs with sponges. There are also records from sandy reefs with *Pinna* razorfish and sponges, and silty substrates with sponges. *Zoila thersites* ranges in depth from about 2m to more than 50m deep. A form known as *thersites contraria* may range from 100m to 300m (Academy of Natural Sciences 2006). In South Australia, there is a recreational bag limit of 1 per day for *Zoila thersites*, prescribed in the *Fisheries Management (General) Regulations 2007* (PIRSA web site, February 2014). It is noted that the current possession limit, which has no basis in population dynamics research or knowledge of population sizes, is capable of resulting in localised depletion of cowries by repeated collecting, principally by recreational divers. Shells on egg masses, or those depositing eggs, are not to be taken (PIRSA 2010). An example of a mature cowrie with an egg mass recorded on a sponge by C. Carthew at a south-eastern Yorke Peninsula is shown in **Figure 12A**.

Commercial collectors, of which there was only one licensed operator in South Australia during the 2000s, reportedly take only the best (gem) quality specimens for sale, and pass over numerous other shells in an effort to find specimens of highest commercial value. Generally, experienced recreational collectors who have interests in conchology (study of shells) and malacology (study of molluscs, as well as the shells) are also careful with collection. However, some recreational collectors may be less discerning, particularly those who may not understand the potential vulnerability of shell populations. It is possible for accessible reef and sponge areas to be easily "fished out" of cowries due to uncontrolled recreational collecting. For this reason, a number of divers in SA mark the surface of cowrie shells, to decrease their value and reduce the likelihood of those animals being collected. It is illegal in SA for recreational collectors to sell shells (e.g. over the internet).

[1] (NB often incorrectly spelled "cowry")

Black Cowrie was previously classified as being of moderate vulnerability to over-exploitation (category "C" in Ponder and Grayson 1998, cited in Baker 2012). The locations of black cowries recorded by divers during the 2013-14 invertebrate searches in the NY NRM region will not be detailed here, in the interests of conservation, but a second example is shown in **Figure 12B**, that being sub-adult on sponge, photographed by A. Futterer. Conservation Council of South Australia manages a public reporting program (CCSA 2005, 2012) in which divers are encouraged to report sightings of several species of conservation interest, including Black Cowrie, to a secure, national database system. It is noted that several other large cowrie species in South Australia are far less abundant than *Zoila thersites,* and such species (not discussed here), do yet not have legislatively-defined collecting limits in place.

The smaller and relatively abundant cowrie Compton's *Notocypraea comptoni* is found across southern Australia from NSW through to WA, with various regional forms (FMNH 2005): *N. comptoni comptoni* mainly in the west and extending to SA; *N. comptoni casta* mainly in SA, and *N. comptoni mayi,* mainly in the east and south-east (Ponder and Middelfart, undated, in ABRS 2014). Compton's Cowrie is found under stones, rocks and rubble. The southern form has a published depth range of 5m to 150m, and the western form from 0m to 100m deep. During 2013/14, this small cowrie was found on reef in various locations in several parts of Yorke Peninsula (**Table 5**).

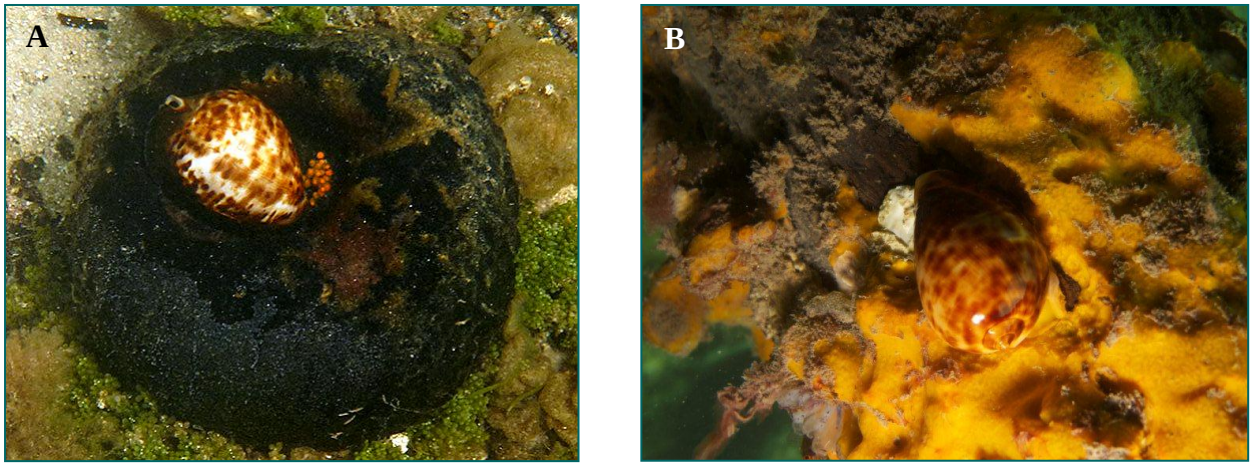


Figure 12: Adult *Zoila thersites* brooding egg mass (A); *sub-adult Zoila thersites* on food sponge (B). Photos from Yorke Peninsula (NB: locations not presented here). © C. Carthew (A); © A. Futterer (B).

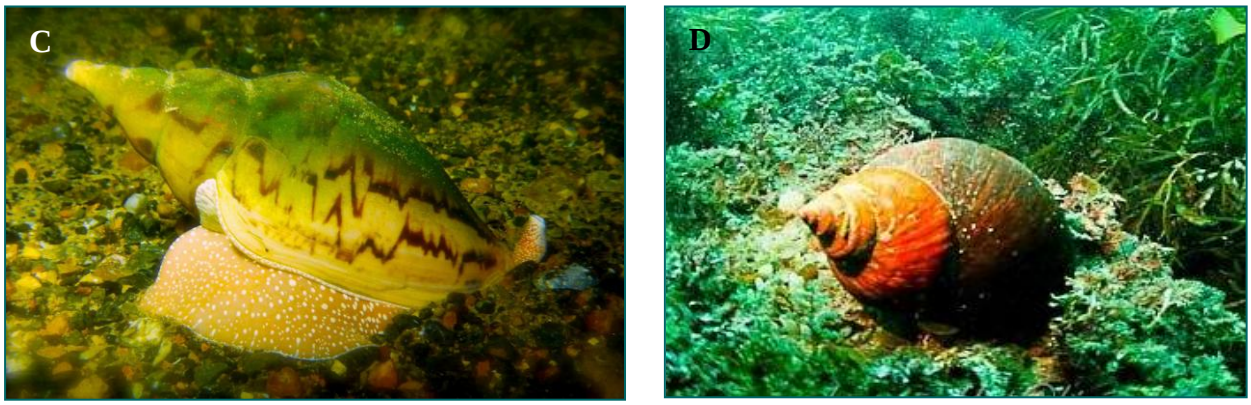


Figure 12 (continued): Lightning Volute *Ericusa fulgetrum* (C); Giant Turban *Turbo jourdani* (D). Photos from Yorke Peninsula (NB: locations not presented here). © W. Butvila (C); © B. Moffat (D).

