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Spatial and temporal reassessment of by-catch in the Spencer Gulf Prawn Fishery

Burnell, O.W., Barrett, S.L., Hooper, G.E., Beckmann, C.L., Sorokin, S.J. and Noell, C.J.

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SARDI Research Report Series No. 860

SARDI Aquatics Sciences
PO Box 120 Henley Beach SA 5022

September 2015

Report to PIRSA Fisheries and Aquaculture

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia
Primary Industries and Regions SA

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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EXECUTIVE SUMMARY

This report reassesses the spatial distribution of by-catch in relation to trawling activity in Spencer Gulf, making the first fishery-scale temporal comparisons with an earlier (2007) survey. Data were analysed to determine the correlations of environmental factors and historical fishing effort with spatial and temporal patterns in: 1) overall species richness, biomass and abundance, 2) community structure, 3) phyla groupings, and 4) individual species (i.e. abundant species, protected species and species of interest).

A fishery-independent survey was undertaken on commercial prawn trawlers using a standard double-rig otter trawl. Sites chosen represent the range of habitats and depths historically targeted by prawn trawlers in Spencer Gulf. In 2013, 65 sites were sampled, compared with 120 sites in 2007, including proportionally fewer samples from areas of low trawl intensity.

The 125 fishery reporting blocks were categorised by intensity (hours trawling per km^2) for the 5-yr period associated with each survey. In 2013, there were 7, 23 and 95 blocks in the high, moderate and low trawl intensity categories, respectively. High intensity blocks comprised 2.8% of the total area of Spencer Gulf, but >45% of commercial catch and effort. Moderate intensity blocks comprised 13.7% of the area and between 38-40% of catch and effort. Low intensity blocks comprised 83.5% of the area and between 9-14% of catch and effort.

In 2013, the by-catch-to-prawn ratio was 4.9:1 in areas subjected to high trawling intensities, 5.3:1 in areas subject to moderate trawling intensities and 4.1:1 in areas subject to low trawling intensities. The high by-catch ratios in moderate-to-heavily fished areas of Spencer Gulf were a result of low prawn catch in 2013.

Trawl intensity and survey year had no statistically significant effect on overall abundance, biomass or species richness of by-catch. There was a pattern of decreasing mean standardised catch in 2013 (670 individuals and ~26 kg per hectare) when compared with 2007 (1326 individuals and ~40 kg per hectare). This occurred partially due to high catches from a small number of sites in 2007.

Differences in community structure were primarily associated with regional effects (i.e. distance from the top of the Gulf) and depth, while temporal and trawl related differences in community structure were small.

Chordates (fish) and crustaceans (principally prawns and crabs) dominated the catch, which was similar to the 2007 study. Together these two phyla comprised 92% of the total abundance and 79% of the total biomass in 2013. Despite remaining among the most dominant phyla, fish biomass decreased significantly, constituting only 31% of total biomass in 2013, in comparison to 51% in 2007. Compared to 2007, fewer large catches of fish were recorded from low intensity trawl sites in southern and western areas of Spencer Gulf during 2013.

The biomass of sponges and bryozoans was significantly lower in moderate-to-heavily trawled areas. This was consistent with the 2007 survey and previous studies which have shown that sessile, long-lived and slow growing organisms can be disproportionally susceptible to the impacts of demersal trawling. No temporal differences in the biomass or abundance of sponges and bryozoans were evident between the two survey years.

The four most abundant species (King Prawn, Skipjack Trevally, Blue Swimmer Crab and Degen's Leatherjacket) were consistent with those most commonly encountered in surveys over the past two decades, collectively accounting for 68% of the total abundance and 58% of the total biomass in 2013. The two crustaceans (King Prawn and Blue Swimmer Crab) had significantly greater abundance and biomass in moderate-to-heavily trawled areas, whereas the two chordates (Skipjack Trevally and Degen's Leatherjacket) were distributed homogenously among the three trawl intensities.

The two by-product species taken within the fishery showed no significant change in distribution between 2007 and 2013. Southern Calamari were found in greater abundance and biomass in moderate-to-heavily trawled areas, while slipper lobsters (or 'bugs') were distributed homogenously among the three trawl intensities.

Seven species collected during the 2013 survey are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) as threatened, endangered or protected. All seven species belong to the Family Syngnathidae, which comprises seahorses, seadragons and pipefish. The 2013 catch of 31 individuals included Tiger Pipefish (4), Bigbelly Seahorse (5), Knifesnout Pipefish (2), Brushtail Pipefish (4), Leafy Seadragon (3), Common Seadragon (2), Spotted Pipefish (10).

Temporal stability of by-catch in relation to fishing intensity suggests that any current impacts of commercial trawling are difficult to detect from the initial baseline that was established in 2007. The most notable change to the by-catch composition since 2007 (i.e. decreasing fish biomass) appears to be unrelated to trawl intensity, but more likely a result of inter-annual variation in biomass in the lower part of the Gulf.

The current by-catch sampling methodology is limited by its inability to detect both intra- and inter-annual variation, which is important for interpreting variation in by-catch species, particularly for highly motile species, such as fish. In the future gulf-wide by-catch surveys are just one of numerous possible ecosystem monitoring techniques that could be used. Alternatively, ecosystem impacts of the fishery may be mitigated by: 1) continued optimisation of fishing practices through spatial management of effort, in conjunction with 2) monitoring of selected by-catch species.

1. INTRODUCTION

1.1. Background

The Spencer Gulf Prawn Fishery (SGPF) is managed by Primary Industries and Regions South Australia (PIRSA) under the framework provided by the *Fisheries Management Act 2007*. It is a limited entry fishery with 39 licensed operators. Fishers are entitled to harvest the target species King Prawn, *Melicertus latisulcatus*, and two by-product species: Southern Calamari, *Sepioteuthis australis*, and slipper lobsters (or ‘bugs’), *Ibacus* spp. Since 1999, the export of prawns from Spencer Gulf has been controlled under the wildlife protection provisions of the Australian Government’s *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). To gain export status under the EPBC Act (Part 13A), the South Australian Government must demonstrate that harvesting strategies for the fishery are ecologically sustainable. This includes demonstrating that impacts on the structure, productivity, function and biological diversity of the ecosystem are minimised. In 2004, the Commonwealth Government provided recommendations to enhance the ecologically sustainable fishing of prawns in the Spencer Gulf (DEH, 2004). These included recommendations to assess and mitigate ecological impacts on: 1) by-catch species, 2) by-product species, and 3) threatened, endangered and protected species (TEPS).

As little or no baseline information exist prior to the commencement of trawling in Spencer Gulf an ecosystem-wide approach is most effective for considering potential trawl effects. In 2007, the first comprehensive by-catch study of prawn trawling in Spencer Gulf was undertaken within an ecological framework, encapsulating both heavily fished areas, as well as infrequently trawled regions (Currie *et al.*, 2009). At a whole-of-gulf-scale, Currie *et al.* (2009) found putative trawl-related differences in community structure were small compared to those associated with latitude (north-south gradient). Fish, prawns and crabs dominated the catch and together comprised 96% of the total abundance and 82% of the total biomass. Notably, the same four most abundant species from surveys in February 1996 (i.e. Carrick, 1997) still dominated trawl catches eleven years later (i.e. Degen’s Leatherjacket *Thamnaconus degeni*, King Prawn, Blue Swimmer Crab *Portunus pelagicus* and Skipjack Trevally *Pseudocaranx wright*) (Currie *et al.*, 2009).

Many protected species also occur in Spencer Gulf, including syngnathids (sea dragons, seahorses and pipefish), blue groper, marine turtles, white sharks, dolphins, seals and whales. While syngnathids are often captured in trawl nets (Currie *et al.*, 2009; Sorokin *et al.*, 2009), direct interactions with other protected species are rare (Tsolos and Boyle, 2014), although indirect interactions with dolphins that consume by-catch discards are common (Svane, 2005). Since reporting of interactions with protected species was introduced in 2007/08, approximately 1% of reports have been species other than syngnathids, including one great white shark and one fur seal (Tsolos and Boyle, 2014). The remaining 99% (n = 406) of reported interactions from fishery-dependent data have all been with syngnathids (Tsolos and Boyle, 2014). Currently, management of the SGPF includes two industry self-imposed spatial closures and prohibition of trawling at depths <10 m, which help to protect syngnathids and their habitats (Currie *et al.*, 2009; Mayfield *et al.*, 2014).

A number of important by-catch species in Spencer Gulf were identified in the Ecologically Sustainable Development (ESD) Risk Assessment for the Spencer Gulf Prawn Fishery (PIRSA, 2014a). Twenty three species were further assessed for the purposes of considering management arrangements to mitigate identified risks. Blue Swimmer Crabs were also included as they were considered a species of high abundance. Nine of these were designated as high risk based on their productivity (i.e. recovery rate following potential fishing-associated depletion) and susceptibility (i.e. likelihood they are impacted by the fishery). Twenty of these species were considered to have adequate management arrangements and the fishery under the current management arrangements did not pose significant risk to their sustainability. Three species required additional information to ensure the fishery does not pose a risk to their sustainability (referred to hereafter as ‘species of interest’ for this report). These were the Coastal Stingaree *Urolophus orarius*, Tiger Pipefish *Filicampus tigris*, and Giant Cuttlefish *Sepia apama*.

In 2011, the SGPF became the first prawn trawl fishery in the Asia-Pacific region and first King Prawn fishery in the world to obtain Marine Stewardship Council (MSC) certification for sustainability. More recently, research has been undertaken toward developing an Ecosystem-Based Fisheries Management (EBFM) reporting framework to ensure ecologically sustainable development within the SGPF and support continued MSC accreditation (Mayfield *et al.*, 2014). As part of this reporting framework, temporal change in the composition of by-catch species is considered one of the most suitable ecological performance indicators (Mayfield *et al.*, 2014).

1.2. Impacts of trawling

Spencer Gulf is a shallow embayment with depths <40 m in northern areas and up to 60 m in southern areas. It extends >300 km from north to south, creating one of the largest marine incursions into continental Australia (Richardson *et al.*, 2005). Sediments are predominately sand and mud. Seagrass habitats are common at depths <10 m, where trawling is prohibited. Due to the minimal freshwater inputs and high summer evaporation rates, Spencer Gulf is classified as an inverse estuary, with salinity increasing towards the head of the Gulf (Nunes and Lennon, 1986; Nunes Vaz *et al.*, 1990).

Benthic communities are important functional components of ecosystems. Benthic organisms play a significant role in the diets of many seabirds and marine mammals and can influence the abundance and species composition of these tertiary consumers (Skagen and Oman, 1996; Bowen, 1997). Many benthic organisms also play an important role in the recycling of nutrients and the maintenance of water quality within estuarine systems (Harris, 1999; Peterson and Heck, 1999). Understanding factors that underpin community structure is important for the ecologically sustainable management of bays and estuaries.

Multiple biotic and abiotic factors affect the distribution of shallow-water benthic fauna and flora. Important physical influences include depth (Gray, 1981), sediment structure (Sundberg and Kennedy, 1993), salinity (Gaston and Nasci, 1988), hydrology (Pearson and Rosenberg, 1987) and temperature (Belanger *et al.*, 2012). Key biological factors include predation (Peterson, 1979), competition (Wilson, 1990) and recruitment (Olafsson *et al*., 1994). Estuarine benthic communities can also respond to a range of human-induced impacts, including organic enrichment (Pearson and Rosenberg, 1987), chemical pollution (Warwick, 1988), and commercial fishing (Blaber *et al*., 2000), as well as many other industrial developments (e.g. ports, shipping and mining) (Gillanders *et al.*, 2013; Robb, 2014). Thus, few generalisations regarding the primary structuring forces of benthic communities are conclusive.

Demersal trawling can have significant impacts on benthic habitats and species (Andrew and Pepperell, 1992; Dayton *et al*., 1995; Jennings and Kaiser, 1998; Thrush and Dayton, 2002; Svane *et al.*, 2009). High mortality rates of by-catch species and significant modifications to community structure have been widely reported (Jennings and Kaiser, 1998; Tanner, 2003). Typically, trawling dislodges attached epifauna and flattens existing topographical features (Jennings and Kaiser, 1998) which can disrupt sediment stratification, destroy burrows and other structures and reduce the number of ecological niches available (Sainsbury, 1988; Kaiser *et al*., 2000). Trawling can also open new ecological niches, whereby scavenger species benefit from the trophic subsidies provided by discarded by-catch (Svane *et al.*, 2007). Such changes can all have cascading effects on ecosystem function (Pinnegar *et al*., 2000).

Increasing environmental awareness has focused attention on the need to assess the biological impacts of trawling (reviewed by Jennings and Kaiser, 1998; Thrush and Dayton, 2002). However, trawling impacts are difficult to assess because of the complexity of the biological communities and our limited understanding of their natural variability (Messieh *et al*., 1991) and pre-disturbance states (Rice, 2000; Currie *et al.*, 2009). While, it is unclear which exact taxonomic groups and species are impacted by trawling in Spencer Gulf, it appears that benthic community structure is driven largely by regional effects not trawl intensity (Currie *et al.*, 2009). Nonetheless, long-term datasets of by-catch with high levels of spatial and temporal replication associated with trawling remain rare.

1.3. Spencer Gulf Prawn Fishery

The Spencer Gulf Prawn Fishery produces between 1,600 and 2,400 t of King Prawns annually (Figure 1). Commercial prawn trawling in Spencer Gulf began in 1967 and large areas have been trawled at varying intensities (Carrick, 2003). Catches and trawling intensity increased dramatically over the first six years of the fishery. In 1973/74, more than 2,000 t of prawns were harvested with approximately 25,000 hours of trawling effort (Figure 1). Since then, annual catches have remained relatively stable. Trawling effort has declined from a peak of 45,786 hours in 1978/79 to 19,081 hours in 2012/13. The reduction in the number of hours trawled has occurred because the fleet works cooperatively to maximise economic returns and reduce costs. Pre-fishing surveys are conducted to identify areas that support high densities of large (high value) prawns. Fishing is formally confined to these areas through legislative notices signed by a delegate of the Minister for Fisheries. There are several areas of the Gulf that have not been fished for many years. These closure areas were determined by industry, and are identified on each legislative notice documented by Government.

While vessels are permitted to use single or double-rigged demersal otter-trawls (Figure 2), the current fleet is exclusively comprised of double rig trawls. Considerable technological advancements have been made in the fishery including the use of “crab bags” within the nets to exclude mega-fauna by-catch, and “hoppers” for efficient sorting and grading of prawns and rapid return of by-catch. Trawling is not permitted during daylight hours. Gear restrictions include vessel size and power, type and number of trawl nets towed, maximum headline length and minimum mesh sizes. There are generally six or seven fishing periods within each fishing year. Each fishing period lasts a maximum of 18 nights from the last to first quarters of the lunar cycle in November, December, March, April, May and June. Commercial trawl shots are generally less than 1 hour duration.

1.4. By-catch research

Prior to the first Gulf-wide by-catch study in 2007 (i.e. Currie *et al.*, 2009) several research projects were conducted to obtain information on the ecological consequences of prawn trawling in Spencer Gulf. Initial studies focused on documenting the magnitude and composition of by-catch species captured incidentally during commercial fishing operations (Carrick, 1997), determining the fates and consequences of discarded by-catch (Svane, 2003, 2005; Svane *et al.*, 2007, 2008) and impacts on benthic habitats and assemblages (Svane *et al.*, 2009). From these studies, few consistent patterns emerged on the dominant components of the catch composition from prawn trawlers in Spencer Gulf, possibly as a result of spatial and temporal differences among surveys. Carrick (1997) reported that the by-catch composition in commercial trawls at 32 sites in the northern and central Spencer Gulf during February 1996 was dominated by small fin-fish. In contrast, Svane *et al.* (2007) found that sessile benthos (i.e. sponges, bryozoans, bivalves) were the dominant by-catch group (by average weight) at five sites in the northern Spencer Gulf sampled during fishery-independent surveys in October 2004 and January 2005. Svane *et al.* (2007) also found relatively high proportions of sand trevally, blue crabs, sharks and rays in the by-catch. While these studies provided important biological information on by-catch, their focus on specific areas of Spencer Gulf limited their use for assessing trawling impacts at the scale of the fishery.

The issues associated with quantitatively determining the direct effects of trawling have meant that most studies have focused on determining species composition, distribution patterns and relative abundance. One can, however, determine correlations between the composition of the catch and the abiotic factors that may affect it, such as trawling effort or environmental parameters. Svane *et al.* (2009) documented a negative correlation between commercial trawling effort and the biomass and abundance of by-catch at five sites in Spencer Gulf, and suggested that the observed differences among sites were caused by variations in trawl histories. This conclusion was based on the assumption that the confounding effects of differences among the sites associated with biophysical factors were minor. Spatial confounding of differences in community structure associated with environmental factors and levels of trawling effort has complicated interpretation of the results of many studies (Lindegarth *et al.*, 2000). However, experiments in Gulf St Vincent have effectively demonstrated the negative effects of prawn trawling on sessile epibenthos in areas that had not been fished commercially for 15–20 years (Tanner, 2003).

In 2007, it was found differences in the overall community structure of benthos in Spencer Gulf were not associated with different trawl intensities (Currie *et al.*, 2009). However, Currie *et al.* (2009) found three commercially important species were more abundant in areas of high trawl intensity (i.e. King Prawn, Blue Swimmer Crab and Southern Calamari). In contrast, there were significantly lower biomasses of poriferans, bryozoans and fish in heavily trawled areas. These results correspond with previous studies which have shown that: 1) trawling can significantly reduce the abundance and biomass of sessile benthos, and 2) that a reduction in these taxa can result in a reduction in the abundance and biomass of fish.

In terms of species diversity, Currie *et al.* (2009) reported almost four-times the number of species (395) compared to earlier studies (106) by Carrick (1997), reflecting the greater size and expanse of the 2007 survey, and the omission of sessile biota by Carrick (1997). Other previous studies (i.e. Svane *et al.*, 2007) often reported by-catch in broad faunal categories (e.g. miscellaneous fish, benthos), which limited opportunities for comparison of overall by-catch biodiversity. The diversity of species increased with latitude, including a large number of fish and sponges in the south of Spencer Gulf with affinities for open coastal environments (Currie *et al.*, 2009), further highlighting the non-uniform distribution of by-catch in the Gulf.

1.5. Objectives

This study supports the SGPF ongoing goal to protect and conserve aquatic resources, habitats and ecosystems, which include objectives to ensure sustainable impacts on by-catch, by-product, and threatened, endangered and protected species (PIRSA, 2014b). It presents important findings that can be incorporated into the EBFM framework now established for the fishery. To achieve this, the report reassesses the spatial distribution of by-catch species in relation to trawling activity within the SGPF, making the first temporal comparisons at a fishery scale.

The specific aims were:

1. To make temporal comparisons between 2007 and 2013 of the species composition and spatial distribution of prawn trawl catch in Spencer Gulf.

2. To make temporal comparisons between 2007 and 2013 of the community structure of by-catch species, in relation to i) historical trawl effort, and ii) environmental parameters.

3. To make temporal comparisons between 2007 and 2013 of a) overall species richness, abundance and biomass, b) taxonomic groups, c) abundant species, d) threatened, endangered or protected species and e) species of interest, in relation to i) historical trawl effort, and ii) environmental parameters.

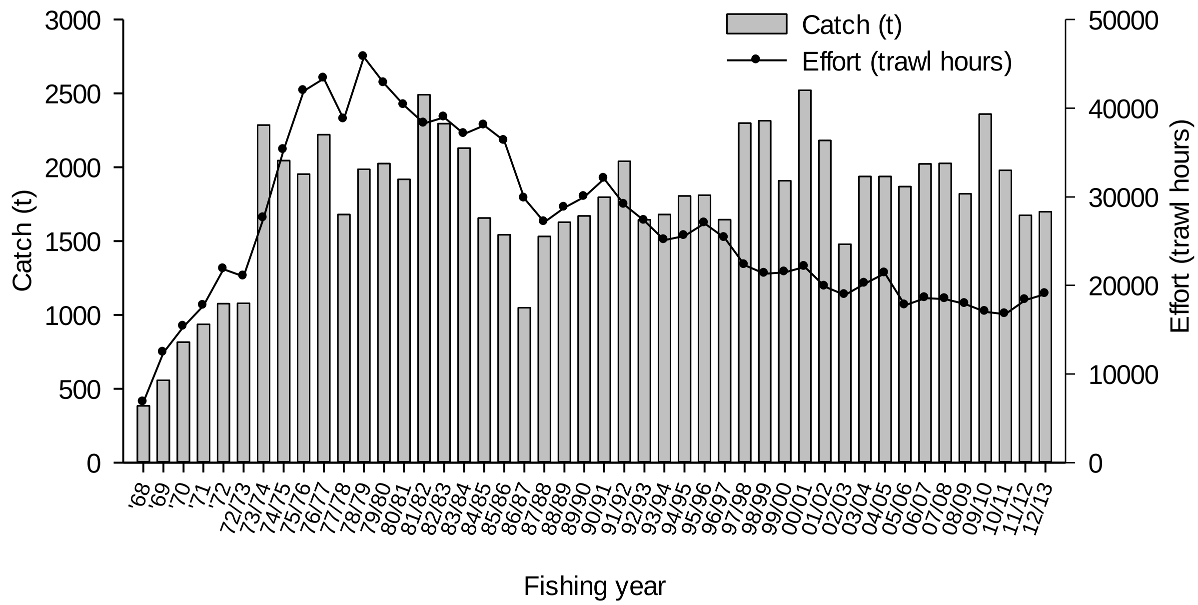

Figure 1. Data for 1972/73 are from January to September 1973. From 1973/74 data are from October to September each year (season).

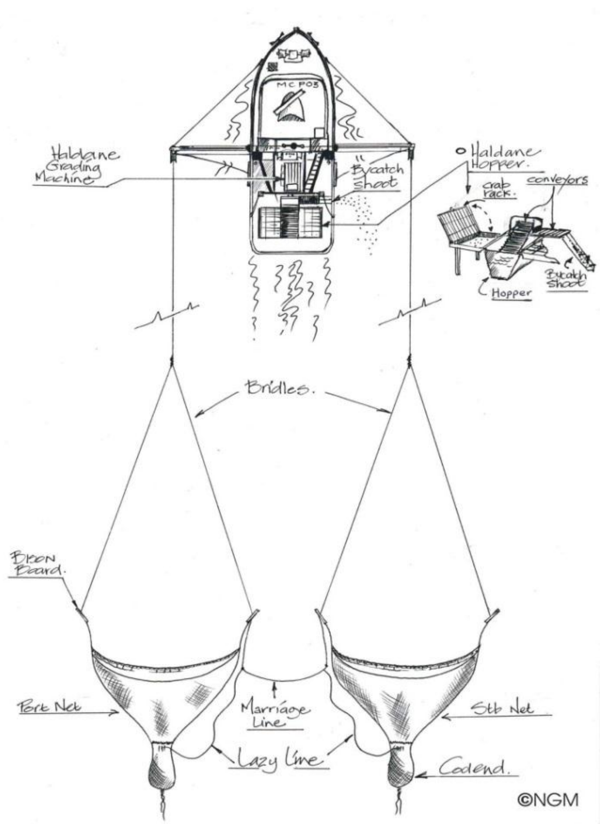

Figure 2. Double-rigged demersal otter trawl and location of hopper system used for sorting prawns in the Spencer Gulf Prawn Fishery. Figure reproduced from Carrick (2003).

2. METHODS

2.1. Available data

This study compares data collected from two independent by-catch surveys: 1) in 2013, experimental trawls for by-catch were undertaken at 65 sites in Spencer Gulf; and 2) in 2007, experimental trawls for by-catch were undertaken at 120 sites in Spencer Gulf (Figure 3). In 2013, the survey design was reduced in size for efficiency reasons. In particular, numerous sites located in areas of low trawl intensity were removed from the design. A number of planned sites were also not sampled due to difficulty with trawling gear (Appendix 1 – aborted shots). Initial evaluation of figures for abundance, biomass and community structure data indicated the 65 sites in 2013 were a representative subset of the larger 2007 survey, therefore quantitative comparisons for the two surveys were undertaken using all sites sampled during both survey years. Restricting comparisons to the 61 sites sampled in both years would have had negligible influence on the statistical outcomes.

All of the catch sampling, laboratory processing and data standardisation were undertaken using similar methods to those used in the 2007 study (i.e. Currie *et al.*, 2009), however, there are some differences (e.g. statistical analyses, number of sites sampled). The methods hereafter are specific to the 2013 study. For details of the 2007 survey, see Currie *et al.* (2009).

2.2. Catch sampling

Catch samples were collected from 65 sites in Spencer Gulf (Figure 3), trawled by six commercial prawn trawlers over four successive nights (8-11 February 2013). The sites were selected *a priori* to provide a context for evaluating historical levels of trawling effort and were allocated to one of the 125 fishery reporting blocks for Spencer Gulf (Figure 4). Sites were also stratified to reflect the range of depths >10 m historically fished and to maximise the variety of sediments (e.g. mud, sand, gravel, rhodolith) and sea-scapes (e.g. banks, gutters, bays) sampled.

Shots of approximately 30-minute duration were conducted at each site using standard double-rig prawn gear (2 × trawl nets each with 14.63 m headline length and 4.5 cm diamond mesh cod-ends). To maintain consistent ground coverage skippers were asked to maintain a speed of ~3 knots. This was not always possible due to variations in tidal currents. Accordingly, the positions of the start and end points of each shot were recorded on a GPS plotter to provide accurate measures of trawl distance.

One level fish bin (~68 L) of homogenised catch was retained and frozen from a single trawl net at each sampling site. All large sharks and rays (>0.5 m length/width) and sponges (generally >2-3 kg) that could not be effectively sub-sampled in each fish bin were individually measured or weighed before being returned to the water. Large sharks/rays were identified by observers and/or photograph records. Large sponges were identified by cutting small sub-samples for laboratory processing. The remaining catch was then placed into fish bins to estimate the total catch for the shot, before being processed by the crew; with commercial sized prawns and by-product removed and the by-catch discarded overboard.

2.3. Laboratory processing

Each sample was sorted into component taxa (i.e. fish, invertebrates, seagrass and algae) in the laboratory before identification of individual species. Individuals were counted, measured and weighed. Length measurements were taken to the nearest mm, while weight was recorded to the nearest 10 g. Individuals weighing fewer than 10 g were recorded as <10 g. During this process, fragments of the same non-unitary organism (e.g. colonial ascidians and plants) were consolidated and collectively weighed and counted as a single entity. For abundant species (excluding prawns and blue crabs) the first approximately 50 individuals encountered for the whole study had their length and weight recorded. Within each shot, counts of these abundant species were calculated by weighing the first 50 individuals and then extrapolating this count using the total weight (i.e. Total Count = Total Weight/(Weight of Sub-sample/Count of Sub-sample)).

Detailed information for each species is provided in Appendix 5, including:

- a photograph (taken in the laboratory where possible), taxonomic classification and common name(s),
- a map of its spatial distribution, list of sites captured, and depth and size range of capture
- average biomass, rank biomass, average abundance and rank abundance.

Classification to phyla level followed the methods of Currie *et al.* (2009). While Urochordata has traditionally been considered a sub-phylum of Chordata, some taxonomists now consider it to be a unique phylum. For the purpose of this report Chordata (fish) and Urochordata (tunicates) are considered separate phyla.

2.4. Quality assurance

A relational MS Access database was constructed to archive all data obtained during the by-catch survey. This database is presently held on the PIRSA server at \\cluscbdfs02\user26\Wild Fisheries\Prawns\SpencerGulfPrawn\bycatch\Bycatch Survey 2013\Database, and includes three primary tables:

Vessel - information related to each trawl shot position and duration.

Species - identification codes and taxonomic nomenclature for each organism.

Laboratory - individual measurement for all sub-samples processed in the laboratory.

In an effort to limit errors in this database, an intensive cross-validation procedure was applied. A detailed account of all quality assurance procedures undertaken during this process is provided in Appendix 1.

2.5. Data standardisation

Prior to all analyses, species abundance and biomass measures were standardised as either number (n) or weight (g) per area trawled (hectares, ha). The area A swept by each shot was estimated as follows:

$$A = (H * S * D) / 10{,}000$$

where H was the headline length of the net (i.e. 14.63 = 0.5*29.26 m (maximum permissible headline length for a double otter-trawl configuration)), S was the net spread factor (i.e. 0.75 constant used from Carrick, 1996) and D (m) was the distance trawled. Division by 10,000 converts the area from square meters to hectares.

By-catch ratios were calculated as the sum of the standardised weight of by-catch divided by the sum of the standardised weight of prawns.

Due to the uncertainty associated with scaling up individuals at low abundance, standardised data are only presented down to the phyla level and for the 20 most abundant species. Syngnathid data are also presented as unstandardised abundance.

2.6. Environmental parameters

Temperature-depth profiles were recorded at each sampling site using data loggers attached to the otter boards of the trawl gear. Where loggers failed or data were lost (i.e. two vessels) the linear relationship between the 2007 and 2013 data at each site was used to estimate 2013 values (Depth: y = 0.99X + 0.43, R^2 = 0.98; Temperature: y = 0.53X + 9.75, R^2 = 0.83).

Distance from the top of the Gulf (TOG) was calculated for each site as the straight line distance from Port Augusta, which was later used to classify each site into four spatial regions (Figure 3).

Sites were also spatially classified into eastern or western side of the Gulf, by visually assigning each fishing blocks as either east or west (Appendix 2, Figure 3).

2.7. Trawling history

For 1987 to 2012, the annual number of hours fished in each of 119 reporting blocks (each 29 to 1031 km^2) was estimated from trawling effort data (hours fished per day per fisher) provided by licence holders to SARDI Aquatic Sciences. These data were standardised by the area of the reporting block (km^2) and averaged over five, 5-year periods (1988-1992, 1993-1997, 1998-2002, 2003-2007, 2008-2012).

As the abundant species caught in Spencer Gulf are relatively short-lived (<5 years) and spawn annually (i.e. prawns, crabs, small fish), levels of prawn trawling effort over a 5-year period associated with each survey were used to assign reporting blocks to categories of high (>10 hours per km^2), moderate (1-10 hours per km^2) and low trawling effort (<1 hour per km^2) for each survey (Appendix 3). As there were relatively few areas with zero trawling effort (Appendix 3), these areas were included in the low trawl effort category.

2.8. Data analysis

Spearman's rank correlation coefficients were determined using the host of non-categorical environmental parameters and catch data (i.e. total species richness, abundance and biomass) collected at each trawl site, to examine bio-physical associations among these variables.

Two-way analysis of variance (ANOVA) was used to test differences in total species richness, abundance and biomass of captured organisms across the trawl intensity categories (low, moderate and high) and the two survey years (2007 and 2013). Two-way ANOVAs (trawl intensity × year) were also used to test differences in abundance and biomass for each phylum and for the 20 most abundant species caught in each survey year, as well as the by-product species Southern Calamari and slipper lobsters. These tests were not applied to the majority of other taxa due to their low and variable densities. Type III Sum of Squares were computed as recommend for studies with unbalanced designs (Shaw and Mitchell-Olds, 1993). Where significant effects were detected post-hoc Student–Newman–Keuls (SNK) pairwise comparisons were used to examine differences. Prior to conducting all ANOVAs the assumption of normality was examined using quartile-quartile plots and homogeneity of variance was tested using Levene’s test. Where possible deviations from normality and heterogeneity were removed using $\log_{10}(x+1)$ transformations. In some instances assumptions of normality and homogeneity could not be met, nonetheless for experiments with large numbers of replicate samples, ANOVA are generally robust to any violations of these assumptions (Underwood, 1997).

The computer package PRIMER and PERMANOVA+ was used to undertake all multivariate analyses (Clarke and Gorley, 2001; Anderson *et al.*, 2008). Variations in community structure between the trawl sites from 2007 and 2013 were examined using Bray-Curtis (B-C) dissimilarity measures (Bray and Curtis, 1957). This dissimilarity measure was chosen because it is not affected by joint absences, and it has consistently performed well in preserving ecological distance in a variety of simulations on different types of data (Field *et al*., 1982; Faith *et al*., 1987). Single square-root transformations were applied to the data before calculating the B-C dissimilarity measures to prevent the small number of abundant species from disproportionately influencing the dissimilarity measures (Clarke, 1993).

Distance-based linear models (DSITLM) and distance-based redundancy analysis (dbRDA) were used to investigate how the environmental variables (temperature, depth), spatial variables (distance from TOG, side of Gulf, latitude and longitude), fishing effort (trawl intensity (hours per km^2)) and time (year) impacted the overall B-C community structure (Anderson *et al.*, 2008). DISTLM partitions variation in the multivariate data cloud resulting from the predictor variables incorporated into a model. Predictor variables were either continuous (temperature, depth, distance from TOG, start latitude, start longitude and trawl intensity as hours per km^2) or categorical (side of Gulf and year). Categories representing the predictor variables were then superimposed on dbRDA plots for the variables explaining the largest proportion of variation on each of the two principal co-ordinates (PCO) axes (i.e. distance from TOG and depth). Other predictor variables of interest were also superimposed to provide a visual indication of their effect on the principal axes (i.e. trawl intensity, side of Gulf and year). Temperature and start longitude are not displayed. Draftsmans plots were used to examine predictor variables for highly significant correlations, curvilinear correlations or any skewness. Start latitude was excluded from the analysis owing to its high correlation with distance from TOG (>0.95) (Anderson *et al*., 2008). Trawl intensity (log (x+1)), distance from TOG (SQRT) and depth (SQRT) were transformed to correct for skewness. Temperature and start longitude were not transformed. Numerous others predictors had moderate to high correlations, but were retained in the analyses. Backward selection was utilised, which is preferable when correlations exist between predictor variables (Tuck and Hewitt, 2013). Backward selection starts with a full model containing all variables, and then sequentially removes those which result in the greatest improvement to the model. Adjusted R^2 values were used, which account for the number of terms in the model.

The same DISTLM and dbRDA procedure was used to examine the influences of the predictor variables on the four key trophic groupings (i.e. fish, motile invertebrates, sessile invertebrates and plants/algae). dbRDA plots were then overlaid with categories representing the predictor variables driving the largest proportion of variation on each of the two PCO axes.

To re-examine the strong latitudinal structuring of benthos initially found in 2007 non-metric multidimensional scaling (MDS) was used to group sites according to their B-C community composition. This was complimented by a similarity percentage test (SIMPER) to determine those species contributing most to within- and among-site groupings for each of the four regions.

It should be noted that all 45 records of organisms that could only be identified to phyla level in 2013 (or broader taxonomic classification) (Appendix 1) were removed prior to any multivariate analysis, due to potentially confounding effects. These unidentified organisms constituted only ~0.1% of total abundance and ~1% of total biomass in 2013.

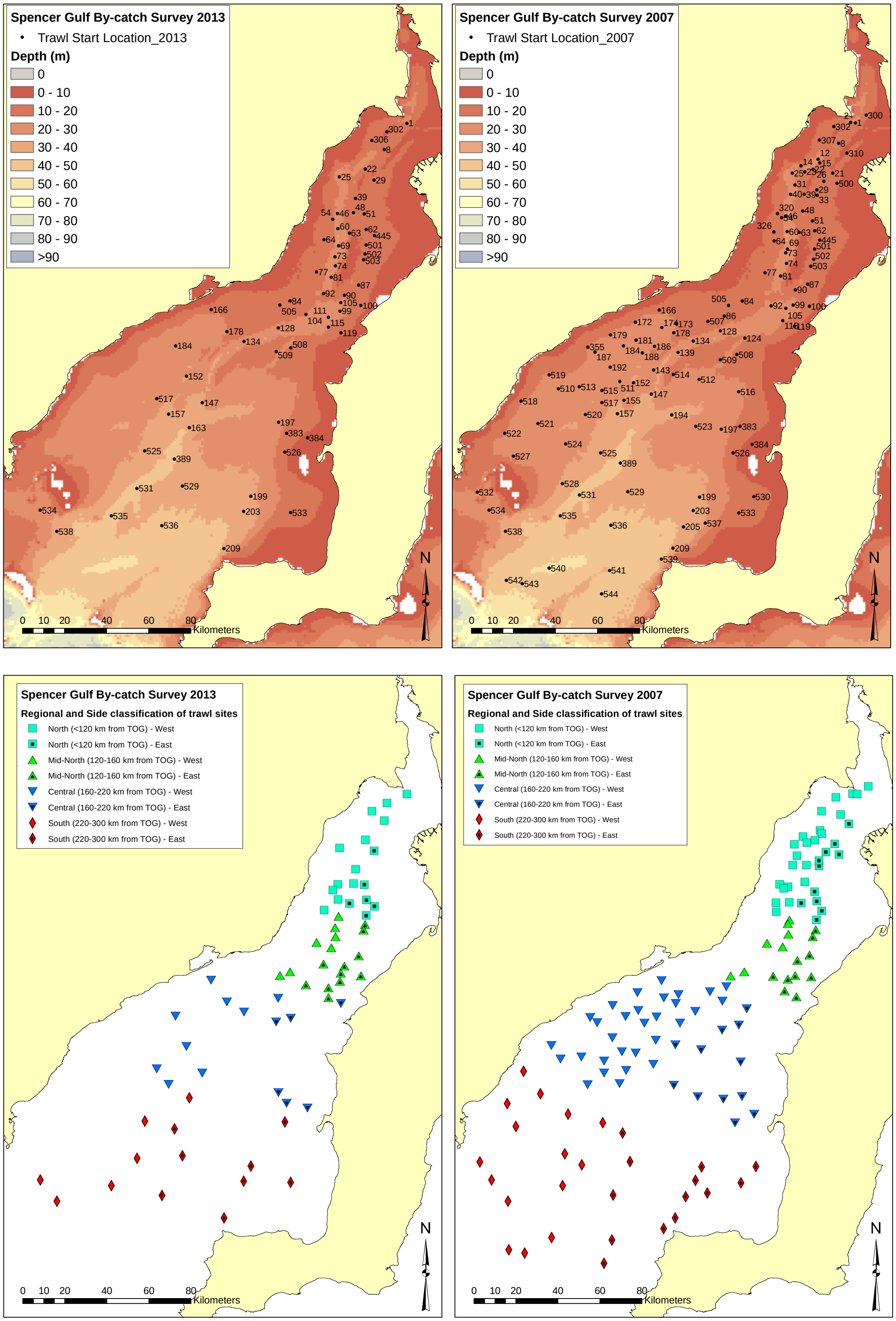

Figure 3. Above - Bathymetric map of the Spencer Gulf showing the locations (small filled circles) of trawl sites sampled in February 2013 (n = 65) and 2007 (n = 120). Below - Map of Spencer Gulf showing classification of trawl sites by Region and Side in 2013 (n = 65) and 2007 (n = 120). TOG = top of Gulf.