Two of the relatively common volute shell species recorded in the NY NRM region during the 2013-14 invertebrate searches included Lightning Volute *Ericusa fulgetrum* (**Figure 12C**) known from WA and SA, and the smaller Mitre Volute, *Lyria mitraeformis*, found across southern Australia from WA through to Victoria. Like the cowries, volutes are of conservation concern due to their 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 both commercial and recreational collectors.

Of interest at a site on south-eastern Yorke Peninsula was the recording by diver B. Moffat of the Giant Turban, *Turbo* (*Dinassovica*) *jourdani* (**Figure 12D**), which grows to about 20cm. Giant Turban (also known as Jourdan's Turban) ranges from central South Australian coast to Geraldton in Western Australia. This species occurs on reef with large brown and red macroalgae, and also in tide pools in some areas. The published depth range is 2m to about 40m. This species has moderate value in the commercial shell market. According to the WA Department of Fisheries (2005), 448 specimens were collected in WA between 1999 and 2003. In an assessment of molluscs in the shell trade that are vulnerable to over-exploitation, Ponder and Grayson (1998) classified this species as vulnerability category "C". This species is not common SA, but was previously reported to be widespread (Verco 1908). There are various dive collection records (by the late P. Clarkson) from the 1980s, of specimens collected from islands in the eastern Great Australian Bight. There are few records from Yorke Peninsula, and it is possible that shallow water populations were previously more abundant, but have been "fished out" during the early 20th century. Previous examples from Yorke Peninsula include offshore waters in Investigator Strait, and Moonta area in Spencer Gulf (taken in 1880s). Giant Turban requires population assessment in both SA and WA.

In contrast to the large mollusc discussed above, unusual small shells related to the "bean cowrie" family Triviidae were also recorded on Yorke Peninsula during the 2013/14 survey period. One example is *Proterato lachryma*, and so-called Erato Cowrie or Common Teardrop (**Figures 12E** and **12F**), known mainly from Queensland and NSW. This 1cm long shell was found by J. Baker in a sample of *Amphibolis* seagrass with filamentous red epiphytes, collected under permit by R. Kinasz at Ardrossan. Animals in this family keep the shell surface glossy, by folding over the mantle flaps onto the shell surface, similar to the cowries. However, bean cowries are not related to the true cowries, but are more closely aligned with the velutinids / lamellarias (slug-like animals with a thin, internal shell). The taxonomic affiliation of *Proterato* shells and their relatives is still not agreed upon, and some workers place this genus in a separate family, the Eratoidae (e.g. Fehse 2010; Grove 2014). *Proterato lachryma* has a broad distribution across southern Australia, and is known mainly from shells on beaches (Beechey 2000). The live animal, which usually lives under rocks and stones (Grove 2014) is uncommonly seen. Also in 2014, a related species of erato cowrie, *Proterato denticulata*, was recorded in shell grit during a Malacological Society of South Australia survey on southern Yorke Peninsula (Hunt and Robinson 2014).

Another animal likely to be closely related to those in the Triviidae was photographed *in situ* by divers during the 2013 and 2014 in NY NRM region, but cannot easily be identified without examination of the shell, which was not visible in the images. Two examples are shown in **Figures 12G** and **12H**. These small (~ 7mm) animals had a pustulose, bright yellow mantle folded over the shell. Like the bean cowries and velutinids, both had dark eyes at the base of the pair of head tentacles, and a single siphon. There are at least 9 species previously grouped into the "bean cowrie" family Triviidae, which are known to occur in South Australia (Anonymous, in ABRS 2012),several are more widespread across southern or SE Australia, and others have not been recorded elsewhere to date.

Table 5: Various gastropod molluscs of interest which were recorded in NY NRM during 2013-14 project period. Larger specimen shell species - common but of conservation concern - are also included (grey shading in table). * = locations regionalised, to protect populations. # = collected during previous SACReD / MRG survey to Yorke Peninsula in January 2013, but not identified until 2014.

Latin Name	Common Name	Location (* = regionalised)	Date (month / year)
Cancellaria spirata (Nevia spirata)	Spirate Cross-barred shell / Excavated Nutmeg Shell	Edithburgh Pool	4/14
Rissoellidae: *R. vitrea* and *R. confusa umbillicata*	rice shells	Point Gilbert	4/14; 9/14
Rissoellidae: *Liranoba*	a spiral rice shell	-	4/14
Epitonium jukesianum	Jukes Wentletrap	Port Hughes	9/14
Ericusa fulgetrum	Lightning Volute	SW Gulf St Vincent*	12/13; 12/14
Gabrielona nepeanensis and possibly another *Gabrielona* species	(small phasianellid shells)	Edithburgh Pool; Ardrossan	4/14 10/14
Incisura auriformis	a scissurellid (slit shell)	Edithburgh Pool	4/14
Limidae, probably *Limatula strangei*	Strange's File Shell	Edithburgh	4/14
Lironoba species	unidentified rice shell		4/14
Scissurellidae	unidentified ribbed scissurellid (slit shell)	Edithburgh Pool	4/14
Scissurella	unidentified smooth scissurellid (slit shell)	Point Gilbert	4/14
Lyria mitraeformis	Mitre Volute	SW Gulf St Vincent*	12/13
Mesoginella sp.	a small margin shell	Island Point #	1/13
Notocypraea comptoni	Compton's Cowrie	SW Gulf St Vincent* Investigator Strait	05/13; 12/13; 3/14; 4/14 (juvenile)
Omalogyridae	(a minute spiral mollusc)	southern YP in sediment - location not determined	4/14
Proterato lachryma	Erato Cowrie / Common Teardrop	Ardrossan	10/14
Scutus antipodes	Elephant Snail	Edithburgh Pool; Ardrossan	4/14
Turbo jourdani	Giant Turban	S Yorke Peninsula*	4/14
Zoila thersites	Black Cowrie	SW Gulf St Vincent* (2 locations) W Yorke Peninsula	11/13; 4/14 (juvenile) 11/14 (parent + eggs) 12/14

Figure 12 (continued): Eratos Cowrie *Proterato*, probably *P. lachryma* (E and F); triviid sea snail, species undetermined (G and H). Photos from Yorke Peninsula: © J. Baker (E and F), © S. Ruxton (G), © A. Futterer (H).

Another small shell found in marine plant samples is the tiny phasianellid (pheasant) shell *Gabrielona*, which was particularly numerous in a sample from Edithburgh Pool. *Gabrielona nepeanensis* was present, and, based on the variations in size, shape and pigmentation of the shells (R. Burn, pers. comm. 2014), possibly other species as well, such as *G. pissina*. **Figure 13** shows some examples from Edithburgh Pool. Specimens were provided on loan to P. Vafiadis of the Marine Research Group of FNCV, who has undertaken taxonomic work on this group in southern Australia.