3. RESULTS

3.1. Environmental parameters

Average sea surface temperature was 22.93±0.10°C for the northern region (i.e. from 18 sites <120 km from TOG) and 21.61±0.14°C for the southern region (i.e. from 14 sites >220 km from TOG). Bottom water temperature was 22.77±0.11°C in the northern region and 21.47±0.10°C in the southern region. Mean bottom temperature across the 65 sites was 22.19±0.07°C, which was cooler than a mean value of 23.03±0.10°C recorded in 2007. Depths trawled during the 2013 survey ranged from 16 to 45 m.

3.2. Trawling history

Trawling effort has been concentrated in similar areas of Spencer Gulf since at least 1987 (Figure 4). High intensity trawling (>10 hours per km^2) has consistently occurred in the near-shore waters off Wallaroo (i.e. blocks 43 and 44) and around Middlebank (i.e. blocks 31 and 36). Several blocks surrounding these areas and extending along the main channel to the south (42, 51, 52 and 64) also consistently support moderate levels of trawling effort (1-10 hours per km^2). In contrast, most blocks situated near the coast, or in the southern reaches of the Gulf, consistently experience low levels of trawling (0-1 hours per km^2). The concentration of effort has remained relatively stable during the two periods considered for this study (i.e. 2003-2007 and 2008-2012). Patterns of trawl effort decreased in a number of northern fishery reporting blocks from 1988 to 2003, however, this trend stabilised during the 2003-2007 and 2008-2012 periods.

Fisheries statistics indicate the distribution of catch relative to trawl intensity was similar from 2003-07 to 2008-12 (Table 1). Catch of prawns in Spencer Gulf is concentrated in areas of moderate-to-high trawl intensity. In 2008-2012, >90% of catch was taken from moderate-to-high trawling areas, which comprised <17% of entire Gulf waters. The actual area fished within many blocks is also much less than the total block area used in calculations for Table 1.

The survey design was changed from 2007 to 2013 to include fewer sites in low intensity trawl areas (Table 1). Of the 65 sites surveyed in 2013, 10 were located in areas of high trawl intensity, 23 were located in areas of moderate trawl intensity and 32 were located in areas of low trawl intensity. In comparison, during the 2007 survey of the 120 sites surveyed, 10 were located in areas of high trawl intensity, 27 were located in areas of moderate trawl intensity and 83 were located in areas of low trawl intensity.

Table 1. Survey and fishery statistics for high, moderate and low intensity fishing blocks from 2008-2012 (2003-2007 values are listed in brackets).

Intensity	No. of blocks	No. of Survey Sites	Proportion of total area	Proportion of commercial effort	Proportion of commercial catch
High	7 (6)	10 (10)	2.8% (2.4%)	46.8% (41.5%)	52.1% (47.5%)
Moderate	23 (27)	23 (27)	13.7% (16.1%)	39.8% (48.7%)	38.1% (45.5%)
Low	95 (92)	32 (83)	83.5% (81.5 %)	13.4% (9.8%)	9.7% (7%)

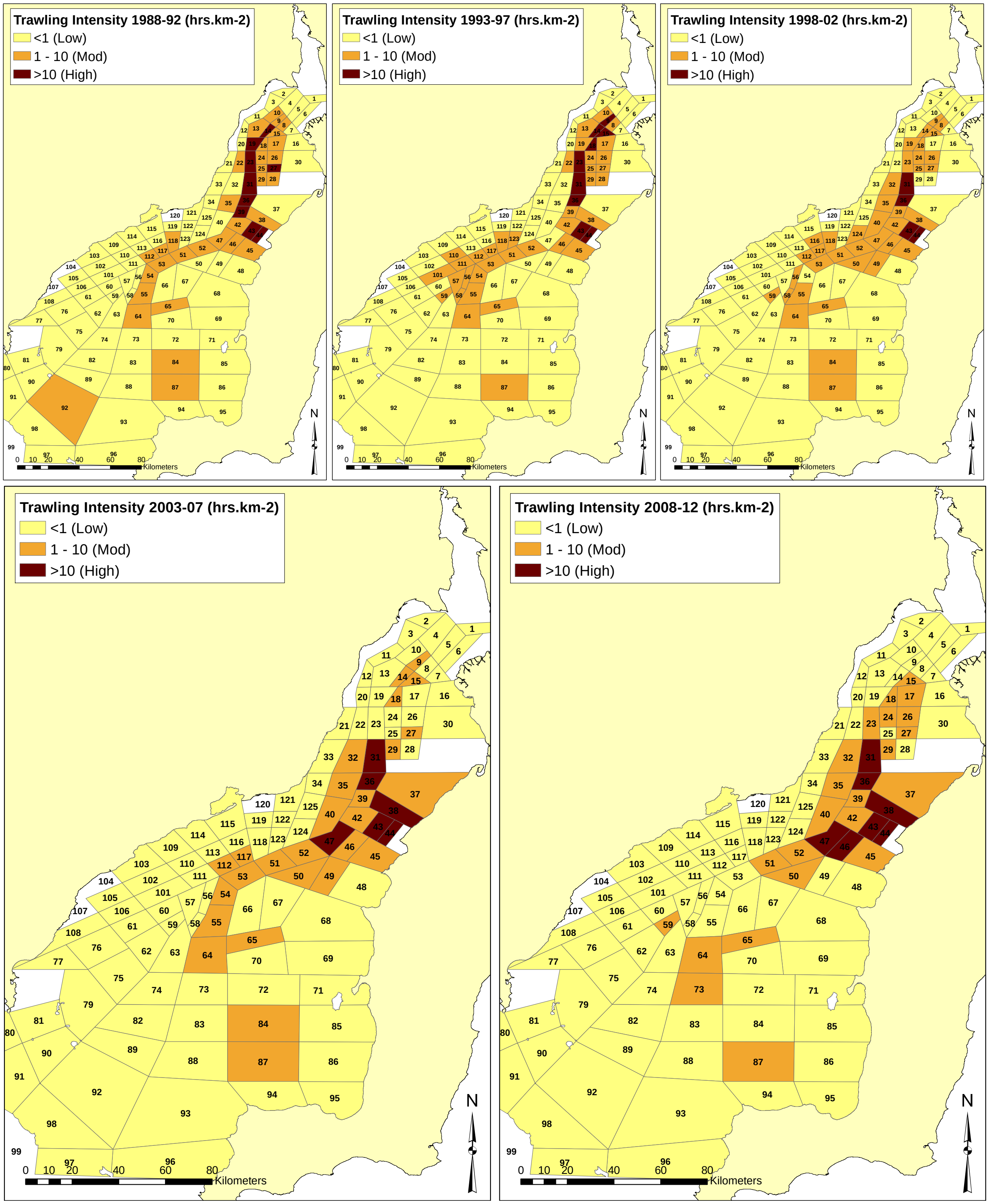

Figure 4. Map of mean (5-year average) prawn trawling effort (hours fished / km^2) reported for 125 fishing bocks in Spencer Gulf between 1988 and 2012.

3.3. Species composition and spatial distribution

3.3.1 Captured species

A total of 2.5 t (fish bin units plus excess weights) of catch samples were collected and processed from 65 sites in 2013, constituting almost half (~44%) of the total catch after scaling (5.6 t). From this, 286 species from 13 phyla were recorded, including Chordata (fish), Crustacea, Porifera (sponges), Mollusca (squid, snails and bivalves), Chlorophyta (green algae), Phaeophyta (brown algae), Rhodophyta (red algae), Magnoliophyta (seagrasses), Bryozoa (bryozoans and lace corals), Urochordata (tunicates/ascidians), Cnidaria (soft corals, hydroids and jellyfish), Echinodermata (sea stars, sea urchins and sea cucumbers) and Sipuncula (peanut worms).

3.3.2 By-catch to prawn ratio

The by-catch to prawn ratio was 4.7:1 across the 65 sites surveyed, in comparison to 6.0:1 when the survey was undertaken in 2007. Direct comparisons across all sites can be misleading as a greater proportion of sites in 2013 were from areas subjected to moderate-to-high trawl intensity. The by-catch to prawn ratio at high intensity trawling sites was 4.9:1 in 2013 (n = 10), compared to 2.0:1 in 2007 (n = 10). At moderate intensity trawling sites the ratio was 5.3:1 in 2013 (n = 23), compared to 3.2:1 in 2007 (n = 27). At low intensity trawling sites the ratio was 4.1:1 in 2013 (n = 32), compared to 8.7:1 in 2007 (n = 83). Increases in the by-catch ratio at moderate-to-high intensity trawl sites reflect lower prawn catch during the 2013 survey rather than greater by-catch (Figure 6), while decreases at low intensity sites reflect a reduction in fish by-catch from these areas of the Gulf (Figure 9).

3.4. Relationship with trawl effort history and environmental parameters

3.4.1 Species richness, abundance and biomass

In general, abundance and biomass of total catch decreased in the southern half of Spencer Gulf in 2013 (Figure 5). This contrasted with the results from the 2007 study, where a number of central and southern sites, in particular those along the western side of the Gulf, supported high levels of abundance and biomass. Abundance and biomass remained lowest in the south-eastern section of the Gulf, consistent with the 2007 survey.

Distributional patterns of abundance and biomass were broadly similar to one another in 2013 (Figure 5), which resulted in a strong correlation between these two variables (Table 2). Abundance and biomass were also correlated with the same three physical parameters (distance from TOG, temperature and latitude), which themselves were also highly correlated. Contrastingly, in 2007 only abundance was correlated with these three variables, and the strength of the association between abundance/biomass and these three variables was much weaker. In 2013, biomass was also correlated with longitude. Species richness was not associated with any other variables, unlike 2007 where a negative association was detected with abundance and biomass. Similarly to 2007, depth had no association with any of the biological response variables (i.e. richness, abundance or biomass).

When sites were categorised by trawl intensity, species richness was consistent between 2007 and 2013, with a slightly greater number of species observed in areas subjected to low trawl intensity (~39 per hectare), compared to areas subjected to high trawl intensity (~34-36 per hectare) during both surveys (Figure 6). Nonetheless, these differences in species richness were not statistically significant for either trawl intensity or survey year (Table 3).

Mean abundance (670 vs. 1326 individuals per hectare) and biomass (~26 kg vs. ~40 kg per hectare) were lower in 2013 compared to 2007 (Figure 6). In 2007, exceptionally high abundances and biomasses occurred at a small number of sites, whereas in 2013 fewer large catches were recorded. These exceptionally high catches in 2007 occurred in low-to-moderate trawling areas, contributing to the pattern of lower abundance and biomass at high intensity sites. In contrast, there was no consistent pattern between trawl intensity and abundance or biomass in 2013. Despite varying patterns in mean abundance and biomass across the two surveys, these differences were not statistically significant for either trawl intensity or survey year (Table 3).

Table 2. Spearman's rank correlation coefficients between depth, latitude, longitude, distance from top of Gulf (TOG), bottom temperature, abundance, biomass and species richness in 2008-2012 (n = 65). Correlations from 2003-2007 are listed in brackets (n = 120). Significant correlations are denoted at $*p < 0.05$ and $** \ p < 0.01$.

	Depth	Latitude	Longitude	Distance	Temperature	Abundance	Biomass
Depth	-	-	-	-	-	-	-
Start latitude	-0.593**						
	(-0.658**)	-	-	-	-	-	-
Start longitude	-0.662**	0.859**					
	(-0.630**)	(0.832**)	-	-	-	-	-
Distance from TOG	0.606**	-0.995**	-0.893**				
	(0.659**)	(-0.992**)	(-0.879**)	-	-	-	-
Bottom temperature	-0.580**	0.949**	0.760**	-0.935**			
	(-0.584**)	(0.863**)	(0.683**)	(-0.851**)	-	-	-
Abundance	0.086	0.426**	0.228	-0.418**	0.410**		
	(-0.096)	(0.304**)	(0.076)	(-0.280**)	(0.226*)	-	-
Biomass	-0.175	0.530**	0.353**	-0.515**	0.503**	0.768**	
	(-0.025)	(0.142)	(0.013)	(-0.12)	(0.127)	(0.783**)	-
Richness	0.132	-0.195	-0.127	0.182	-0.222	0.024	-0.009
	(-0.03)	(-0.152)	(0.057)	(0.12)	(-0.153)	(-0.457**)	(-0.247**)

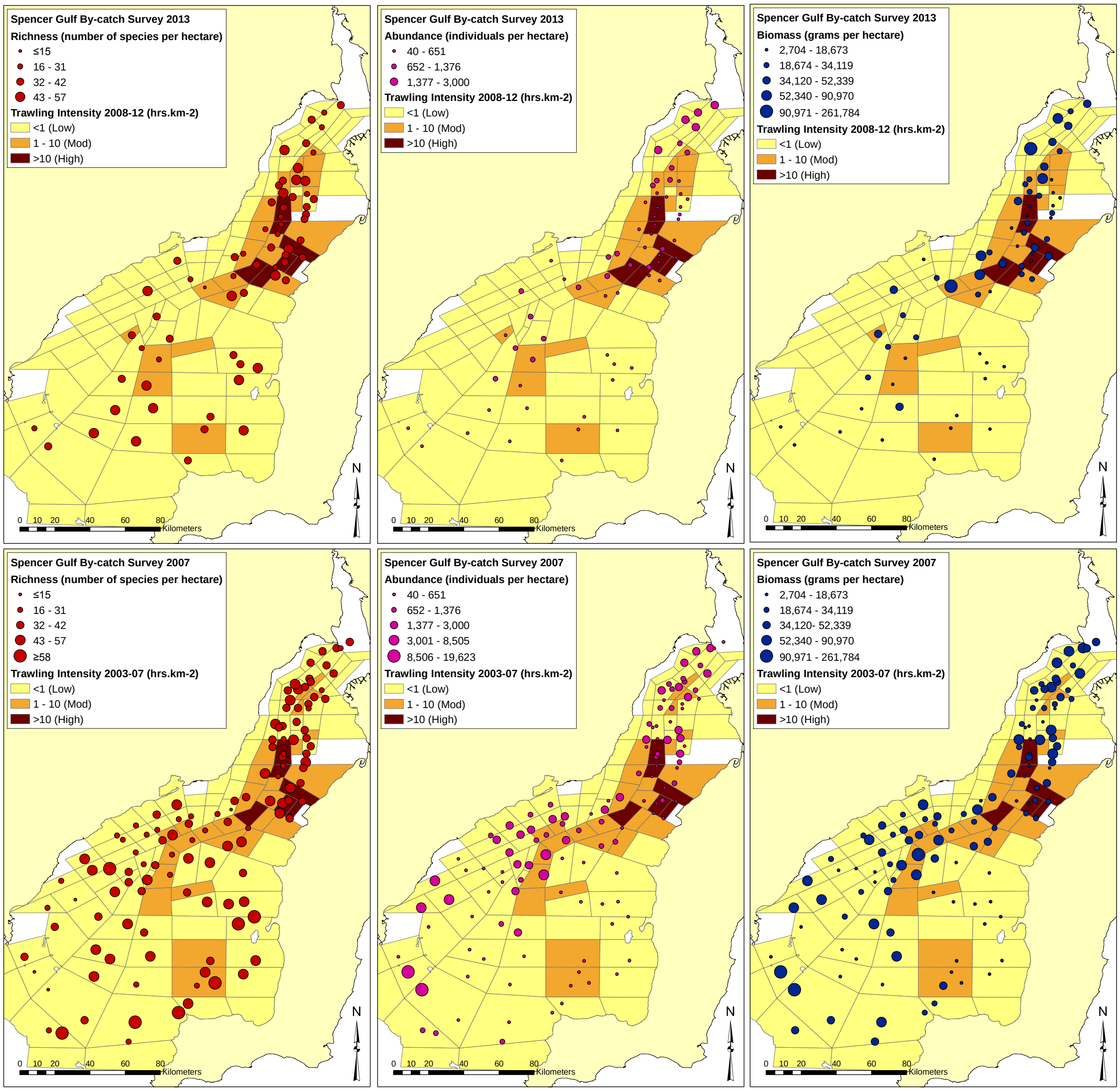

Figure 5. Bubble plots of species richness, abundance and biomass at all trawl sites surveyed in the Spencer Gulf during February 2013 (n = 65) and 2007 (n = 120). Values are overlayed on a map of mean prawn trawling effort (hours fished / km^2) for each fishing block during the 5-year period associated with each survey.