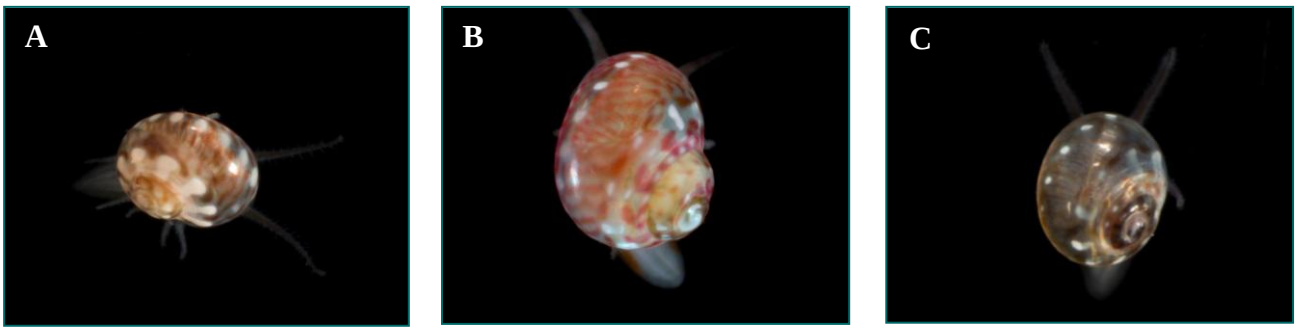


Figure 13: Small pheasant shells in genus *Gabrielona*, recorded at Edithburgh Pool and Ardrossan. Photos: ©L. Altoff, MRG.

Small slit shells in the family Scissurellidae were recorded in seaweed samples, and in debris of sediment, seaweed and seagrass during the April 2014 field work (**Figure 14 A - F**). The smooth-shelled species *Incisura auriformis* was recorded at Point Gilbert and Edithburgh Pool, including 9 mating pairs (Burn 2014). Also recorded in an Edithburgh Pool sample was a ribbed species which is yet to be identified, possibly in genus *Sinezona*. Eight named species in several genera are known from South Australia (Geiger 2012), and all of these are found in other Australian States.

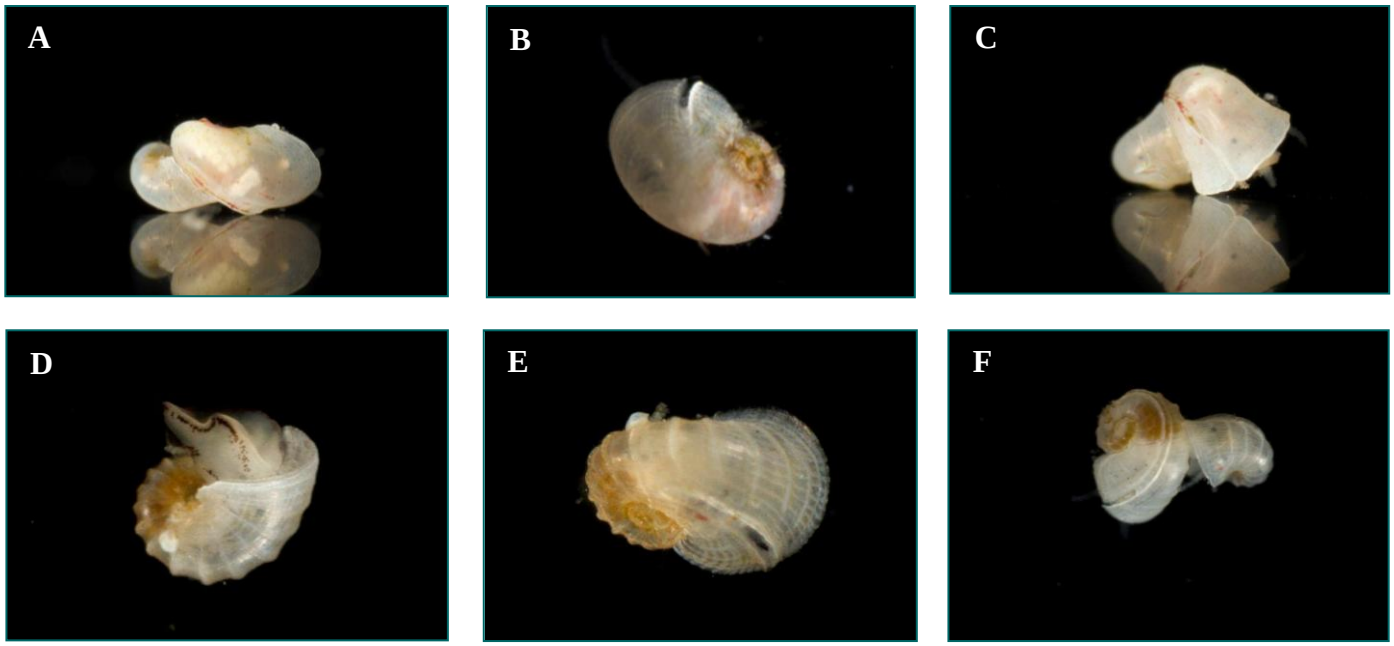


Figure 14 A-F: Small slit shells in Scissurellidae, recorded at Point Gilbert and Edithburgh Pool. *Incisura auriformis*, and possible *Sinezona*. A, C and F are mating pairs (Burn 2014). Photos: ©L. Altoff, MRG.

Two small rice shell species were recorded in abundance by R. Burn from an *Amphibolis* sample collected at Point Gilbert, these being *Rissoella vitrea* (1mm diameter) and *R. confusa umbilicata* (R. Burn, pers. comm. 2014). The animals are black, and visible through the transparent shell (**Figure 15B**). Other *Rissoella* examples from Yorke Peninsula were found by J. Baker in an *Amphibolis* sample collected by D. Kinasz from Ardrossan, in October 2014 (**Figures 15A** and **15C**). Several species and subspecies of rice shell in Rissoellidae known to occur in South Australia (Ponder and Yoo 1977), and a number of others from south-eastern Australia or Western Australia may also occur here. During the 2013/14 field sampling, a spiral rice shell in genus *Liranoba* was also found (R. Burn., pers. comm. 2014).

Figure 15 A-C: Rice shells in *Rissoella* genus, from Yorke Peninsula seagrass samples. Photos: © J. Baker (A and C); © L. Altoff, MRG (B).

Small shells in Triphoridae and Eulimnidae were also recorded and are yet to be identified, and a juvenile *Sassia* was also found in an *Amphibolis* sample from Point Gilbert. Of greater interest is the record from seagrass and seaweed debris of a minute, flat spiral shell in family Omalogyridae. The shell was red-brown, and body of the animal was not visible, hence it was not possible to determine if the shell was in genus *Omalogyra*, or *Ammonicera* (Burn 2014). There are few published records of Omalogyridae shells in Australia, and three several named species known to occur here have all been recorded mainly in New South Wales, and are considered to be Australian endemics (Beechey and Ponder 2011). It is likely that such species are more widespread across southern Australia, but are rarely recorded dur to their habitats and small size. Animals may be more easily detected in sand and rubble sievings / washings than *in situ*. Omalogyrid shells are known to occur in South Australia, but have not been formally documented (B. Burn, pers. comm. 2014). Globally, the distribution of some *Omalogyra* shells may spread by rafting (e.g. Thiel and Gutow 2005).

Crustacea

Crustaceans are arthropods which have a hard exoskeleton (carapace); a symmetrical, segmented body (often divided into a head, a thorax and an abdomen), and more than four pairs of jointed appendages. The head often include two pairs of sensory antennae; one pair of mandibles (for chewing food); appendages which help in food capture or manipulation; and smaller appendages for walking and/or swimming. The Crustacea is a very species-rich sub-phylum of animals. There are over 67,000 known species of crustaceans divided into a number of major groups, such as the brine shrimps, the barnacles and copepods, the ostracods (seed shrimps), and various groups of malacostracans, collectively containing about 40,000 species, and comprising the decapods (e.g. crabs, lobsters and shrimp), stomatopods (mantis shrimp), euphausiids (krill), amphipods (e.g. sandhoppers) and isopods (pill bugs and sand skaters). Most crustaceans are found in marine and fresh water, and there are few terrestrial groups. Marine crustaceans are found in all habitats, including beaches, estuaries, mangroves, saltmarshes, subtidal sand, reefs, and seagrass beds. They are found throughout the water column, from the tropics to the poles. Most are free-living and mobile, but a few groups are parasitic, and one group, the barnacles, is sessile and attached to surfaces.

Most groups of crustaceans are not being considered as part of the current project, due to the abundance of species within each group, and the difficulty in identifying crustacean species from photographs. Crustacean taxonomy is a specialist task, and many years of work is required to understand the richness and diversity within each group. Crustacean taxonomists often specialise in a single group (e.g. crabs, isopods, amphipods, tanaids, etc). There are likely to be hundreds of undescribed species of small crustaceans in South Australia, in groups such as the amphipods and isopods. Currently, a global revision of species in one group of planktonic amphipods (suborder Hyperiidea) is being undertaken at South Australian Museum by Dr Wolfgang Zeidler. During the invertebrate searches throughout 2013-14, divers recorded incidentally a number of crustacean species of note.

An unusual crustacean, a cryptic sand shrimp (**Figure 16A**) was found at Edithburgh by A. Futterer. The Humped Shrimp *Vercoia gibbosa* has been recorded at few disjunct locations to date, including the gulfs region and Great Australian Bight in South Australia (Davie 2002; Gowlett-Holmes 2008), and several tropical localities such as Lizard Island in Queensland (Poore 2004), the Marshall Islands and Eniwok Atoll (Davie et al. 2002). This species was also recorded and photographed in 2014 by R. Kinasz at Broken Bottom in eastern Gulf St Vincent. It is not known if this tropical species occurs in other southern States of Australia, and records from South Australia are sparse. *Vercoia gibbosa* is found mainly in coral reef rubble, rock gravel and in shelly sand, and has been found from the shallow subtidal down to around 54m deep (Davie 2002; Gowlett-Holmes 2008). This uncommonly recorded and very well camouflaged species may be more abundant and of wider distribution than current records would indicate.

Two shrimps in genus *Tozeuma* (*T. pavoninum* and *T. elongatum*) from the "broken-back" shrimp family Hippolytidae have been recorded in South Australia, mainly in seagrass, and both are known from few records. One of these (*T. elongatum*), was recorded on a *Scaberia* plant at Edithburgh by S. Ruxton in April 2014. This species has mainly been found in seagrass beds in parts of SA and Victoria, and known to date from few records, from the shallow subtidal down to about 30m deep (Davie 2012, in ABRS 2013; Poore 2004; Museum of Victoria records). This species is closely related to (if not identical to) *Tozeuma kimberi*, previously thought to be a South Australian endemic (Poore 2004; Davie 2012, in ABRS 2013), but which has apparently also been recorded in Victoria (Plummer et al. 2003). The taxonomic relation between *Tozeuma kimberi* and *T. elongatum* need to be ascertained. *Tozeuma elongatum* is considered to be uncommon (Edgar 2000, 2008), but may be relatively abundant in some areas. For example, during a survey in Portland Harbour, this species was found in 1 (20%) of 5 sled samples, in low densities (Parry et al. 1997). *Tozeuma elongatum* is often well camouflaged, lying in the same direction as seagrass blade, and mimicking it in colour, but the example on brown seaweed at Edithburgh shown in **Figure 16B** is more colourful.

A brightly coloured and patterned cleaner shrimp, *Ancylomenes aesopius*, has regularly been recorded by divers on Yorke Peninsula in recent years, and is known to date in SA from few locations, mainly around Yorke Peninsula. Aesop's cleaner shrimp, previously known as *Periclimenes aesopius*, has also been recorded in southern Western Australia, and is related to tropical cleaner shrimps of the Indo-West Pacific, of which there are about a dozen species (Okuno and Bruce 2010). *Ancylomenes aesopius* on Yorke Peninsula has been observed on various substrates, including brown seaweed (**Figure 16C**, by A. Futterer); on rocks (photo by L. Baade); on wood debris (photos by J. Lewis); on sponges; on ascidians (**Figure 16D**, by B. Moffat); in *Pinna* razorfish shell (photo by J. Lewis); on *Ceratosoma brevicaudatum* nudibranch (photo by A. Newton), and other reef substrates. Member of the *Ancylomenes* group are known to clean fish, and also feed on detritus.

One of the most unusual kinds of small crustaceans observed in the NY NRM region during 2013-14 is the "sea bee" *Idiomysis* (**Figure 16E**, photo by K. Hart). Sea bees are a type of mysid, also known as opossum shrimps. Mysid species mostly range from 2mm to a few centimetres in size, and females have a brood pouch called a marsupium. Some mysids are found as individuals, and others occur as large swarms in the water column, or near the sea floor. Mysids play an important role in marine food webs, and many species feed on the particles produced by decomposition of seagrass and marine algae, but others eat crustaceans smaller than themselves. Mysids are important food for many fishes, including pipefishes, seahorses and seadragons. Globally, the Mysida is a species-rich group, with more than 1000 species known. There are more than 140 named species in Australia, plus numerous undescribed species, including some of the mysids in SA waters. The species in *Idiomysis* which occurs in South Australia is reported to be *I. inermis*, apparently the only member of the genus in Australia. *Idiomysis inermis* has been found in Queensland as well as South Australia (Keable, Fenton and Lowry, 2013, in ABRS 2013), and the same species also occurs in India. This species may have a broader distribution than currently published. In the tropics, *I. inermis* has been recorded in association with the carpet anemone *Stichodactyla haddoni* (Greenwood and Hadley 2982, cited by Lowry and Stoddart 2003).

One group of small crustaceans for which there are many unnamed species in South Australia is the Sphaeromatidae, known as marine pill-bugs. Pill-bugs are common on rocky shores, and in marine vegetation, and in coastal waters. Some species are parasitic on fishes. Pill-bugs can fold over or roll into a ball when disturbed. Females of many species brood the juveniles in internal pouches. Within the pill-bug family, there are more than 60 genera in Australia, but few named species in each genus (Baker 2013). Many species in southern Australia are undescribed, including numerous South Australian reef isopods. One example of a sphaeromatid isopod, recorded by S. Ruxton at Edithburgh, is shown in **Figure 16F**.