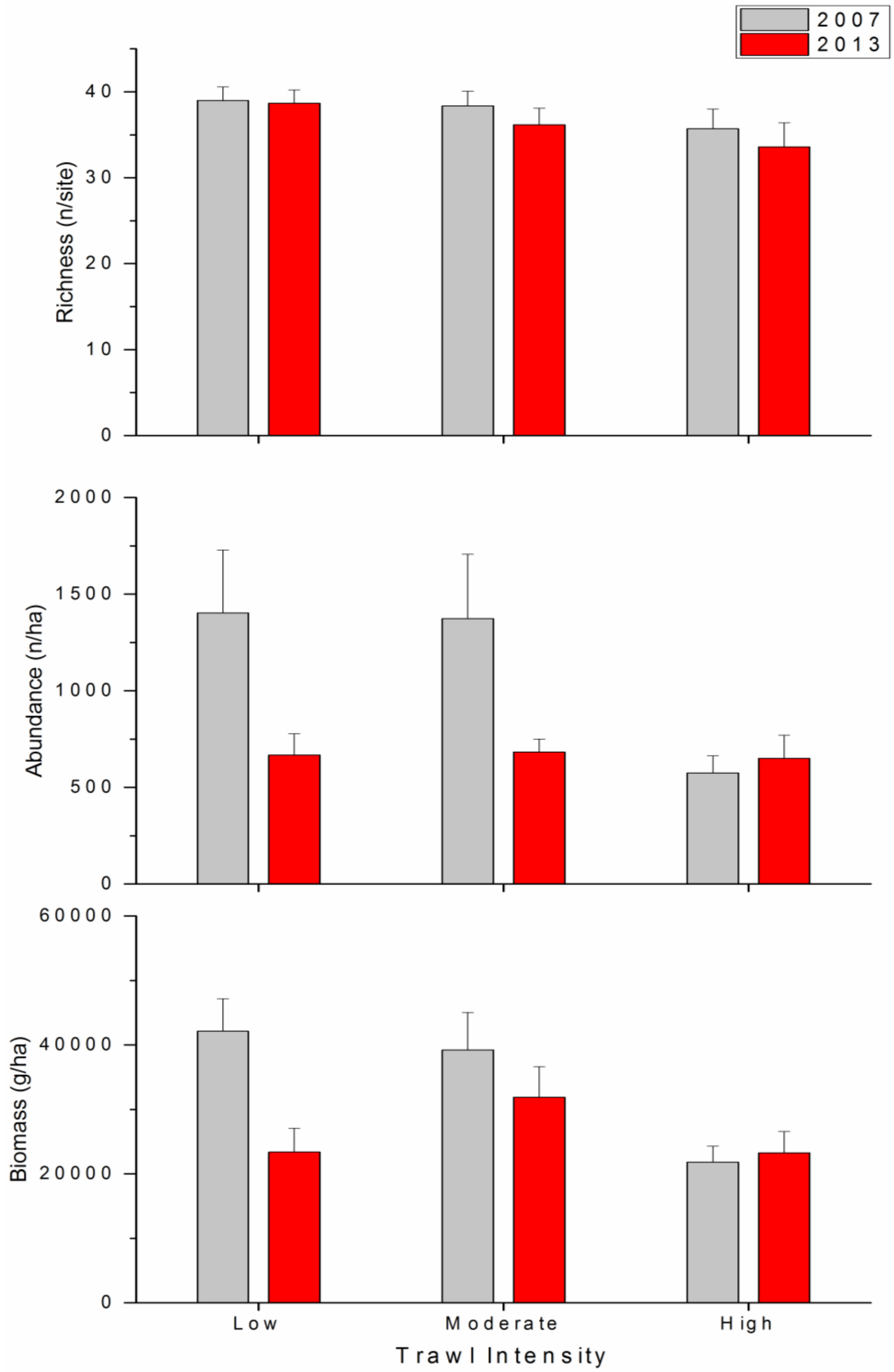

Figure 6. Bar graphs showing mean (+ s.e) species richness (per site), abundance and biomass of total catch collected from three areas of the Spencer Gulf subject to low (<1 hour trawling per km^2; n = 83 (2007), n = 32 (2013)), moderate (1-10 hours trawling per km^2; n = 27 (2007), n = 23 (2013)) and high levels (>10 hours trawling per km^2; n = 10 (2007), n = 10 (2013)) of prawn trawling effort over the 5-year period associated with each survey (i.e. 2003-2007 and 2008-2012).

Table 3. Results of two-way ANOVA on differences in species richness, abundance and biomass across areas of the Spencer Gulf subject to different trawl intensity (low, moderate and high for the 5-year period associated with each survey) and two different years (2007 and 2013). Abundance and biomass were $\log_{10}(x + 1)$ transformed prior to analyses.

Dependent	Source	Sum of Squares	df	Mean Square	F	*p*
Richness	Intensity	307.54	2	153.77	1.11	0.33
	Year	65.80	1	65.80	0.48	0.49
	Intensity × Year	33.99	2	16.99	0.12	0.88
	Within Groups	24703.27	179	138.01		
	Total	292491.00	185			
Abundance	Intensity	0.85	2	0.42	2.24	0.109
	Year	0.35	1	0.35	1.85	0.176
	Intensity × Year	0.27	2	0.13	0.71	0.494
	Within Groups	33.89	179	0.19		
	Total	1473.28	185			
Biomass	Intensity	0.53	2	0.27	2.49	0.086
	Year	0.33	1	0.33	3.10	0.080
	Intensity × Year	0.46	2	0.23	2.16	0.119
	Within Groups	19.23	179	0.11		
	Total	3617.91	185			

3.4.2 Community structure

All seven predictor variables explained a significant proportion of the overall variation in the by-catch community when fitted to the model independently (i.e. p <0.001) (Table 4). The greatest proportion of variation was generally explained by the environmental and spatial predictor variables (distance from TOG, longitude, depth and temperature), ranging between 9-14%. This is expected given these variables all display some degree of correlation and were initially fitted independently to the model. The degree of variation explained by trawl intensity (hours per km^2), year (2007 vs. 2013) and side of Gulf (east vs. west) were much smaller in comparison, ranging between 2-4% when all variables were fitted independently. When all predictors were incorporated into the model sequentially, 27% (adjusted R^2 = 0.27) of the total variation was explained.

The primary axis in the dbRDA explained 14.5% of total variation and ~49% of the fitted variation (Figure 7a). The primary predictor of this variation was distance from TOG, indicated by the length of this vector relative to the x-axis of the dbRDA plots. The secondary axis in the dbRDA explained 6.5% of total variation and ~22% of the fitted variation. The primary predictor of this variation was depth, as indicated by the length of this vector relative to the y-axis. Trawl intensity, side of Gulf and year all explained a much smaller component of the variation along these primary axes, indicated by the relatively shorter length of each of these three vectors.

Superimposed categorical variables provide an indication of how each predictor variable relates to the primary PCO axes (Figure 7b-f). The distinct spatial separation for distance from TOG (indicated by region) and depth (indicated by 10 m bins) reflect their large relative contribution to the overall variation in by-catch community structure. In contrast, the overlapping and less distinct separation for trawl intensity, year and side of Gulf reflect their relatively minor contribution to the overall community structure.

Table 4. Above - Independent marginal tests of predictor variables for the distance based linear model (DISTLM) for the by-catch community. Below - Best result for the inclusion of each additional variable in the DISTLM using backward selection.

Predictor variable	Sum of Squares	F	*p*	Proportion of variation
Year	10991	4.44	0.001	0.02
Distance from TOG	63992	29.29	0.001	0.14
Trawl intensity	19298	7.95	0.001	0.04
Side of Gulf	15180	6.19	0.001	0.03
Temperature	42416	18.42	0.001	0.09
Depth	45846	20.07	0.001	0.10
Start longitude	50594	22.41	0.001	0.11

Predictor variable	No Variables	Cumulative variation	Adjusted R^2
Distance from TOG	1	0.14	0.13
+ Depth	2	0.19	0.19
+ Trawl intensity	3	0.23	0.21
+ Start longitude	4	0.26	0.24
+ Year	5	0.28	0.26
+ Temperature	6	0.29	0.27
+ Side of Gulf	7	0.30	0.27

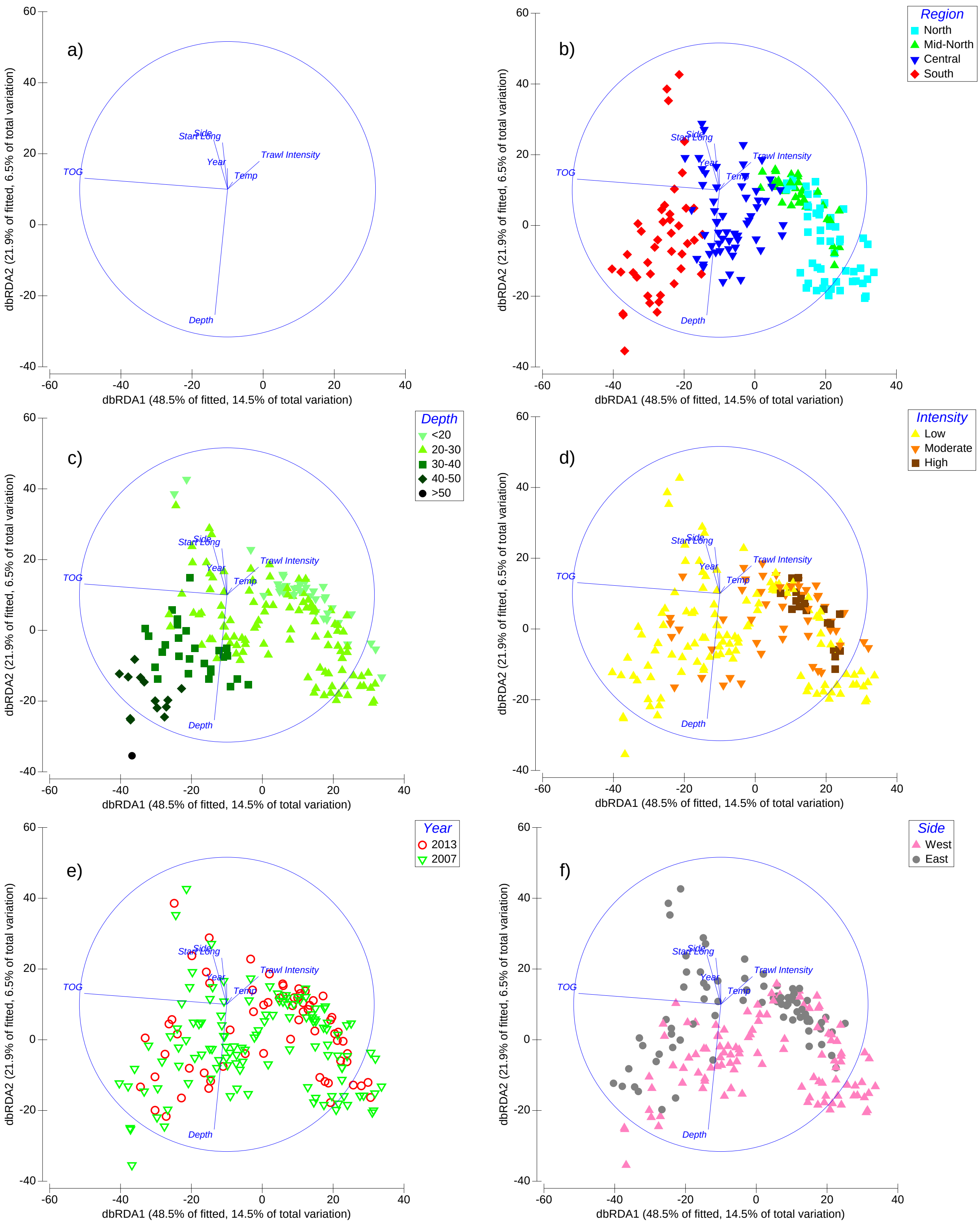

Figure 7. dbRDA plots of overall by-catch community. Superimposed symbols represent categorical variables associated with b) distance from TOG (Regions: North, Mid-North, Central and South), c) depth (<20m, 20-30m, 30-40m, 40-50m and >50m), d) trawl intensity (low, moderate and high), e) year (2013 and 2007) and f) side of Gulf (East and West).

3.4.3 Taxonomic groups

In 2013, Chordata (fish) and Crustacea (principally prawns and crabs) were the dominant phyla in terms of abundance, both independently accounting for ≥45% of the standardised catch (Figure 8). This contrasted with the 2007 results, where Chordata alone accounted for 68% of the standardised catch and Crustacea 28%. All other phyla collected constituted a minor component of the total abundance. The most abundant of these minor phyla in both surveys was Mollusca, which accounted for 5% and 3% of the abundance in 2013 and 2007, respectively.

Crustacea dominated the biomass in 2013 (Figure 8), accounting for just under half (48%) of the total biomass. Mean biomass of Crustacea was consistent between 2007 and 2013 (~13 kg ha^{-1} during both surveys). Chordata biomass decreased between the two surveys, constituting only 31% of total biomass in 2013 (~8 kg ha^{-1}) compared to 51% in 2007 (~20 kg ha^{-1}). Porifera accounted for 10% of biomass in both 2013 (~3 kg ha^{-1}) and 2007 (~4 kg ha^{-1}). All other phyla collected constituted a minor component of the total biomass. The most substantial of these minor phyla was Mollusca, which accounted for 3% of biomass (~1 kg ha^{-1}) in both surveys.

Species richness was similar between the 2013 and 2007 surveys (Figure 8). Chordata was the best represented phyla in both surveys, followed by Crustacea, Mollusca and Porifera.

When trawl intensity was taken into account (two-way ANOVA) lower abundances of Porifera were recorded in heavily trawled areas (Table 5, Figure A.4.1). In addition, the biomasses of both Porifera and Bryozoa were significantly lower in intensely trawled areas. Chordata did not vary in either abundance or biomass across areas of different trawl intensity (Tables 5-6, Figures A.4.1-A.4.2). In contrast, the abundances and/or biomasses of Crustacea, Magnoliphyta, Mollusca and Rhodophyta were significantly greater in moderate-to-high trawl intensity areas (Tables 5-6, Figures A.4.1-A.4.2).

When year was taken into account (two-way ANOVA) the biomass of Chordata was lower in 2013. There were few other changes among the most common phyla between 2007 and 2013 (i.e. Crustacea, Porifera and Mollusca), whereas some of the less common phyla increased (i.e. Magnoliphyta and Phaeophyta) or decreased (i.e. Chlorophyta, Echinodermata and Urochordata) in either abundance and/or biomass from 2007 to 2013. Bubble plots with graduated symbols (Figure 9) display the decrease in abundance (non-significant) and biomass (significant) of Chordata from 2007 to 2013. In particular, the southern (often low intensity sites) saw a large decrease in the biomass of fish from 2007 to 2013, albeit no statistical interaction occurred between trawl intensity and year, suggesting this effect was homogenous across all trawl intensities. This change in Chordata from 2007 to 2013 explains a major part of the decreasing pattern in overall abundance/biomass shown in Figure 6.

Only one interaction was evident between trawl intensity and year (Chlorophyta biomass; see footnote Table 6), indicating the effect of trawl intensity as a function of time on abundance and biomass of most phyla was stable.

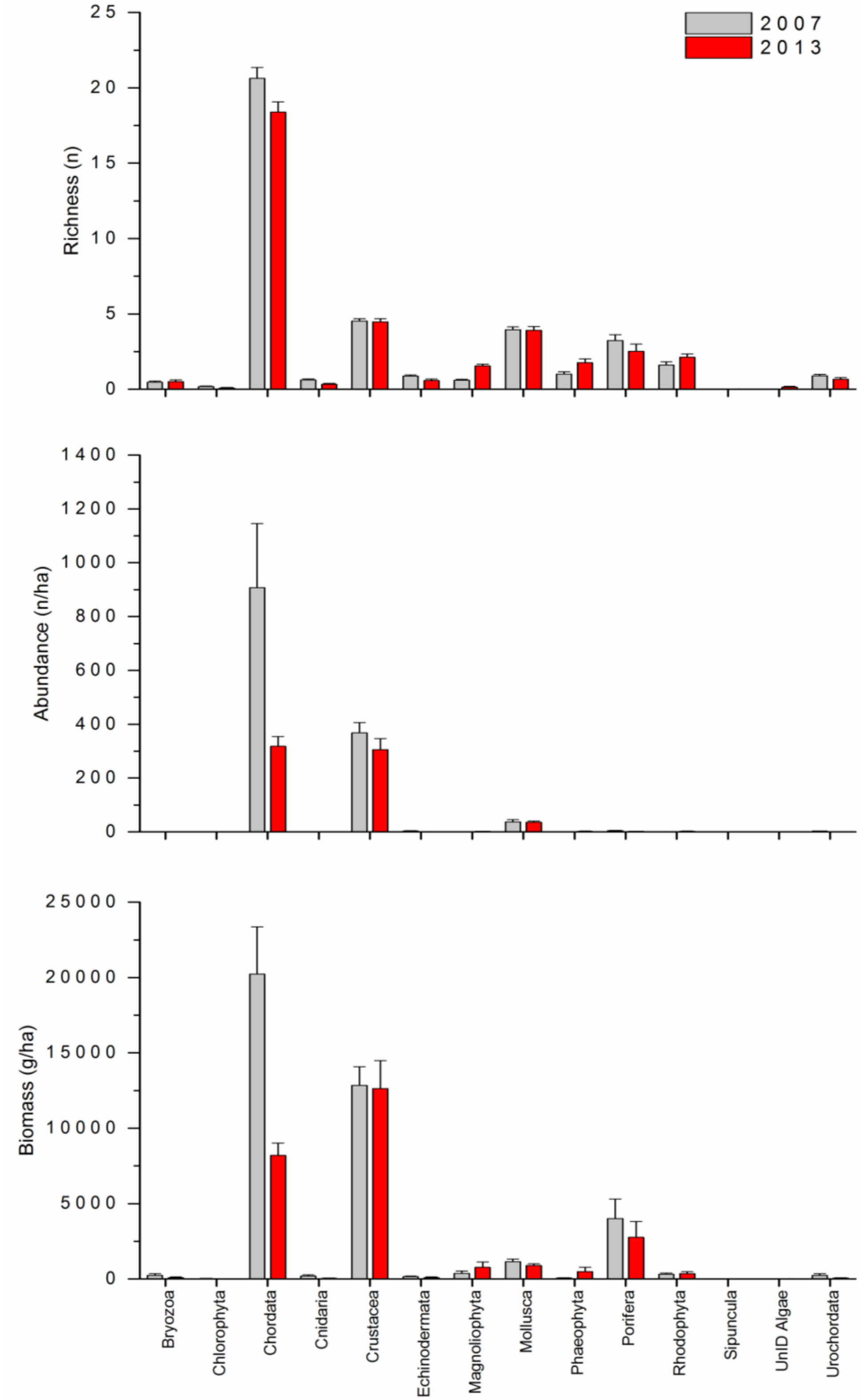

Figure 8. Bar graphs showing mean (+ s.e) for species richness, abundance and biomass of each major phyla collected from trawl samples in Spencer Gulf during February 2013 (n = 65) and 2007 (n = 120).