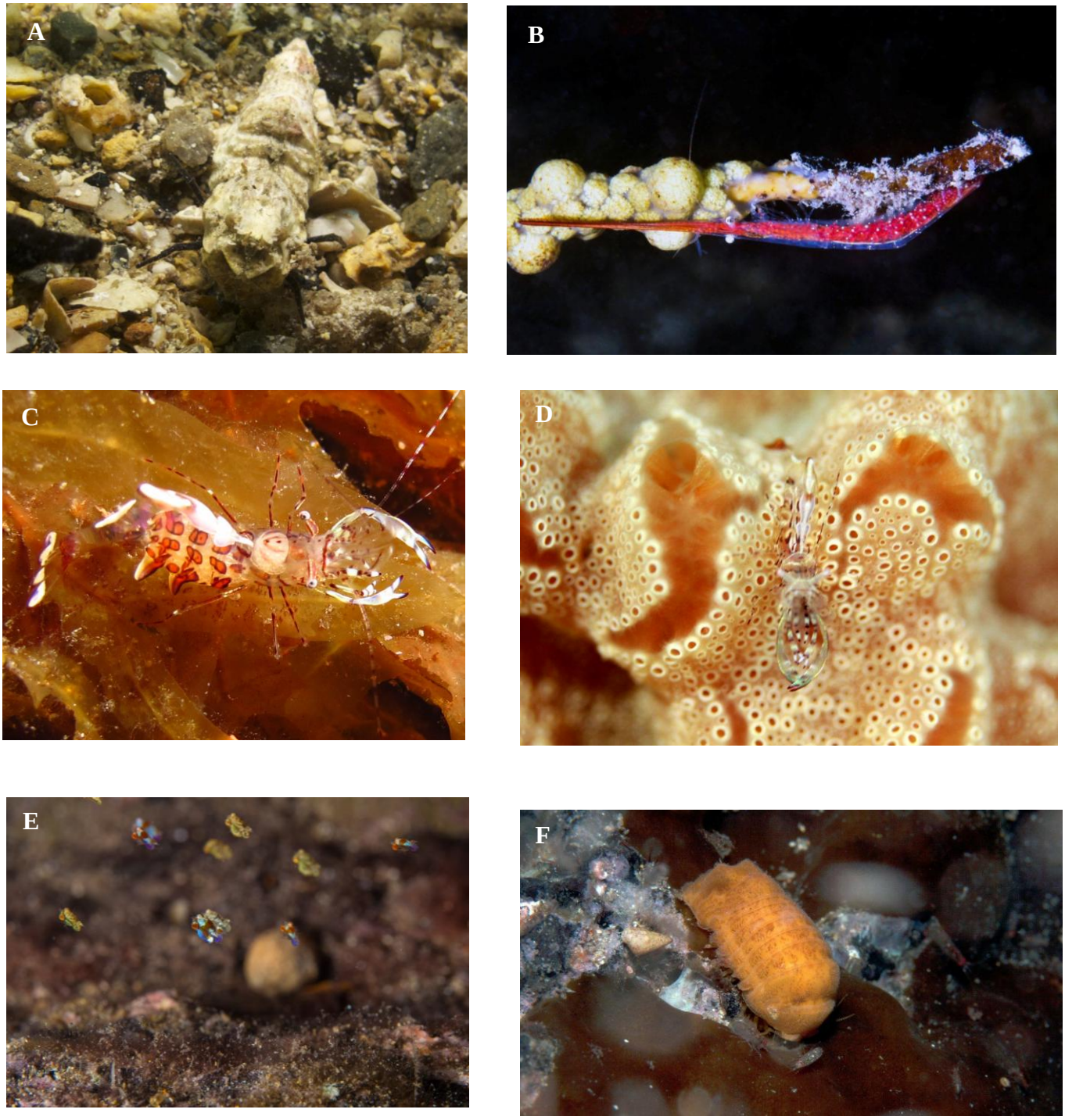


Figure 16: Humped Shrimp *Vercoia gibbosa* (A); shrimp *Tozeuma elongatum* (B); cleaner shrimp *Ancylomenes aesopius* (C and D); "sea bees" *Idiomysis*, probably *I. inermis* (E); reef isopod is Sphaeromatidae. Photo: ©A. Futterer (A and C); S. Ruxton (B and F); B. Moffat (D); K. Hart, A&K Diving (E).

Holothuroidea (Sea Cucumbers)

Sea cucumbers (Holothuroidea) are a large group of echinoderms which have leathery skin; calcareous ossicles in the body; retractable tentacles which catch drift food, and numerous small tube feet. These animals also have collagen in the body wall, which can be stiffened or relaxed, enabling them to squeeze through small spaces by "liquefying" their body. Sea cucumbers have numerous ways of reproducing. Some species split in half and regrow the other half (fissiparity); some release sperm and eggs into the water; and others brood the young in the tentacles, or inside the body cavity. The latter species give birth through a small rupture in the body wall (Baker 2013).

There are over 250 named species in Australia, including around 50 species from SA (Baker 2013). New species have been described in southern Australia in recent years, some from near shore, and others from more than 2km deep.

Two examples of sea cucumber species of interest which were recorded in the NY NRM Region during the 2013-14 survey period are a 5mm juvenile of *Thyone joshuai* (a recently described species: O'Loughlin et al. 2012) and the larger (6cm) *Rowedota shepherdi*. These and other sea cucumber species recorded during the Yorke Peninsula field work are listed in **Table 6.**

During the 2013-14 field work period, a small, cream-coloured sea cucumber with prominent longitudinal rows of tube feet was recorded from a *Heterozostera nigricaulis* seagrass sample collected under permit at Edithburgh Pool in April 2014. This animal was identified by P.M O'Loughlin as most likely being a juvenile *Thyone joshuai* (**Figure 16A**). The species, which grows to around 2cm long, is also known from a few locations in southern NSW, eastern Victoria, and upper Spencer Gulf in South Australia, particularly samples collected in 1987 from the Whyalla area, including the holotype (O'Loughlin et al. 2012).

Rowedota (formerly *Trochodota*) *shepherdi* (**Figure 16B**) is a black species which grows to about 6cm. It is known from very few locations in Victoria (O'Loughlin and VandenSpiegel 2007), and from the South Australian gulfs and the north coast of Kangaroo Island. This species has been recorded from sand and seagrass (*Posidonia* and *Heterozostera*) habitat, and from epiphytic seaweed (e.g. the brown *Lobospira bicuspidata*) on seagrass. It has also been recorded on sponges at about 10m deep, in places of moderate current. The sea cucumber positions itself high on the sponge, facing into the current to aid filter-feeding (S. Shepherd. pers. comm. 2011). The published range is 0m–30m (O'Loughlin 2011). Information on reproduction in *Rowedota shepherdi* has apparently not been published, but it is noted that a number of species in the Chiridotidae brood the young (e.g. McEdward and Miner 2001). In Victoria, *R. shepherdi* is known from less than 5 records, in isolated populations, and it is a listed threatened species in that State. This species is considered threatened in Victoria, especially in areas of seagrass decline (O'Hara and Barmby 2000; O'Hara 2002), and is reported to not occur in western Victoria or south-eastern South Australia, and this there is a break within the known distribution between eastern populations in Victoria and western populations in the SA gulfs (O'Loughlin and VandenSpiegel 2007). The status of *R. shepherdi* in South Australian is unclear, because the full distribution within this State is unknown, and no population censuses have been undertaken. During the 2013-14 field work on Yorke Peninsula, this species was recorded at Port Julia and Ardrossan, in *Amphibolis* seagrass.

During this project a species in *Staurothyone* was also found, related to the south-eastern Australian *S. inconspicuosa* but likely to be an undescribed species (P.M. O'Loughlin, pers. comm. 2013). This small sea cucumber was recorded by J. Baker in the shallow subtidal at Point Julia in October 2013. Females in the genus *Staurothyone* seasonally brood many juveniles in an internal body cavity during late winter (O'Loughlin 2011), and release the young in spring through a hole in the body wall.

Table 6: Sea cucumber species recorded during the 2013-14 field work in NY NRM region. Identifications by P. Mark O'Loughlin, taxonomic associate of Museum Victoria.

Latin Name	Location	Habitat	Date (month / year)
Holothuria hartmeyeri	Ardrossan	sand/rubble	4/14
Leptosynapta dolabrifera	Edithburgh	reef with coral skeletons	5/14
Neoamphicyclus mutans	Edithburgh Pool	*Posidonia*	4/14
Rowedota epiphyka	Port Julia Edithburgh Pool Point Gilbert	mixed red seaweeds (*Wrangelia*, *Polysiphonia*, *Wollastoniella* etc) *Amphibolis* with brown & red seaweed epiphytes	10/13 4/14 4/14
Rowedota shepherdi	Port Julia (unconfirmed) Ardrossan	 *Amphibolis*	10/13 10/14
Staurothyne cf *inconspicuosa* (undescribed)	Port Julia	mixed red seaweeds (*Wrangelia*, *Polysiphonia*, *Wollastoniella* etc)	10/13
Stichopus or *Australostichopus* species	Ardrossan	sand/rubble	10/14
Thyone joshuai	Edithburgh Pool	*Heterozostera*	4/14

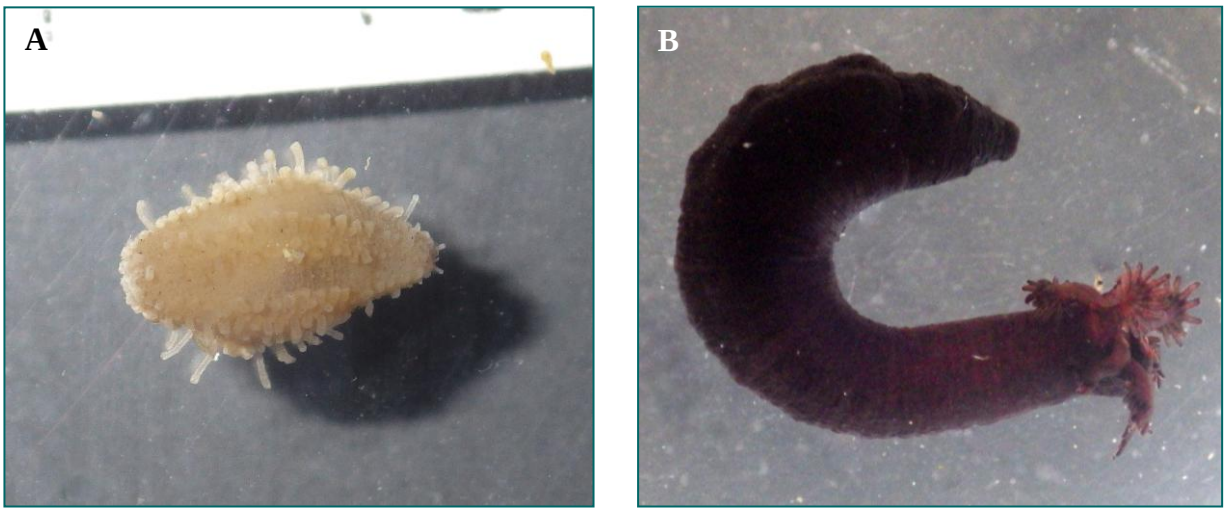


Figure 16: Two of the smaller, less commonly known, seagrass-associated sea cucumber species recorded during the surveys in NY NRM region. *Thyone joshuai* (juvenile) (A) and *Rowedota shepherdi* (B), the latter of which belongs to a family of of sea cucumber species whose members brood the young. Photos: ©J. Baker.

Other Invertebrates

Many other invertebrates were recorded during the field work, including a *Phascolosoma* sipunculid (peanut worm), leeches, numerous types of small crustaceans (crabs, amphipods, copepods, tanaids, caprellids, ostracods etc), chitons, and brittlestars, including a probable undescribed southern relative of the tropical species *Amphiura* (*Amphiura*) *septemspinosa*. Several foraminifera, including the globally distributed species *Discorbis dimidiatus* and *Peneroplis planatus*, were also recorded in seagrass samples.

6. Discussion

This report discusses some of the most biogeographically and taxonomically interesting finds from the 2013 and 2104 marine invertebrate searches in NY NRM Region. These include:

- 12 types of ribbon worm which represent new species and will be taxonomically described in future (with some places on Yorke Peninsula becoming the type localities);
- first records of several polychaete worms which will be described as new species, including an unusual, purple-headed species in *Notphyllum*;
- records of the globally rare group staurozoa (stalked jellyfish) including one which will be described by taxonomists in the US, and a westward extension of the known range of the south-eastern Australian stalked jellyfish *Lucernariopsis tasmaniensis;*
- a crawling hydrozoan medusa in the family Cladonematidae, for which there are very few records in Australia, mostly from NSW. The crawling medusa was in the genus *Staurocladia*, a group for which there is very little information in Australia, and, according to hydrozoan experts, no species previously documented for South Australia;
- new information about habitats and depth of undescribed ribbon worm (Nemertea) species previously known only from Victoria;
- 6 species of sea slugs which represent first documented records in SA of eastern or SE species, and 9 other species of sea slug which are uncommonly recorded in South Australia. During the survey period, 43 species of nudibranch and other sea slugs were found;
- tropical nudibranch species, and uncommonly recorded southern relatives of tropical shrimp and anemone species;
- new information about distribution, habitats and depth range for various described and undescribed marine invertebrates which have been previously recorded in few other locations.