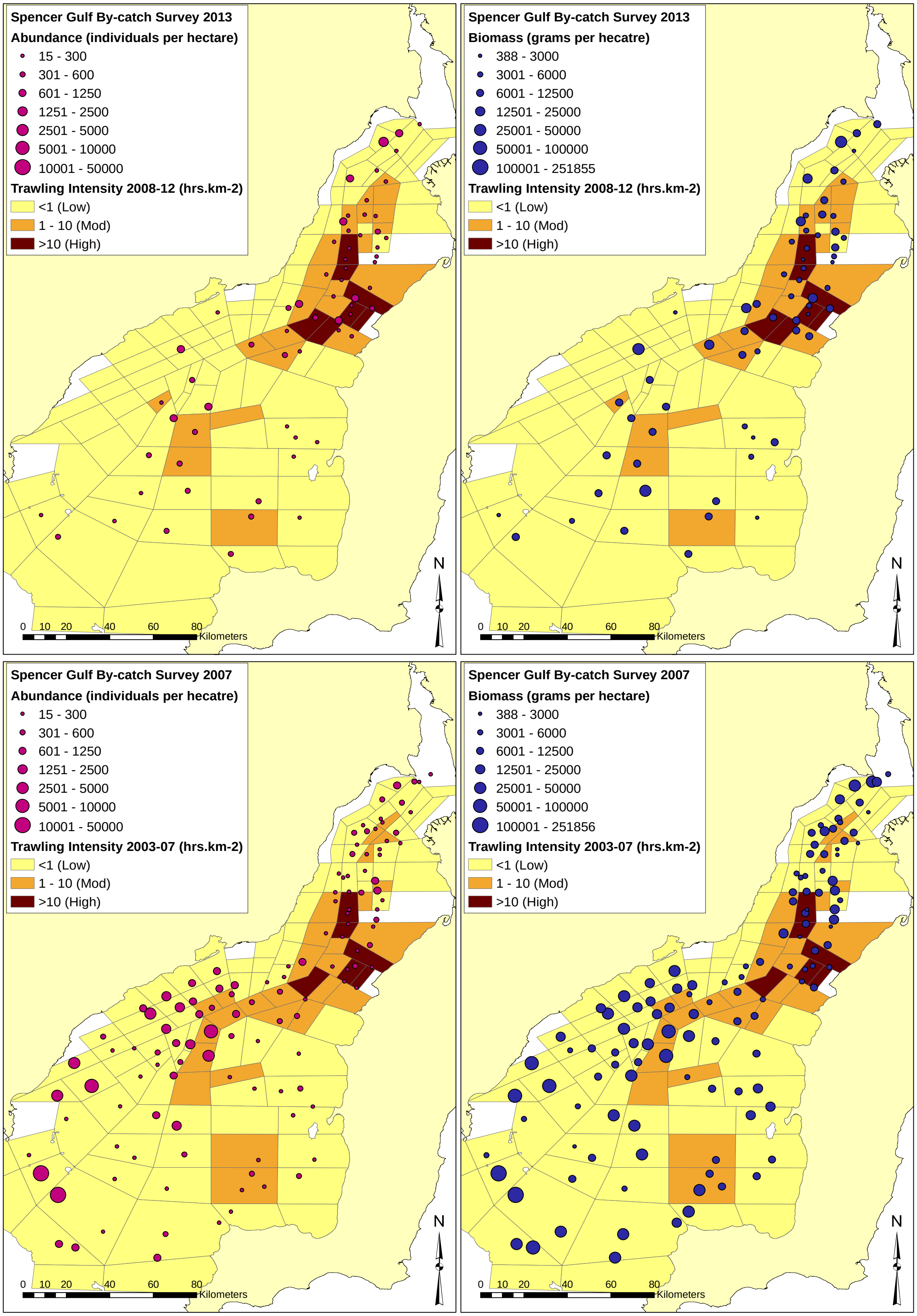

Figure 9. Bubble plots of fish abundance and biomass collected from trawl samples in Spencer Gulf during February 2013 (n = 65) and 2007 (n = 120).

Table 5. Results of two-way ANOVA (trawl intensity × year) for differences in abundance of catch grouped by phylum. Phyla that display significant (p < 0.05) differences are highlighted in bold. Homogeneous groups of means identified from *post hoc* SNK tests are highlighted by similar shades of grey backfill or boxes. Note mean values displayed have been back-transformed from $\log_{10}(x+1)$ to aid interpretation (Plots of mean + se prior to back transformation are included in Appendix 4).

Phylum	Year	Trawl Intensity			ANOVA		
		Low (n/ha)	Mod (n/ha)	High (n/ha)	Year (F, p)	Intensity (F, p)	Year x Intensity (F, p)
Bryozoa	2013	0.36	0.28	0.48	2.924, 0.089	1.953, 0.145	1.815, 0.166
	2007	0.42	0.10	0.04			
Chlorophyta	2013	0.06	0	0.09	**7.587, 0.006**	1.713, 0.183	1.818, 0.165
	2007	0.09	0.17	0.30			
Chordata	2013	212.65	223.36	172.36	1.824, 0.179	1.671, 0.191	0.472, 0.625
	2007	337.74	357.63	162.11			
Cnidaria	2013	0.22	0.15	0.19	2.692, 0.103	0.935, 0.394	0.228, 0.797
	2007	0.47	0.28	0.30			
Crustacea	2013	70.39	260.70	295.91	0.281, 0.597	**14.108, <0.001**	0.096, 0.909
	2007	81.36	368.85	298.2			
Echinodermata	2013	0.71	0.58	0.26	2.686, 0.103	1.799, 0.169	0.716, 0.490
	2007	1.50	0.62	0.90			
Magnoliophyta	2013	0.92	1.67	1.34	**24.238, <0.001**	**4.483, 0.013**	0.813, 0.445
	2007	0.25	0.44	0.66			
Mollusca	2013	13.51	33.30	34.25	1.803, 0.181	**5.266, 0.006**	1.551, 0.215
	2007	14.88	18.23	23.62			
Phaeophyta	2013	1.07	1.21	1.30	**6.831, 0.010**	1.121, 0.328	0.280, 0.756
	2007	0.38	0.55	0.93			
Porifera	2013	1.27	1.18	0.40	1.120, 0.291	**4.539, 0.012**	0.289, 0.749
	2007	2.11	1.56	0.45			
Rhodophyta	2013	1.27	1.40	1.77	1.695, 0.195	2.850, 0.060	0.745, 0.476
	2007	0.64	0.82	2.03			
Urochordata	2013	0.54	0.65	0.20	**4.776, 0.030**	0.886, 0.414	0.150, 0.861
	2007	0.93	1.24	0.82			

Table 6. Results of two-way ANOVA (trawl intensity × year) for differences in biomass of catch grouped by phylum. Phyla that display significant ($p < 0.05$) differences are highlighted in bold. Homogeneous groups of means identified from *post hoc* SNK tests are highlighted by similar shades of grey backfill or boxes. Note mean values displayed have been back-transformed from $\log_{10}(x+1)$ to aid interpretation (Plots of mean + se prior to back transformation are included in Appendix 4).

Phylum	Year	Trawl Intensity			ANOVA		
		Low (g/ha)	Mod (g/ha)	High (g/ha)	Year (F, p)	Intensity (F, p)	Year x Intensity (F, p)
Bryozoa	2013	4.08	1.27	1.85	0.211, 0.647	**4.434, 0.013**	0.597, 0.552
	2007	6.26	0.95	0.28			
Chlorophyta	2013	0.49	0	0.22	12.167, 0.001	2.325, 0.101	**4.041, 0.019a**
	2007	0.55	1.20	6.07			
Chordata	2013	5673.54	6730.31	5098.48	**4.346, 0.039**	2.282, 0.105	1.817, 0.165
	2007	12743.78	9682.37	5064.78			
Cnidaria	2013	1.71	1.01	0.67	1.860, 0.174	1.680, 0.189	0.279, 0.757
	2007	5.44	1.91	1.45			
Crustacea	2013	2543.17	12304.21	13183.01	0.038, 0.845	**16.428, <0.001**	0.061, 0.940
	2007	2963.03	14545.34	11587.06			
Echinodermata	2013	3.85	2.26	2.26	**6.489, 0.012**	1.648, 0.195	1.127, 0.326
	2007	10.17	3.60	28.22			
Magnoliophyta	2013	27.11	28.22	36.16	**9.551, 0.002**	0.235, 0.791	0.056, 0.945
	2007	4.17	6.12	7.85			
Mollusca	2013	342.46	789.75	675.64	0.069, 0.794	2.796, 0.064	1.453, 0.237
	2007	501.88	526.31	842.57			
Phaeophyta	2013	10.12	14.60	38.50	**6.349, 0.013**	2.603, 0.077	0.103, 0.902
	2007	3.10	3.09	14.24			
Porifera	2013	77.02	88.02	9.07	1.873, 0.173	**5.155, 0.007**	0.278, 0.757
	2007	329.01	261.84	11.05			
Rhodophyta	2013	22.14	19.49	147.88	0.019, 0.891	**12.954, <0.001**	2.157, 0.119
	2007	6.25	12.14	607.31			
Urochordata	2013	3.86	10.24	0.80	**9.542, 0.002**	1.456, 0.236	1.596, 0.206
	2007	10.55	19.39	29.01			

a Significant interaction term for Cholorophyta; Year: low, 2007 = 2013; moderate, 2007 = 2013; high 2007 > 2013. Intensity: 2013, low = moderate = high; 2007, low = moderate, moderate = high, low < high.

The dbRDA plots for fish and motile invertebrates (Figure 10) bear the most resemblance to the primary dbRDA (Figure 7). This is because fish and motile invertebrates comprise the majority of the biomass captured. The two primary PCO axes explain 20% and 26% of the total variation for fish and motile invertebrates, respectively. The predictor variable with the largest influence on the primary axis for fish and motile invertebrates was distance from TOG, followed by depth on the secondary axis. When all predictor variables were incorporated into the model 28% (R^2 = 0.28) of total variation was explained for both fish and motile invertebrates.

The dbRDA plots for sessile invertebrates and plants/algae show less resemblance to the primary dbRDA. This is because sessile invertebrates and plants/algae constitute a more minor component of the overall biomass. The two primary PCO axes explain only 8% and 9% of the total variation for sessile invertebrates and plants/algae, respectively. For sessile invertebrates distance from TOG followed by trawl intensity explain the most variation along the two primary axes. For plants/algae, depth followed by trawl intensity explain the most variation along the two primary axes. When all predictor variables were incorporated into the model, 13% (R^2 = 0.13) and 12% (R^2 = 0.12) of total variation was explained for sessile invertebrates and plants/algae, respectively.

The relative contribution of year (i.e. temporal effects) remained low in the analysis for all four key trophic groupings, as indicated by the short length of this vector in all dbRDA plots. While, it appears longer in the plot for sessile invertebrates, only 8% of total variation is explained by these two axes. Therefore, there is no evidence of large-scale temporal changes in any of the key trophic groupings in Spencer Gulf from 2007 to 2013.

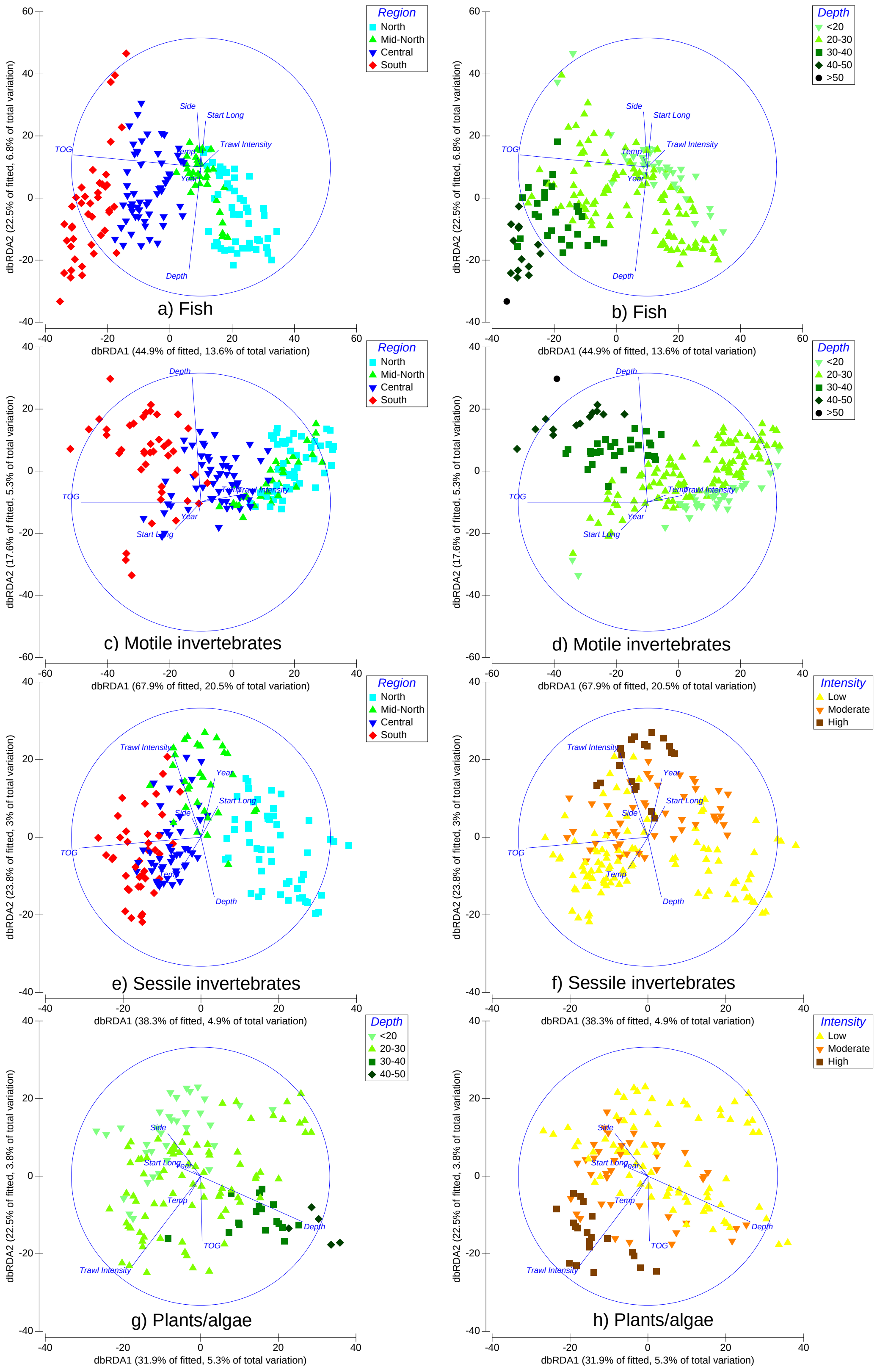

Figure 10. dbRDA plots of by-catch communities for the four key trophic groupings. Superimposed symbols represent categorical variables associated with distance from TOG (Regions: North, Mid-North, Central and South), depth (<20m, 20-30m, 30-40m, 40-50m and >50m) and trawl intensity (low, moderate and high). Variables with the strongest relationship to each of the two primary axes are superimposed.

3.4.4 Abundant species

The most abundant species were similar over time (Table 7). The primary target species for the fishery, King Prawn, was the most abundant species collected during the trawl survey. King Prawns occurred at over 92% of sites (60/65), accounting for 29% of the overall abundance and 18% of the overall biomass. Notably, the King Prawn was not found at a number of sites located closer to shore (~20 m depth) along the eastern and western sides of the Gulf (Appendix 5). During the 2007 survey Degen's Leatherjacket was the most abundant species, accounting for 47% and 21% of the overall abundance and biomass, respectively, whereas in 2013, it was the fourth most abundant species accounting for 10% of abundance and 4% of biomass. In 2007, almost 10% of sites (11/120) had in excess of 1,000 Degen's Leatherjackets per hectare trawled, with a maximum of 19,491 per hectare, whereas in 2013, the highest number was 633 per hectare trawled. This reduction of large schools of Degen's Leatherjackets accounts for a significant component of the reduction of all Chordata for the 2013 groupings by phyla (Figure 8). The Blue Swimmer Crab, and Skipjack Trevally also made significant contributions to the overall abundance in 2013. The abundance of these species was similar to that in 2007, with a slight decrease in crabs and a slight increase in trevally. The Blue Swimmer Crab occurred at 77% of all sites (50/65), but was not collected south of a line from Port Neill to Port Victoria, as was the case in 2007 (Appendix 5). The Skipjack Trevally was broadly distributed, being encountered at 83% of all sites (54/65).

The densities of 10 of the 20 most abundant species differed significantly among the three trawl intensities (Table 8, Figure A.4.3). Of these, six were more abundant in the intensively trawled areas (i.e. King Prawn, Blue Swimmer Crab, Rough Leatherjacket *Scobinichthys granulatus*, Southern Calamari, Strawberry Prawn *Metapenaeopsis* sp., and Slender Bullseye *Parapriacanthus elongatus*). In contrast, four of these were more abundant in the low or moderate intensity trawl areas (i.e. Spotted Stinkfish *Repomucenus calcaratus,* Silverbelly *Parequula melbournensis,* Hairy Mussel *Trichomya hirsute*, and Striped Perch *Pelates octolineatus*).

Because abundance and biomass co-vary for most common species, spatial differences in biomass often mirror observed trends in abundance. The biomass of seven of the 20 most abundant species differed significantly among the three trawl intensities (Table 9, Figure A.4.4), six of which reflected those patterns already described for abundance. For four species marginally non-significant results for biomass were detected (i.e. Spotted Stinkfish, Hairy

Mussel, Strawberry Prawn, and Striped Perch). The Red Mullet *Upeneichthys vlamingii* also had lower biomass in areas of high trawl intensity.

Of the 20 most abundant species, the densities of five differed between 2007 and 2013 (Table 8, Figure A.4.3). Of these, three were more abundant in 2013 (i.e. Strawberry Prawn, Orangebarred Puffer Fish *Polyspina piosae*, and Mosaic Leatherjacket *Acanthaluteres spilomelanurus*), whereas two were more abundant in 2007 (i.e. Rough Leatherjacket, and Slender Bullseye).