The composition of the marine invertebrate fauna of NY NRM region is influenced by the diversity of habitats and oceanographic conditions, which range from warm, calm water, mangrove and seagrass environments of the upper gulf, through to cooler, deeper water, wave- and current-exposed reef environments of Investigator Strait and some of the islands off Yorke Peninsula. Gulf St Vincent and Spencer Gulf are biogeographically positioned 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). This enables species from both the east and west to exist in the NY NRM Region. The sea slug (nudibranch and opisthobranch) fauna is one example. Within the 2013-14 period of opportunistic sampling as 23 sites, 43 species were recorded, and these range from tropical nudibranchs which are widespread through the Indo-Pacific, to first records of south-eastern species known from Victoria and Tasmania. The species richness of nudibranchs in NY NRM, like many other invertebrate groups, is likely to be greater than is currently known, and a number of species are rarely recorded due to their rarely sampled habitats, and/or cryptic habits.

The results from the invertebrate searches to date indicate how little is known of the full species richness and diversity of marine invertebrates in the NY NRM region, and the habitats of marine invertebrates. A number of rarely recorded species, as well as new species never previously documented, have been found in various parts of the Region in 2013 and 2014. Many of these species live in cryptic and under-surveyed habitats, such as the surface of reefs, the underside of rocks, or in seagrass or macroalgae. It is not known how many of these species are truly endemic within South Australia; how many occur in south-eastern or south-western Australia with SA as the western and eastern edge of the respective ranges; how many are recent arrivals from topical and sub-tropical waters; and how many are cosmopolitan in distribution. In some cases, apparent tropical species may be undescribed temperate relatives, and further taxonomic work is required, and this is currently progressing.

Determining the species richness and distribution of marine invertebrates across South Australia is an enormous undertaking. Sampling in SA began with the sand dredging and 'beachcombing' work of marine naturalists in the 19th century, and has developed over time since the advent of SCUBA diving. During the latter decades of the 20th century, substantial collecting efforts around South Australia by S. Shepherd and colleagues, and by K. Gowlett-Holmes who undertook intensive exploratory surveys at a number of locations, both helped to better determine the invertebrate richness and diversity of South Australian waters. One of the most intensively sampled areas in Yorke Peninsula is the seagrass beds and sediment around Port Pirie, which were the subject of heavy metal pollution monitoring studies during the 1980s (e.g. Ward et al. 1983; Hutchings et al. 1993), and much information about species composition and relative abundance was collected as part of that work. The invertebrate fauna of few other areas in the region have been surveyed. It is noted, however, that during 2008, research agency SARDI undertook destructive sampling by trawling, benthic sled, benthic grab and traps, at sites from 10m to 30m deep around Yorke Peninsula to identify spatial variability in flora and fauna (Rowling et al. 2009). Hundreds of kilograms of marine animals and plants were trawled and dredged up during the 2008 surveys, and it is hoped that the material will serve a purpose in future comparisons of habitat cover and species distribution at those sites.

More recently, detection of small reef invertebrates has been aided by the increasing popularity and availability of macro-photography equipment during the past two decades, and the effort of citizen science researchers, assisted by recreational divers and marine photographers. Following collection in the field, taxonomic description of new species and accurate identification of existing marine invertebrate species, are both time consuming undertakings requiring specialist techniques and many hours of meticulous research by taxonomists. It is likely that the lack of substantial survey efforts in most States, coupled with the small number of specialists who have provision and resources to identify samples, will mean that the true species richness of South Australia's invertebrate fauna - as well as the true geographical distribution of many species here (including those which may be unique within South Australia) - will not be known for many years.

Use of Results

This project has entailed invertebrate searches by divers who engage in macro-photography; collection of intertidal and subtidal seagrass and seaweed samples under permit; processing of invertebrates therein for later taxonomic identification; and volunteer assistance by numerous marine taxonomists from around Australia (and some overseas) to examine photographs and specimens. The project by SACReD and associates is proving valuable in terms of new and rare species finds, and biodiversity studies on a broader scale, including distribution and habitat of invertebrates from many taxonomic groups. A number of marine photographs (which show morphological detail and also habitat), coupled with both live and preserved specimens from SACReD and associates' marine invertebrates project in NY NRM region have been useful to taxonomic workers, particularly in Victoria, who specialise in Anthozoa (corals and anemones), Opisthobranchs/Heterobranchia (sea slugs, nudibranchs); Polychaeta (sea worms); Platyhelminthes (flatworms); and several other groups. Staurozoans (stalked jellyfish) found during SACReD and associates' field work on Yorke Peninsula are being examined by researchers at the Smithsonian Museum in Washington USA, and will contribute to a world-wide study on the morphology and DNA of staurozoans, headed by Dr A. Collins. The material from Yorke Peninsula will contribute to the naming of new species in this globally uncommon group of invertebrates. Also, several of the small mollusc shells in Rissoellidae and Eatonidellidae and other groups which were collected during the 2013-14 field work on Yorke Peninsula are also being used in a globally significant project in which the phylogenetics of all molluscs is being revised (managed by Dr A. Moussalli, at Museum Victoria).

Some of the undescribed invertebrate species from South Australia recorded during this project will be formally named, and the taxonomy of some described species is being revised. The locations where new species were first recorded in NY NRM region will become the type localities when the species are formally described. 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.

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 (such as Redmap) 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.

One of the main uses for these data is education, not only to show some of the remarkable and "new" invertebrate species that exist in South Australian waters, but to highlight the fact that many of these species are strongly associated with reef surfaces, and with seagrasses and seaweeds growing within the Region. The small species which live in such environments, and cannot move away from them, illustrate the importance of protecting these habitats from degradation. Unless the health of reef cover and seaweed and seagrass beds are maintained, populations of these small invertebrates would not survive. This is discussed further in the following section.

Threatening Processes, and Potential Impacts upon Marine Invertebrates of NY NRM Region

Small invertebrates provide many ecological functions in the marine environment, such as food sources for larger animals, and recycling of nutrients through ecosystems. Many of the species discussed in this report are strongly associated with reefs surfaces, and others are reliant upon seagrass and seaweed as habitat in which they live, feed and reproduce. Degradation of such habitats may result in a decline in the species richness of the invertebrate fauna in NY NRM region, and this may have flow-on effects to higher order animals.

There is strong evidence to indicate that in the adjacent NRM region to the east of the NY NRM region (i.e. AMLR NRM region - particularly along the metropolitan coast), increased nutrients from coastal discharges and run-off, and sedimentation from creek and stormwater discharges, dredging, and coastal development, have all contributed to the declines in canopy-forming kelp and other large brown seaweeds, and an increase in the cover of sediment-trapping, turf-forming algae (Turner 2005, Turner and Kildea 2006, Turner et al. 2007, Gorman 2009). Once turfs become established in the place of canopy seaweeds, they can trap sediment and further inhibit the re-establishment of canopy-forming species such as *Ecklonia* kelp and species of brown seaweeds in the genera *Sargassum* and *Cystophora* (Gorman 2009).

It is noted that *Sargassum* and *Cystophora* provide living area for a diverse suite of small invertebrates, including small anemones, hydroids, flat worms, ribbon worms, polychaete worms, nudibranchs and other sea slugs, sea spiders, small crustaceans (amphipods, isopods, tanaids and other groups), and small gastropod and bivalve shells (J. Baker, pers. obs. 1992-1996; 2011-2014). During the 2014 invertebrate sampling in NY NRM, between 25 and 35 species were recorded in some of the seaweed and seagrass samples between 500g and 1kg.