Similarly, the biomass of four of the 20 most abundant species differed between 2007 and 2013 (Table 9, Figure A.4.4). Of these species, three of those that had greater abundance also had greater biomass in 2013 (i.e. Strawberry Prawn, Orangebarred Puffer Fish, and Mosaic Leatherjacket), as well as one additional species, the Tiger Flathead *Neoplatycephalus richardsoni.*

Only one species among the 20 most abundant, the Little Scorpion Fish *Maxillicosta scabriceps*, differed in abundance and biomass dependent upon the interaction between trawl intensity and survey year, whereby it had greater density and biomass at high and moderate trawl sites in 2007, but in 2013 was homogenous across all trawl intensities.

In 2013, three new species occurred among those comprising the 20 most abundant (i.e. Orangebarred Puffer Fish, Striped Perch, and Mosaic Leatherjacket). The three species no longer classified in the top 20 were the Silver Whiting *Sillago bassensis*, the Doughboy Scallop *Mimachlamys asperrima*, and the Jack Mackerel *Trachurus declivis*.

In 2013, by-product species the Southern Calamari was the ninth most abundant species found in Spencer Gulf, while the other by-product species the slipper lobsters were ranked 31 in terms of abundance. Both species were broadly distributed throughout the Gulf, with Southern Calamari and slipper lobsters found at 97% (63/65) and 46% (30/65) of survey sites, respectively. The Southern Calamari accounted for 2% of the total abundance and 1.5% of the total. Slipper lobsters accounted for <0.2% of the total abundance and <1% of the total biomass. The abundance and biomass of these two by-product species was stable in relation to trawl intensity and survey year. The Southern Calamari remained significantly more abundant and of greater biomass in areas of moderate-to-high trawl intensity compared to sites of low trawl intensity. The abundance and biomass of slipper lobsters remained homogenous across the three different trawl intensities.

Table 7. Mean abundance and biomass of the 20 numerically most abundant species collected from the by-catch survey in the Spencer Gulf during 2013 and 2007. Those species listed below the dashed line were not ranked in the top 20 from 2013, but were in 2007. Slipper lobsters are included due to their value as by-product species.

Rank	Species Name	Common Name	Year	Abundance (n/ha)	Abundance (% total)	Biomass (g/ha)	Biomass (% total)
1 (2)	*Melicertus latisulcatus*	King Prawn	2013	194.49	29.01	4646.49	17.62
			2007	257.77	19.43	5705.06	14.35
2 (4)	*Pseudocaranx wrighti*	Skipjack Trevally	2013	97.88	14.60	1753.19	6.65
			2007	75.74	5.71	1461.67	3.68
3 (3)	*Portunus pelagicus*	Blue Swimmer Crab	2013	96.15	14.36	7699.40	29.20
			2007	100.96	7.61	6852.95	17.23
4 (1)	*Thamnaconus degeni*	Degen’s Leatherjacket	2013	65.64	9.79	1105.99	4.20
			2007	627.41	47.30	8265.79	20.79
5 (5)	*Scobinichthys granulatus*	Rough Leatherjacket	2013	24.00	3.58	593.26	2.25
			2007	43.43	3.27	753.96	1.90
6 (13)	*Repomucenus calcaratus*	Spotted Stinkfish	2013	23.92	3.57	296.65	1.13
			2007	9.90	0.75	135.44	0.34
7 (7)	*Upeneichthys vlamingii*	Red Mullet	2013	19.60	2.92	534.72	2.03
			2007	26.27	1.98	784.59	1.97
8 (9)	*Acanthaluteres vittiger*	Toothbrush Leatherjacket	2013	16.71	2.49	346.25	1.31
			2007	13.29	1.00	227.46	0.57
9 (8)	*Sepioteuthis australis*	Southern Calamari	2013	15.66	2.34	388.77	1.47
			2007	13.40	1.01	412.94	1.04
10 (6)	*Parequula melbournensis*	Silverbelly	2013	14.60	2.18	184.32	0.70
			2007	27.37	2.06	408.25	1.03
11 (10)	*Trichomya hirsuta*	Hairy Mussel	2013	11.84	1.77	200.39	0.76
			2007	11.93	0.90	223.90	0.56
12 (19)	*Metapenaeopsis* sp.	Strawberry Prawn	2013	10.67	1.59	36.19	0.14
			2007	3.97	0.30	12.72	0.03
13 (14)	*Lepidotrigla papilio*	Spiny Gurnard	2013	6.28	0.94	85.32	0.32
			2007	8.27	0.62	110.27	0.28
14 (12)	*Parapriacanthus elongatus*	Slender Bullseye	2013	6.18	0.92	49.42	0.19
			2007	10.46	0.79	57.37	0.14
15 (40)	*Polyspina piosae*	Orangebarred Puffer Fish	2013	4.90	0.73	77.70	0.29
			2007	0.92	0.07	10.95	0.03
16 (23)	*Pelates octolineatus*	Striped Perch	2013	4.49	0.67	178.81	0.68
			2007	2.72	0.21	139.40	0.35
17 (17)	*Maxillicosta scabriceps*	Little Scorpion Fish	2013	3.77	0.56	50.46	0.19
			2007	4.55	0.34	58.55	0.15
18 (20)	*Neoplatycephalus richardsoni*	Tiger Flathead	2013	3.22	0.48	262.11	0.99
			2007	3.66	0.28	260.03	0.65
19 (70)	*Eubalichthys mosaicus*	Mosaic Leatherjacket	2013	2.79	0.42	75.45	0.29
			2007	0.26	0.02	40.46	0.10
20 (18)	*Acanthaluteres spilomelanurus*	Bridled Leatherjacket	2013	2.37	0.35	19.96	0.08
			2007	4.34	0.33	44.37	0.11
21 (15)	*Sillago bassensis*	Silver Whiting	2013	2.34	0.35	74.21	0.28
			2007	5.92	0.45	259.16	0.65
30 (16)	*Mimachlamys asperrima*	Doughboy Scallop	2013	1.01	0.15	8.90	0.03
			2007	4.82	0.36	50.36	0.13
31 (31)	*Ibacus* spp.	Slipper lobster	2013	1.00	0.15	168.04	0.64
			2007	1.23	0.09	201.30	0.51
40 (11)	*Trachurus declivis*	Jack Mackerel	2013	0.64	0.10	45.62	0.17
			2007	11.31	0.85	515.06	1.30

Table 8. Results of two-way ANOVA (trawl intensity × year) for differences in abundance of the 20 most abundant species. Species that display significant (p < 0.05) differences are highlighted in bold. Homogeneous groups of means identified from *post hoc* SNK tests are highlighted by similar shades of grey backfill or boxes. Note all abundances presented have been back-transformed from $\log_{10}(x+1)$ to aid interpretation. Those species listed below the dashed line were not ranked in the top 20 from 2013, but were in 2007. Slipper lobsters are included due to their value as by-product species. (Plots of mean + se prior to back transformation are included in Appendix 4).

Rank	Species	Common Name	Year	Trawl Intensity			ANOVA		
				Low (n/ha)	Mod (n/ha)	High (n/ha)	Year (F, p)	Intensity (F, p)	Interaction (F, p)
1 (2)	*Melicertus*	King Prawn	2013	23.95	71.70	62.93	2.882, 0.091	**7.579,<0.001**	0.364, 0.695
	latisulcatus		2007	33.02	178.40	150.08			
2 (4)	*Pseudocaranx*	Skipjack	2013	12.86	18.76	11.24	0.034, 0.853	0.939, 0.393	0.048, 0.953
	wrighti	Trevally	2007	14.91	23.03	9.80			
3 (3)	*Portunus*	Blue Swimmer	2013	6.25	46.78	147.9	0.000, 1.000	**19.92,<0.001**	0.946, 0.390
	pelagicus	crab	2007	10.83	67.80	62.36			
4 (1)	*Thamnaconus*	Degen's	2013	8.35	7.78	18.11	0.004, 0.947	0.106, 0.900	0.544, 0.581
	degeni	Leatherjacket	2007	14.76	10.98	8.12			
5 (5)	*Scobinichthys*	Rough	2013	3.71	14.57	18.70	**6.219, 0.014**	**13.29,<0.001**	0.175, 0.840
	granulatus	Leatherjacket	2007	8.21	25.98	55.23			
6 (13)	*Repomucenus*	Spotted	2013	4.81	5.87	1.45	3.867, 0.051	**3.581, 0.030**	0.038, 0.963
	calcaratus	Stinkfish	2007	2.09	3.22	0.27			
7 (7)	*Upeneichthys*	Red Mullet	2013	8.97	6.28	5.75	1.684, 0.196	2.145, 0.120	1.647, 0.195
	vlamingii		2007	12.60	18.02	4.21			
8 (9)	*Acanthaluteres*	Toothbrush	2013	6.54	6.67	7.09	2.143, 0.145	0.184, 0.832	0.336, 0.715
	vittiger	Leatherjacket	2007	5.61	4.60	3.25			
9 (8)	*Sepioteuthis*	Southern	2013	5.90	13.20	28.31	1.182, 0.278	**17.01,<0.001**	0.303, 0.739
	australis	Calamari	2007	5.69	10.61	19.21			
10 (6)	*Parequula*	Silverbelly	2013	5.98	5.33	2.49	0.016, 0.899	**3.317, 0.038**	0.358, 0.699
	melbournensis		2007	7.66	6.20	1.20			
11 (10)	*Trichomya*	Hairy	2013	1.30	4.23	0.46	2.258, 0.135	**3.835, 0.023**	1.135, 0.324
	hirsuta	Mussel	2007	1.11	1.27	0.09			
12 (19)	*Metapenaeopsis*	Strawberry	2013	3.92	4.20	8.25	**8.353, 0.004**	**3.775, 0.025**	0.96, 0.385
	sp.	Prawn	2007	1.30	3.02	3.54			
13 (14)	*Lepidotrigla*	Spiny	2013	2.49	2.62	2.57	0.195, 0.660	0.493, 0.612	0.399, 0.672
	papilio	Gurnard	2007	2.90	4.28	1.98			
14 (12)	*Parapriacanthus*	Slender	2013	0.54	0.85	4.27	**5.089, 0.025**	**5.279, 0.006**	0.804, 0.449
	elongatus	Bullseye	2007	1.81	3.65	4.76			
15 (40)	*Polyspina*	Orangebarred	2013	0.42	0.83	1.22	**5.377, 0.022**	0.67, 0.513	1.443, 0.239
	piosae	Puffer Fish	2007	0.31	0.44	0			
16 (23)	*Pelates*	Striped	2013	0.97	2.09	0.15	0.886, 0.348	**3.968, 0.021**	0.456, 0.634
	octolineatus	Perch	2007	0.72	1.00	0.16			
17 (17)	*Maxillicosta*	Little	2013	1.80	1.96	2.23	4.939, 0.028	6.191, 0.003	**4.653, 0.011a**
	scabriceps	Scorpion Fish	2007	1.48	5.89	3.94			
18 (20)	*Neoplatycephalus*	Tiger	2013	1.80	1.86	1.32	3.138, 0.078	2.077, 0.128	0.903, 0.407
	richardsoni	Flathead	2007	1.70	1.10	0.24			
19 (70)	*Eubalichthys*	Mosaic	2013	1.37	2.08	1.57	**62.68,<0.001**	0.438, 0.646	1.411, 0.247
	mosaicus	Leatherjacket	2007	0.17	0.09	0.10			
20 (18)	*Acanthaluteres*	Bridled	2013	1.04	1.20	0.08	0.217, 0.642	2.409, 0.093	1.881, 0.156
	spilomelanurus	Leatherjacket	2007	1.60	0.46	0.70			
21 (15)	*Sillago*	Silver	2013	0.85	0.60	0	0.412, 0.522	**3.301, 0.039**	0.345, 0.708
	bassensis	Whiting	2007	0.94	1.23	0			
30 (16)	*Mimachlamys*	Doughboy	2013	0.19	0.02	0	0.241, 0.624	2.322, 0.101	0.318, 0.728
	asperrima	Scallop	2007	0.45	0.04	0			
31 (31)	*Ibacus*	Slipper	2013	0.59	0.50	0.48	0.026, 0.872	0.706, 0.495	0.19, 0.827
	spp.	Lobster	2007	0.77	0.56	0.36			
40 (11)	*Trachurus*	Jack	2013	0.19	0.32	0.27	0.436, 0.510	1.162, 0.315	2.119, 0.123
	declivis	Mackerel	2007	1.18	0.17	0.18			

a Significant interaction term for Little Scorpion Fish (*Maxillicosta scabriceps*)Year: low, 2007 = 2013; moderate, 2007 > 2013; high, 2007 = 2013. Intensity: 2007, low < moderate = high; 2013, low = moderate = high.

Table 9. Results of two-way ANOVA (trawl intensity × year) for differences in biomass of the 20 most abundant species. Species that display significant (p < 0.05) differences are highlighted in bold. Homogeneous groups of means identified from *post hoc* SNK tests are highlighted by similar shades of grey backfill or boxes. Note all abundances presented have been back-transformed from $\log_{10}(x+1)$ to aid interpretation. Those species listed below the dashed line were not ranked in the top 20 from 2013, but were in 2007. Slipper lobsters are included due to their value as by-product species. (Plots of mean + se prior to back transformation are included in Appendix 4).

Rank	Species	Common Name	Year	Trawl Intensity Low (g/ha)	Trawl Intensity Mod (g/ha)	Trawl Intensity High (g/ha)	ANOVA Year (F, p)	ANOVA Intensity (F, p)	ANOVA Interaction (F, p)
1 (2)	*Melicertus latisulcatus*	King Prawn	2013 2007	392.78 525.24	2375.77 4778.16	2362.24 4413.43	1.068, 0.303	**10.45,<0.001**	0.100, 0.905
2 (4)	*Pseudocaranx wrighti*	Skipjack Trevally	2013 2007	96.92 182.66	239.36 312.22	177.48 133.69	0.143, 0.706	1.035, 0.357	0.232, 0.793
3 (3)	*Portunus pelagicus*	Blue Swimmer crab	2013 2007	123.67 233.54	2392.33 2532.92	7807.83 3898.58	0.000, 0.998	**12.85,<0.001**	0.308, 0.735
4 (1)	*Thamnaconus degeni*	Degen's Leatherjacket	2013 2007	70.83 101.13	89.19 80.24	191.54 113.94	0.020, 0.889	0.236, 0.790	0.172, 0.843
5 (5)	*Scobinichthys granulatus*	Rough Leatherjacket	2013 2007	40.47 118.01	206.23 380.68	304.39 715.16	3.213, 0.075	**7.968,<0.001**	0.131, 0.877
6 (13)	*Repomucenus calcaratus*	Spotted Stinkfish	2013 2007	22.35 9.36	24.79 14.70	6.05 0.99	2.827, 0.094	2.924, 0.056	0.152, 0.859
7 (7)	*Upeneichthys vlamingii*	Red Mullet	2013 2007	116.11 290.89	66.64 423.69	41.82 31.89	3.828, 0.052	**4.324, 0.015**	1.680, 0.189
8 (9)	*Acanthaluteres vittiger*	Toothbrush Leatherjacket	2013 2007	78.00 56.21	81.30 41.47	97.60 46.21	1.815, 0.180	0.059, 0.943	0.130, 0.878
9 (8)	*Sepioteuthis australis*	Southern Calamari	2013 2007	113.82 124.58	257.71 248.95	460.68 579.27	0.088, 0.768	**7.640, 0.001**	0.048, 0.954
10 (6)	*Parequula melbournensis*	Silverbelly	2013 2007	41.59 58.12	31.34 42.61	9.48 5.03	0.003, 0.960	**4.154, 0.017**	0.247, 0.781
11 (10)	*Trichomya hirsuta*	Hairy Mussel	2013 2007	4.11 3.30	14.92 3.66	1.33 0.53	1.582, 0.210	2.638, 0.074	0.701, 0.497
12 (19)	*Metapenaeopsis* sp.	Strawberry Prawn	2013 2007	8.60 2.81	10.43 6.45	17.94 8.24	**6.100, 0.014**	2.957, 0.055	0.461, 0.632
13 (14)	*Lepidotrigla papilio*	Spiny Gurnard	2013 2007	15.06 16.89	13.83 32.06	17.69 11.96	0.182, 0.670	0.286, 0.752	0.614, 0.543
14 (12)	*Parapriacanthus elongatus*	Slender Bullseye	2013 2007	2.04 5.27	2.74 11.64	18.82 16.83	2.672, 0.104	**4.669, 0.011**	0.821, 0.442
15 (40)	*Polyspina piosae*	Orangebarred Puffer Fish	2013 2007	1.45 0.94	2.18 1.57	3.34 0	**3.924, 0.049**	0.469, 0.626	1.165, 0.314
16 (23)	*Pelates octolineatus*	Striped Perch	2013 2007	4.82 4.70	24.12 6.66	1.39 3.44	0.152, 0.697	2.708, 0.069	1.113, 0.331
17 (17)	*Maxillicosta scabriceps*	Little Scorpion Fish	2013 2007	12.69 9.11	14.34 58.42	16.89 33.15	2.705, 0.102	4.821, 0.009	**3.464, 0.033a**
18 (20)	*Neoplatycephalus richardsoni*	Tiger Flathead	2013 2007	55.01 29.38	40.25 15.88	59.23 2.56	**7.631, 0.006**	1.317, 0.271	1.337, 0.265
19 (70)	*Eubalichthys mosaicus*	Mosaic Leatherjacket	2013 2007	13.01 1.52	21.89 0.49	26.38 0.69	**45.87,<0.001**	0.052, 0.949	1.508, 0.224
20 (18)	*Acanthaluteres spilomelanurus*	Bridled Leatherjacket	2013 2007	3.25 5.22	4.29 0.93	0.29 1.73	0.012, 0.911	2.751, 0.067	2.626, 0.075
21 (15)	*Sillago bassensis*	Silver Whiting	2013 2007	4.24 6.81	1.85 9.74	0 0	1.443, 0.231	**4.532, 0.012**	0.726, 0.485
30 (16)	*Mimachlamys asperrima*	Doughboy Scallop	2013 2007	0.43 1.21	0.10 0.09	0 0	0.340, 0.561	**3.267, 0.040b**	0.597, 0.552
31 (31)	*Ibacus* spp.	Slipper Lobster	2013 2007	9.93 17.29	10.86 11.68	10.55 9.48	0.094, 0.76	0.088, 0.916	0.163, 0.850
40 (11)	*Trachurus declivis*	Jack Mackerel	2013 2007	1.50 6.48	1.98 0.72	2.67 1.50	0.014, 0.907	1.103, 0.334	2.042, 0.133

a Significant interaction term for Little Scorpion Fish (*Maxillicosta scabriceps*). Year: low, 2007 = 2013; moderate, 2007 > 2013; high, 2007 = 2013. Intensity: 2007, low < moderate, moderate = high, low = high; 2013, low = moderate = high.

b Significant effect of Intensity was detected for Doughboy Scallop (*Mimachlamys asperrima*), but post-hoc pairwise comparisons did not reveal any significant differences between the three levels of intensity.

The MDS ordination shows differences in community structure at the trawl sites in 2013 (n = 65) and 2007 (n = 120) (Figure 11). Symbols representing regions of Spencer Gulf are superimposed on the ordinations.

In 2013, the species assemblage for the North group consisted of 148 species collected from 18 trawl sites, including 18 species only collected from this region. Six species representing two phyla (Crustacea and Chordata) typified this group and contributed more than 5% to the within-group similarity (Table 10). The King Prawn was the dominant species contributing 21% to within group similarity for the North region, on account of the organisms exceptionally high biomass (>3-fold Mid-North, Central or South) and ubiquitous occurrence at the 18 sampling sites. The other five species were all present at ≥17 of the 18 (94%) sampling sites in the North region. Three of these, Blue Swimmer Crab, Skipjack Trevally, and Rough Leatherjacket, were also influential in the 2007 analysis, while two new species, Striped Perch and Small Tooth Flounder *Pseudorhombus jenynsii*, made significant contributions in 2013.

The species assemblage for the Mid-North group consisted of 149 species collected from 18 trawl sites, including 17 species only collected from this region. Four species representing three phyla (Crustacea, Chordata and Mollusca) typified this group contributing more than 5% to the within-group similarity. Like the North group, the Mid-North grouping was also characterised by Blue Swimmer Crab, King Prawn, and Rough Leatherjacket. In addition, Southern Calamari also typified this group. These four species all occurred at ≥17 of the 18 (94%) sampling sites and were the same four species which typified the Mid-North region in 2007.

The species assemblage for the Central group consisted of 147 species collected from 15 trawl sites, including 28 species only collected from this region. Five species representing three phyla (Crustacea, Chordata and Mollusca) typified the Central region, all occurring at ≥12 of the 15 (80%) sampling sites. Three of these species were also influential in the 2007 analysis, including Blue Swimmer Crab, Red Mullet, and King Prawn, as well as two new species, Toothbrush Leatherjacket *Acanthaluteres vittiger*, and Southern Calamari. Four Chordata species no longer made significant contributions to site similarity within the Central region, including Degen's Leatherjacket, Skipjack Trevally, Port Jackson Shark *Heterodontus portusjacksoni*, and Silverbelly *Parequula melbournensis*. This was typical of the lower catch rates of Chordata in the Central region in 2013.

The species assemblage for the South group comprised the richest collection of species (180) from 14 trawl sites, and displayed the highest level of group fidelity. Twenty-nine percent of species (52/180) collected from the 14 sites in this area of the Gulf were not encountered elsewhere. A total of eight species representing three phyla (Crustacea, Chordata and Mollusca) typified the South region (i.e. Degen's Leatherjacket, Red Mullet, Skipjack Trevally, King Prawn, Silverbelly, Southern Calamari, Toothbrush Leatherjacket, and Tiger Flathead) all occurring at ≥11 of 14 sites (79%). Degen's Leatherjacket remained the primary discriminator for this group, despite their biomass being more than an order of magnitude lower than in 2007. It is also notable, that the otherwise ubiquitous Blue Swimmer Crab was not collected in the South region, which was also the case in 2007. The absence of Blue Swimmer Crabs from the South, which contributed 19%, 31% and 20% to site similarity in North, Mid-North and Central regions, respectively, may explain why a greater number of other species were influential in the analysis.

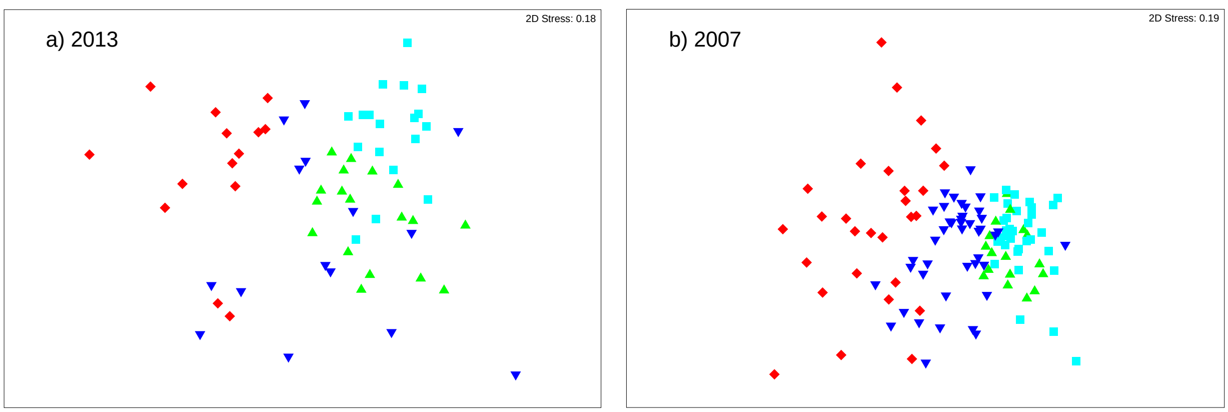

Figure 11. Non-metric MDS plot of by-catch community structure in a) 2013 (n = 65) and b) 2007 (n = 120) at trawl sites in Spencer Gulf with symbols superimposed representing region of Gulf: light-blue squares = North (<120 km from top of Gulf (TOG)), green triangles = Mid-North (120-160 km from TOG), dark-blue triangles = Central (160-220 km from TOG), red diamonds = South (220-300 km from TOG).

Table 10. Mean biomass (grams per hectare ± s.e.) of captured species in four regional (site) groups based on distance from TOG. Species listed were identified as contributing ≥ 5% to the similarity within and dissimilarity between regional groupings in either 2013 or 2007. Those species indicative of each regional grouping (i.e. contributing ≥ 5% to the total similarity within a group) are highlighted in bold. Species are ranked in order of decreasing biomass across all site groupings in 2013. n/a indicates a species contribution of <5% to any region in that given year. Species listed below the dashed line made significant contribution in 2007 only.

Species	Common	Year	Region (n = 2013/2007)			
			North (n = 18/33)	Mid-North (n = 18/17)	Central (n = 15/42)	South (n = 14/28)
Portunus pelagicus	Blue Swimmer Crab	2013	**6701.4 ± 1415.6**	**10289.4 ± 1921.4**	**12975.1 ± 6555.0**	0 ± 0
		2007	**8946.6 ± 1841.8**	**7773.1 ± 1274.7**	**9404.1 ± 2189.4**	0 ± 0
Melicertus latisulcatus	King Prawn	2013	**10539.2 ± 1877.2**	**2681.5 ± 795.1**	**2697.5 ± 991.6**	**1684.8 ± 535.0**
		2007	**11378.5 ± 1486.9**	**5468.7 ± 1232.8**	**4298.9 ± 794.5**	**1271.2 ± 388.8**
Pseudocaranx wrighti	Skipjack Trevally	2013	**3783.8 ± 1664.1**	335.0 ± 164.5	1144.4 ± 554.9	**1618.1 ± 509.0**
		2007	**1451.4 ± 340.0**	626.6 ± 419.7	**2095.4 ± 496.7**	**1030.3 ± 286.4**
Thamnaconus degeni	Degen's Leatherjacket	2013	178.2 ± 69.2	1071.7 ± 503.1	1741.3 ± 897.8	**1662.2 ± 542.2**
		2007	97.0 ± 33.9	308.0 ± 93.5	**7332.5 ± 2286.2**	**24124.8 ± 12124.2**
Scobinichthys granulatus	Rough Leatherjacket	2013	**826.7 ± 159.5**	**933.0 ± 288.8**	433.0 ± 164.7	28.0 ± 12.0
		2007	**1192.7 ± 247.3**	**1356.3 ± 204.3**	596.9 ± 136.3	106.7 ± 36.1
Upeneichthys vlamingii	Red Mullet	2013	149.1 ± 86.0	611.6 ± 240.4	**827.6 ± 272.8**	**617.9 ± 147.8**
		2007	268.0 ± 51.4	511.0 ± 173.9	**1344.7 ± 229.1**	**719.2 ± 191.3**
Sepioteuthis australis	Southern Calamari	2013	307.6 ± 55.8	**528.7 ± 99.4**	**417.2 ± 159.9**	**282.8 ± 86.5**
		2007	469.6 ± 72.2	**684.6 ± 114.3**	290.9 ± 53.6	364.2 ± 119.7
Acanthaluteres vittiger	Toothbrush Leatherjacket	2013	131.3 ± 45.5	462.8 ± 230.0	**523.8 ± 142.7**	**282.4 ± 85.3**
		2007	n/a	n/a	n/a	n/a
Pseudorhombus jenynsii	Small Tooth Flounder	2013	**636.9 ± 110.1**	229.6 ± 79.4	192.2 ± 108.2	16.5 ± 9.8
		2007	n/a	n/a	n/a	n/a
Neoplatycephalus richardsoni	Tiger Flathead	2013	180.4 ± 37.2	195.8 ± 79.7	275.6 ± 126.6	**438.0 ± 129.9**
		2007	35.4 ± 9.9	39.3 ± 19.8	254.8 ± 62.5	**666.7 ± 150.6**
Parequula melbournensis	Silverbelly	2013	44.9 ± 17.1	127.9 ± 55.7	**258.6 ± 89.4**	356.5 ± 109.9
		2007	16.1 ± 5.8	51.0 ± 24.9	**846.8 ± 147.4**	429.5 ± 106.3
Pelates octolineatus	Striped Perch	2013	**615.3 ± 97.0**	17.4 ± 8.8	15.6 ± 10.7	0 ± 0
		2007	n/a	n/a	n/a	n/a
Heterodontus portusjacksoni	Port Jackson Shark	2013	n/a	n/a	n/a	n/a
		2007	1101.0 ± 233.9	923.3 ± 268.3	**957.5 ± 166.0**	306.3 ± 154.9
Trachurus declivis	Jack Mackerel	2013	n/a	n/a	n/a	n/a
		2007	1.1 ± 1.1	3.5 ± 3.5	52.8 ± 30.1	**2124.8 ± 878.4**

3.5. Threatened, endangered and protected species

Seven of the 286 species collected were listed under the *EPBC Act 1999* as protected. All of these species belong to the Family Syngnathidae (Table 11). Figure 12 shows the distribution of the 31 individual syngnathids found during the 2013 survey of 65 sites. In 2007, 112 individual syngnathids were captured during a survey of 120 sites. It should be noted that the abundance data presented in this section of the report represent only those syngnathids found in the sub-samples of the catch (i.e. the abundance is not standardised as it is for the more common species), nor were any statistical analyses undertaken on the abundance or occurrence of syngnathids. This is due to the increased uncertainty associated with scaling infrequently captured species.

The pattern of syngnathids captured in relation to trawl intensity was consistent between the 2007 and 2013 surveys, with most individuals taken from low/closed trawl intensity blocks (93-94%) and the least individuals taken from blocks of high trawl intensity (0-1%). The “Wardang closure” and “Broughton closure” (i.e. areas identified with hatchings) are closed to trawling under an industry code of practice. No syngnathids (0%) were captured from the ten high trawl intensity sites in 2013, while in 2007 one individual (1%) was captured from the same number of sites. Within areas of moderate trawl intensity two syngnathids (6%) were captured in 2013, compared with seven (6%) in 2007, from 23 and 27 sites, respectively. The number of low intensity trawl sites differed between 2013 (25) and 2007 (75), which was reflected in the lower total number of syngnathids captured at these sites during 2013 (21 or 68%), compared to 2007 (61 or 54%). In those areas closed to trawling eight syngnathids (26%) were captured in 2013, compared with 43 (38%) from 2007, from seven and eight sites, respectively. Due to the different number of trawl sites between 2013 and 2007, in particular those from areas of low trawl intensity, direct comparisons of syngnathid abundance can be misleading. Nonetheless, the combination of raw and percentage data show the distribution of syngnathid capture has remained relatively stable in relation to trawl intensity between 2007 and 2013.

There was a change in species abundance and composition between the 2007 and 2013. In 2013, the Spotted Pipefish, *Stigmatopora argus*, was the most frequently captured syngnathid (n = 10, from 3 different trawls), whereas in 2007 the Common Seadragon, *Phyllopteryx taeniolatus* (n = 41, from 10 different trawls) was the most frequently captured. In addition to these two species, four others were also recorded during both surveys, the Leafy Seadragon *Phycodurus eques,* the Bigbelly Seahorse *Hippocampus abdominalis*, the Brushtail Pipefish *Leptoichthys fistularius*, and the Tiger Pipefish. One new syngnathid was captured on two occasions in 2013, the Knifesnout Pipefish *Hypselognathus rostratus*, while Macleays Crested Pipefish *Histiogamphelus cristatus*, which was recorded once in 2007 was not found in 2013. One syngnathid specimen in 2013 was badly damaged and could not be identified.

Table 11. Total abundance and frequency of occurrence of seven syngnathid species (plus one unidentified specimen) collected as by-catch from Spencer Gulf during a prawn trawl survey in February of 2013 (n = 65 sites) and 2007 (n = 120 sites). Measures are presented for each species in relation to levels of trawl intensity during the 5-year period period associated with each survey. Trawl intensity "closed" refers to sites located within areas now closed to prawn trawling. The number of sites in each intensity category is given in brackets under total.

Species	Common Name	Year	Abundance				Occurrence			
			High	Mod	Low	Closed	High	Mod	Low	Closed
Filicampus tigris	Tiger Pipefish	2013	0	0	4	0	0	0	1	0
		2007	1	1	5	0	1	1	5	0
Leptoichthys fistularius	Brushtail Pipefish	2013	0	0	3	1	0	0	2	1
		2007	0	0	9	7	0	0	5	2
Phycodurus eques	Leafy Seadragon	2013	0	0	1	2	0	0	1	2
		2007	0	2	9	10	0	2	5	3
Phyllopteryx taeniolatus	Common Seadragon	2013	0	0	0	2	0	0	0	2
		2007	0	2	29	10	0	2	5	3
Stigmatopora argus	Spotted Pipefish	2013	0	0	10	0	0	0	3	0
		2007	0	0	3	2	0	0	3	2
Hippocampus abdominalis	Bigbelly Seahorse	2013	0	2	1	2	0	2	1	2
		2007	0	2	6	13	0	2	5	4
Histiogamphelus cristatus	Macleays Crested Pipefish	2013	0	0	0	0	0	0	0	0
		2007	0	0	0	1	0	0	0	1
Hypselognathus rostratus	Kinfesnout Pipefish	2013	0	0	2	0	0	0	2	0
		2007	0	0	0	0	0	0	0	0
UnID Syngnathid	UnID Syngnathid	2013	0	0	0	1	0	0	0	1
		2007	0	0	0	0	0	0	0	0
Total		2013	0 (10)	2 (23)	21 (25)	8 (7)	0 (10)	2 (23)	10 (25)	8 (7)
		2007	1 (10)	7 (27)	61 (75)	43 (8)	1 (10)	6 (27)	18 (75)	8 (8)

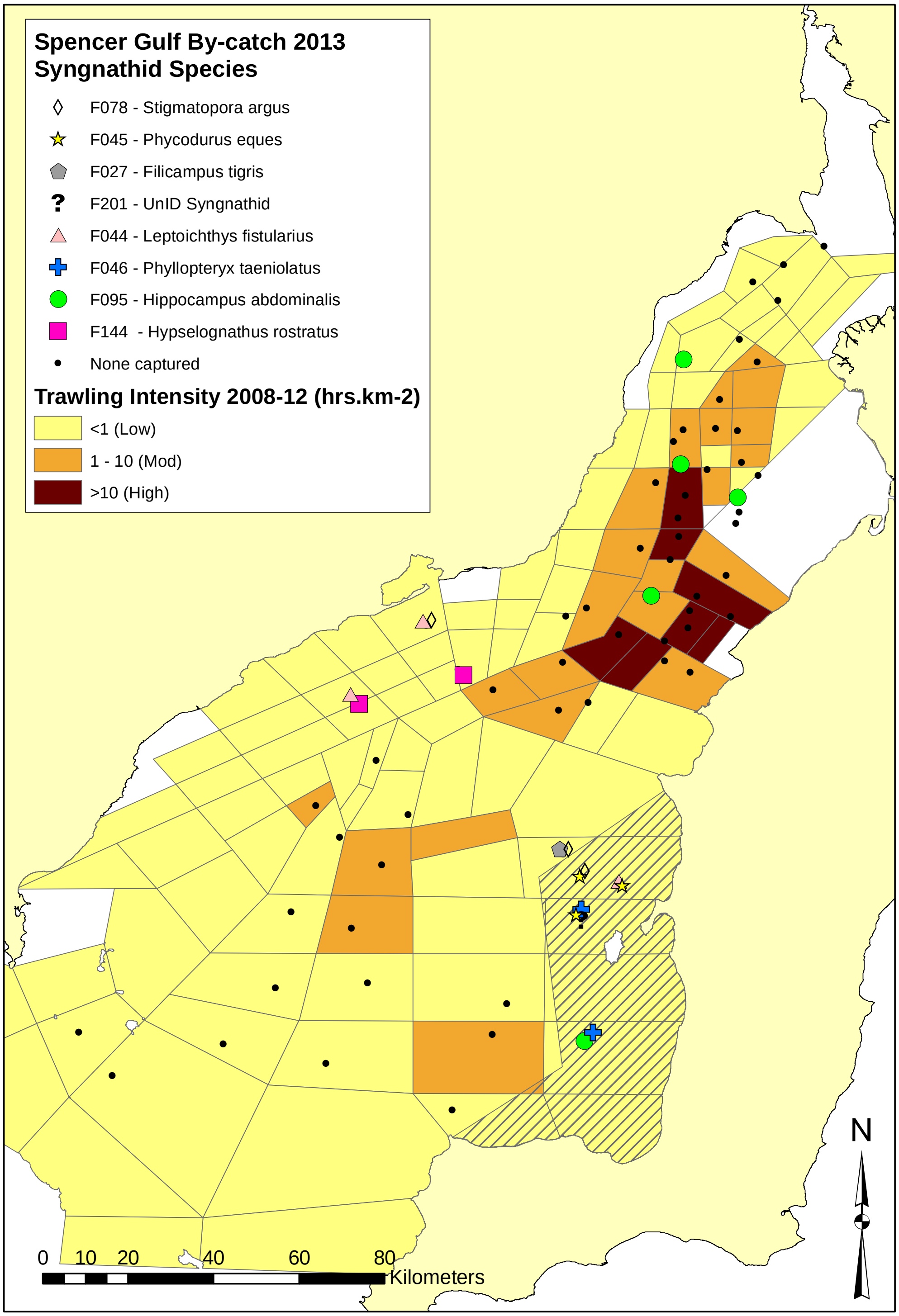

Figure 12. Map of the Spencer Gulf showing the distributions of Syngnathid species collected as by-catch during a prawn trawl survey of 65 sites in February 2013. Hatched polygons on the eastern side of the Gulf denote voluntary spatial closures at Broughton (north) and Wardang (south) implemented by the Spencer Gulf and West Coast Prawn Fisherman's Association. Note: Some symbols are slightly offset from actual location to aid visual interpretation.