Perhaps even more so than seaweeds, seagrass beds contribute significantly to the species richness and diversity of small invertebrates in the NY NRM region, because most seagrasses, particularly the two species of *Amphibolis*, can support numerous small species, many of which eat the small epiphytic algae, hydroids, small anemones and bryozoans which live on the blades of the seagrass. Many of the new species recorded in recent years in Victoria (particularly ribbon worms) have come from *Amphibolis* seagrass beds (e.g. Falconer and Altoff, 2013, 2014). The now well-publicised degradation of seagrass beds in the adjacent AMLR NRM region since the 1950s was known about as early as the 1960s (Shepherd 1970) but information

was suppressed at the time. This degradation has been the subject of numerous investigations over the ensuing decades (see Westphalen et al. 2004, and Fox et al. 2007 for reviews and summaries of impacts). In comparison with the AMLR NRM region, much less monitoring of seagrass beds has been undertaken on Yorke Peninsula, but one example is an aerial photography and ground truthing project to compare seagrass cover between 1979-81 and the mid 2000s (Gaylard 2008). Results indicated some seagrass loss around Corny Point and Point Turton, and apparent seagrass gain in other areas, such as the Tickera region and Moonta Bay.

Nutrient enrichment of nearshore waters from several sources, including fertiliser dusts and soils from coastal agriculture, and from sewage effluent (both run-off and groundwater discharge), may contribute to decline in seagrass and seaweed density in some areas, and increased cover of "nuisance" epiphytes on seagrass and seaweeds in other areas. Coastal mining, coastal housing developments and marina / boat harbour construction and maintenance can also impact coastal reefs and seagrass beds in the NY NRM, and therefore adversely affect the suite of small invertebrates which exist in such habitats. Benthic trawling also has an impact of the habitats which support marine invertebrates around NY NRM region. These impacts are discussed in more detail in a report for Natural Resources - Northern and Yorke (Baker 2015).

Future Studies on Invertebrate Richness and Distribution in NY NRM Region

The invertebrate searches in NY NRM region during the past couple of years by SACReD divers, MRG and dive clubs associates have yielded significant information about uncommonly recorded and new species in the Region, as well as further information about species previously known from other parts of southern, western or eastern Australia, and the habitats which such species occupy, including reef surfaces, and seaweeds and seagrasses.

The current survey period concentrated on a number of locations in eastern and south-eastern Yorke Peninsula, as well as several sites north of Port Victoria. During the previous (January 2013) survey period, sites along eastern side of Yorke Peninsula, particularly Hardwicke Bay area, were sampled (see Baker et al. 2013b and 2014).

Examples of areas for which more information is required include:

- sanctuary zones of coastal Marine Parks (e.g. Cape Elizabeth, Port Victoria, Goose Island, Chinaman's Hat, Point Davenport, Troubridge Hill, Coobowie);
- national parks (e.g. Innes NP) and conservation parks (e.g. Bird Islands, Leven Beach, Point Davenport, Wills Creek and Clinton) which abut the coast;
- offshore waters around Yorke Peninsula, including habitats around islands such as the Althorpe Group, banks and knolls in Investigator Strait (e.g. Orcades Banks), and waters around Wardang Island and other islands in eastern Spencer Gulf;
- the upper part of Gulf St Vincent (including the eastern boundary area of NY NRM);
- Investigator Strait (particularly waters deeper than 5m); and
- north-western end of the NY NRM region, including habitats around Port Broughton, Port Davis, and the Chinaman Creek / Winninowie area.

For such areas, very little is known about the invertebrate fauna, even less than areas for which there has been periodic sampling effort. More should be known about the biodiversity of both nearshore and offshore waters around Yorke Peninsula, to ensure adequate environmental management, and well-informed conservation decision making over the long term.

Targeted studies are also required to determine the current distribution and relative abundance of species known only from very few records (sometimes a single example of an invertebrate species has ever been collected), or from very old records (e.g. 1850s to early 20th century). Many such species are small, and inconspicuous, and require highly trained taxonomists for their precise taxonomic identification.

Without the considerable volunteer effort of numerous marine citizen science participants, such as what has occurred in the current project, such studies could not occur, and new information about the species richness, biodiversity and habitats of marine invertebrate in the Region would not be known.

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 still required in many locations, based on careful observation, macro-photography and specimen 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. Across South Australia, the majority of ranges for small, non-commercial marine invertebrates are opportunistically defined, based on few records from few locations, recorded incidentally. Without substantial search effort across South Australia, in collaboration with researchers who undertake similar work in other southern Australian States, 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, or of the species richness and diversity in any particular area. Much is written in government policy about the need for biodiversity conservation, but reliable assessments of species composition (at the very least, and preferably also relative abundance data) are required for robust diversity analyses across space and time.

One of the aims of South Australian Conservation Research Divers and associates is to document the locations and habitats for uncommonly known, site-associated benthic marine species in South Australia. Our project work concentrates on species which are rarely seen, or exist over apparently narrow geographical ranges, and also new species not previously recorded, but the conservation and education aims are equally relevant to more commonly occurring invertebrates whose populations may be at risk of depletion from threatening processes in their benthic habitats. It is our hope - through education towards a better understanding and appreciation of uncommonly known marine species, and improved management over time of benthic habitat impacts within the NY NRM region - that such species in South Australia will not ever need to be included on threatened species schedules in future.

7. Recommendations

- Undertake further surveys to better determine the composition and distribution of rarely recorded South Australian species from main invertebrate groups, particularly in and adjacent to Marine Park sanctuary zones; national parks (e.g. Innes NP) and conservation parks (e.g. Bird Islands, Leven Beach, Point Davenport, Wills Creek and Clinton) which abut the coast; also in other data-poor areas, such as offshore islands and banks; Investigator Strait; northern part of the NY NRM region (north-eastern Spencer Gulf and north-western Gulf St Vincent); and also in port areas and boat harbours (and other highly modified areas where threatening processes exist).

- Where possible, increased protection of seagrass beds and seaweed-covered reefs in NY NRM region from physical impacts, nutrient enrichment, and sedimentation. By protecting habitat, the invertebrate species populations can be maintained over the long term.

- Implementation of a reliable and sensitive monitoring program for sanctuary zones of Marine Parks, to determine the composition of invertebrate fauna (including rare and limited range species), and provide baseline data to assist in detecting change over time due to local and global stressors. SACReD members and associates from other citizen science research groups (e.g. MRG in Victoria) and associate marine photographers, are developing skills in finding, photographing and identifying marine invertebrates, and can assist this process.

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

- Continued State-level support for monitoring work in the NY NRM region (including seagrass cover monitoring studies being undertaken by the EPA), and remedial action programs to ensure the persistence of remaining healthy reefs and seagrass beds, and the restoration of these where degraded, through the 21st century.

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