3.6. Species of interest

Three of the 286 species collected were identified during the ESD risk assessment as requiring additional information to ensure the fishery does not pose a risk to their sustainability (Table 12). These species included the Tiger Pipefish, Coastal Stingaree, and Giant Cuttlefish. Due to low abundances no scaling or statistical comparisons are presented for these species. In 2013, all three species were less abundant and had lower occurrence when compared with 2007. This decrease was anticipated given the survey sampled fewer sites in 2013. The majority of these species in both surveys were collected from sites of low trawl intensity, although Giant Cuttlefish were also relatively common at moderate intensity trawl sites.

Table 12. Total abundance and frequency of occurrence of species of interest collected as by-catch from Spencer Gulf during a prawn trawl survey in February of 2013 (n = 65 sites) and 2007 (n = 120 sites). Measures are presented for each species in relation to levels of trawl intensity during the 5-year period associated with each survey.

Species	Common name		Abundance				Occurrence			
			Low	Mod	High	Total	Low	Mod	High	Total
Filicampus tigris	Tiger Pipefish	2013	4	0	0	4	1	0	0	1
		2007	5	1	1	7	5	1	1	7
Urolophus orarius	Coastal Stingaree	2013	1	0	0	1	1	0	0	1
		2007	13	1	0	14	10	1	0	11
Sepia apama	Giant Cuttlefish	2013	13	9	1	23	3	3	1	7
		2007	60	10	4	74	28	6	3	37

4. DISCUSSION

4.1. Species composition and spatial distribution

The total number of species (286) collected in 2013 was less than in 2007 (395). This was due in part to the lower number of sites surveyed in 2013 (65), compared with 2007 (120) (see Currie *et al.*, 2009). Most of the sites removed from the experimental design in 2013 were low intensity trawling sites. It has been shown that by-catch studies that include sites in low intensity trawl areas (e.g. Stobutzki *et al.,* 2003) may identify more species that are potentially impacted by prawn trawling than studies confined to the main fishing grounds (e.g. Kennelly *et al.,* 1998; Svane, 2007; Tonks *et. al.,* 2008).

The by-catch ratio provides a snapshot of the prevalence of non-target species taken within a fishery. In 2013, the overall by-catch ratio decreased to 4.7:1 from 6.0:1 in 2007. However, temporal comparisons from 2007 to 2013 within the SGPF must also consider trawl intensity, given a greater proportion of high intensity trawl sites were sampled in 2013. When trawl effort was considered, changes to the by-catch ratio at high intensity sites ran contrary to this overall trend, increasing from 2.0 in 2007 to 4.9 in 2013. Moderate intensity sites also ran contrary to this overall trend, with the by-catch ratio increasing from 3.2 in 2007 to 5.3 in 2013. Previous estimates of by-catch ratios from frequently trawled areas of Spencer Gulf have ranged from 0.5 to 3.5 (Carrick, 1997; McShane *et al.*, 1998; Svane *et al.*, 2007). While this increase in the by-catch ratio in 2013 in moderate-to-highly fished areas appears substantial, it is important to remember changes to by-catch ratios are also sensitive to variation in catch rates of target species (i.e. prawns). As such, this increased ratio in moderate-to-highly fished areas was not a result of increased by-catch, but rather a decrease of prawn catch rate. This was expected given the stock assessment survey during February 2013 (which was run in parallel with the by-catch survey and encompasses 209 different trawl sites) had one of the lowest catches of prawns since consistent February surveys began in 2004/05 (Noell *et al.*, 2014). The opposite was observed at low intensity trawling sites as the by-catch ratio decreased from 8.7 in 2007 to 4.1 in 2013. While prawn catch in these low intensity areas remained stable between surveys, the decrease in by-catch ratio in 2013 was largely a result of decreasing catches of fish.

Traditionally the by-catch ratio in regularly trawled areas of Spencer Gulf (0.5 to 3.5) is relatively low (Carrick, 1997; McShane *et al.*, 1998; Svane *et al.*, 2007), in comparison to those reported from other Australian prawn fisheries. For example, by-catch-to-prawn ratios of 4.3:1 and 10.4:1

have been reported for heavily trawled areas in the Queensland East Coast Trawl Fishery (Poiner *et al*., 1998) and New South Wales Oceanic Prawn Trawl Fishery (NSW OTF), respectively (Kennelly *et al*., 1998). However, as was noted by Currie *et al.* (2009) such comparisons must be interpreted with caution as differences in habitat type, fishing methodology, and level and frequency of trawling effort make direct comparisons between fisheries difficult. In addition, the adoption and continual development of by-catch reduction devices (BRDs) into numerous other Australian prawn fisheries (e.g. NSW OTF) continues to improve fishery performance in terms of by-catch (DEH, 2006).

4.2. Relationships with trawl effort history and environmental parameters

4.2.1 *Overall species richness, abundance and biomass*

Patterns of total abundance and biomass in Spencer Gulf can reflect differences in oceanographic conditions (Currie *et al.*, 2009). The most notable change to bio-physical interdependencies between 2007 and 2013 was the decrease in by-catch from lower Spencer Gulf. This was supported by the greater strength of the rank correlations between abundance/biomass and distance from TOG and latitude. While a larger survey (similar in size to that in 2007) could, perhaps, have re-sampled these greater biomasses from the southern half of Spencer Gulf, it would appear more likely changes simply reflect natural variation. Indeed, Svane *et al.*, (2007) found large annual variation from 2002 to 2003 in the biomass of dominant by-catch species (i.e. leatherjackets and trevally), which was greatest at the most southern site sampled (i.e. Main Gutter).

4.2.2 *Community structure*

Temporal stability of by-catch community structure is an important potential ecological performance indicator for the SGPF (Mayfield *et al.*, 2014). The limited influence of survey year in community structure analyses (2%) indicates there is no evidence for large-scale temporal changes of by-catch communities in Spencer Gulf between 2007 and 2013.

Distance from TOG (14%) and, to a lesser extent, depth (10%), explained the greatest component of variation in the overall community structure. Currie *et al.* (2009) also found distance from TOG and depth explained the most variation in community structure, but doubted that either of these variables is the primary casual factor in structuring the benthos. Currie *et al.* (2009) explained that depth, for example, co-varies with many other environmental variables (e.g. turbidity, sediment grain size), which directly affect the distribution of benthic species and communities, while both salinity and temperature generally decline with increasing distance from TOG (Heggie and Skyring, 1999). Studies conducted elsewhere in temperate Australia (Loneragan *et al*., 1989; Edgar *et al*., 1999; Hirst, 2004) have generally concluded that salinity predominantly structures diversity and community composition of estuarine biota and it seems reasonable to infer that the large north-south salinity gradient reported for the Spencer Gulf (Nunes Vaz and Lennon, 1986) also plays a role in structuring its marine benthos.

Trawl intensity was also found to explain a small component of the variation in by-catch community structure (4%). This finding differed from 2007 when trawl intensity had no detectable association with community structure (Currie *et al.*, 2009). However, the analysis used by Currie *et al.* (2009) (i.e. ANOSIM) cannot easily be extended to designs with multiple factors or predictor variables (Anderson, 2001). Therefore, a more effective way to make comparisons incorporating all temporal, spatial and environmental predictor variables of interest in 2013 was to use a DISTLM combined with dbRDA (Anderson, 2001; Anderson *et al.*, 2008). Analyses based only on ordination scores (like 2007) can also omit some ecological information, as differences between sites are based only on rank values (Clarke, 1993; Anderson, 2001). Thus, the small contribution of trawl intensity to overall variation in community structure in 2013 is unlikely to represent an increased relationship, but rather the different statistical method utilised.

A small portion of variation in community structure was also evident between the two sides of the Gulf (3%). As was suggested by Currie *et al.* (2009), any difference between the two sides of the Gulf may reflect the inflow of nutrient-rich water from the shelf into the western Gulf (Nunes Vaz *et. al.*, 1990), in comparison to the eastern Gulf where nutrient-depleted water flows outward. Other physical and environmental factors may also play a role, such as exposure/fetch to the prevailing swell and/or wind direction. The small magnitude of this effect most likely reflects the limited spatial separation of eastern and western sites in the more northern parts of Spencer Gulf.

4.2.3 *Taxonomic groups*

The total abundances and biomasses recorded in this survey were dominated by fish and crustaceans, which were both widely distributed in Spencer Gulf. These findings were consistent with those of Carrick (1997) and Currie *et al.* (2009) who both found these phyla to be the dominant taxa from trawl samples. While, fish abundance (non-significant) and biomass (significant) decreased from 2007 to 2013, this did not appear related to those areas of Spencer

Gulf that are intensively trawled. Instead, this decrease in fish resulted from the absence of large catches of small finfish from South and Central regions of the Gulf. Nonetheless, the patterns of dominance from these primary taxa still mirrored those from Carrick (1997) and Currie *et al.* (2009), with crustaceans (i.e. prawns and crabs) having the greatest biomass and contribution to site similarity in North, Mid-North and Central regions and fish increasingly common in terms of relative biomass and contribution to site similarity in the South region.

Poriferans (sponges) were broadly distributed in both 2007 and 2013. Surveys prior to 2007 found somewhat variable by-catch results for sponges, as Carrick (1997) reported relatively low levels, whereas Svane *et al.* (2007) found that sessile epibenthos (i.e. sponges, bryozoans, and bivalves) dominated the by-catch (Currie *et al.*, 2009). However, as Currie *et al.* (2009) explained these contrasting results are likely to reflect the spatial differences in the locations surveyed in these two previous studies. The consistently lower biomasses of sponges and bryozoans that were recorded in heavily trawled areas during 2007 and 2013 support the notion that these taxa are particularly susceptible to demersal trawling. This is because they are sessile, long-lived, slow growing, slow to recruit and thus may take years, or even decades, to recover from trawling impacts (Currie *et al.*, 2009). Studies in north-western Australia have shown that a single fish trawl can remove up to 90% of the large sponges in its path (Sainsbury *et al*., 1992). Elsewhere in northern Australia, experimental prawn trawling has been shown to deplete sponge biomass by approximately 78% (Burridge *et al*., 2003). As no quantitative data are available on sponge and bryozoan distribution in Spencer Gulf prior to the commencement of the fishery, the hypothesis that trawling explains the spatial differences in the abundances and biomasses cannot be tested (Currie *et al.*, 2009).

Currie *et al.* (2009) suggested the loss of habitat provided by sponges and other erect sessile fauna on the main trawl grounds of the Spencer Gulf may explain the lower biomass of fish. Support for this explanation was not evident during the 2013 survey, highlighting temporal variation might interact with possible trawl related impacts. Importantly, neither the abundance nor biomass of fish was significantly lower in heavily trawled areas after the 2013 data were included in the analysis. Thus, while some individual fish species appeared to be negatively or positive related to trawl intensity, no overall impact was detected.

In contrast to the sponges and bryozoans, the abundances and/or biomasses of crustaceans, magnoliphytes, molluscs and rhodophytes were significantly greater on moderate and/or intensely trawled areas than on lightly trawled areas. For some species of algae and invertebrates this may reflect the capacity of these fast growing and fecund groups to rapidly colonise areas disturbed by prawn trawling (e.g. Sainsbury *et al*., 1992; Currie *et al.*, 2009). In contrast, the increase in magnoliphytes (seagrasses) at heavily trawled sites seems somewhat anomalous, as seagrasses are generally slow to recruit following disturbance (e.g. Bryars and Neverauskas, 2004). This result should be interpreted cautiously given seagrass constituted a relatively minor component of the total abundance (<0.5% in both surveys) and these may simply coincide with favoured trawling regions (i.e. upper part of the Gulf) or be captured as drift/detritus.

Temporal stability in the abundance/biomass and trophic structure of by-catch organisms is an important potential ecological performance indicator for the SGPF (Mayfield *et al.*, 2014). From 2007 to 2013, the majority of common phyla displayed stable abundance and/or biomass (i.e. crustaceans, molluscs, sponges and bryozoans). Likewise, temporal influences in the community structure analyses were minimal for all four key trophic groupings (i.e. fish, motile invertebrates, sessile invertebrates and plants/algae). While some phyla decreased in abundance and/or biomass from 2007 to 2013 (e.g. fish, echinoderms and urochordates), statistical comparisons found these temporal differences to be unrelated to trawl intensity, thus reflecting more general Gulf-wide changes.

The total variation in fish and motile invertebrate communities explained by the PCO axes (~20-26%), exceeded that for sessile invertebrates and plants (~8-9%). This could be interpreted to reflect a number of environmental or fishing impacts. Historical trawl related impacts may have disrupted the regional structuring of sessile taxa in Spencer Gulf, however, the overall influence of trawl intensity still remained lower for sessile taxa compared with the other trophic groupings. Therefore, a more likely explanation would be that the lower occurrence and higher variation of these sessile species in trawl samples increases the proportion of unexplained variation. Poorer classification to species level may also contribute to the limited spatial differences that were detected.

4.2.4 *Abundant species*

The four most abundant species (King Prawn, Degen's Leatherjacket, Bue Swimmer Crab and Skipjack Trevally) were the same as during previous by-catch surveys (e.g. Carrick, 1997; Currie *et al.*, 2009). While the survey design has been modified since February 1996 (Carrick, 1997), these four species still dominated overall catches throughout Spencer Gulf. Collectively, in 2013 these four species accounted for 68% of total abundance and 58% of total biomass.

This pattern of dominance by a small number of widespread species is not unusual in marine benthic communities, but as Currie *et al.* (2009) highlighted these four species are all motile benthic scavengers. The prevalence of scavenging species is noteworthy in light of the large volume of by-catch discarded annually by prawn trawlers in Spencer Gulf and made available as food for these species (Svane *et al*., 2008; Currie *et al.*, 2009). Numerous studies suggest that discarded catch may increase the size of some scavenging populations (Wassenberg and Hill, 1990; Kaiser and Spencer, 1996; Ramsay *et al*., 1998).

The total biomass of fish was significantly lower in 2013, however, none of the 20 most abundant species exhibited a statistically significant decrease in biomass, and only two species (i.e. Rough Leatherjacket and Slender Bullseye) displayed a decrease in abundance. Large between-site variation of individual species reduces the likelihood of detecting significant differences. For example, the average biomass and abundance of Degen's Leatherjacket decreased by almost an order of magnitude between 2007 and 2013, however, significant differences were not detected due to ~50% of this abundance/biomass occurring at only two sites in 2007. Intra- and inter-annual variation in leatherjacket numbers in trawl samples is known to occur in Spencer Gulf (Svane *et al.*, 2007).

While overall abundance and biomass of fish were not related to trawl effort in 2013, some species showed significant differences among trawl intensities. Four species (i.e. Red Mullet, Silverbelly, Silver Whiting and Spotted Stinkfish) all showed significantly lower abundance and/or biomass in intensively trawled areas. These patterns might be a direct result of trawl mortality, or as suggested by Currie *et al.* (2009) such findings might be consistent with those of Sainsbury (1988) who reported that a measurable decrease in sponge by-catch during trawling led to a reduction in the catches of fish (i.e. snappers and emperors), which sheltered among these structures and fed on the emergent fauna. Alternatively, for some species this distribution might simply reflect a preference for areas or habitats with historically low trawl effort (e.g. Silver Whiting are generally confined to lower sections of Spencer Gulf where trawl effort is historically low – Appendix 5).

The dominant species typifying each region in 2013 (i.e. contributing the most to site similarity) were the same as in 2007 (e.g. Currie *et al.*, 2009). In the North region the dominant species was the King Prawn, in the Mid-North and Central region it was the Blue Swimmer Crab, and in the South it was Degen's Leatherjacket. A number of other fish/mollusc species were slightly more or less influential across different regions in 2013 compared with 2007, but it must be remembered the percentage contribution to site similarity increases or decreases based on the dominance of other taxa, thus only represents a relative change not absolute (Currie *et al.*, 2009).

The four community regions identified within Spencer Gulf were characterised by differences in the number of species. The South region supported the greatest number of species (180), and the highest group fidelity (52 unique species), supporting Currie *et al.* (2009) finding of increasing diversity with latitude. The other three regions supported similar numbers of species (147-149) from a similar number of trawls (15-18), although site fidelity was higher in the Central region (28 unique species).

The abundance and biomass of the two by-product species was similar from 2007 and 2013. The Southern Calamari was once again more abundant in moderate-to-high trawl intensity areas, than areas with historically low trawl intensity. Currie *et al.* (2009) suggested that the higher abundance of Southern Calamari in trawled regions of Spencer Gulf may be a result of the lower number of predatory fish observed in these areas in 2007, as fish predation is considered substantial in many marine food webs (Bax, 1991). While lower fish biomass was not evident in intensively trawled areas during the 2013 survey, known intra- and inter-annual variation in fish abundance (e.g. Svane *et al.*, 2007) means predatory effects might also vary temporally. Slipper lobster did not differ between 2007 and 2013, or in relation to areas of different trawl intensity, despite variable catch reports within this period (Roberts and Steer, 2010; Mayfield *et al.*, 2014). Since 2010, a size limit has been in place for slipper lobster, following recommendations during the SGPF MSC accreditation process (Moody Marine, 2011) and indications that localised depletion might be linked to commercial fishing effort (Roberts and Steer, 2010).

4.3. Threatened, Endangered and Protected Species

Seven species of syngnathids were captured in 2013. South Australian Museum records indicate that 11 other syngnathid species have been recorded for Spencer Gulf but were not captured during this study (Sorokin *et al.*, 2009). While the overall species richness of syngnathids remained stable from 2007 to 2013, the most commonly encountered species changed, reflecting the variable nature of infrequently captured species.

The lower overall syngnathid catch in 2013 was indicative of the change in survey design, reflecting the smaller relative proportion of low/closed intensity sites sampled in 2013. When trawl intensity was considered, the pattern of overall syngnathid capture remained stable across surveys. That is, a much greater proportion of individuals were captured at closed/low intensity sites, in comparison to moderate-to-high intensity sites. In 2013, no individuals were captured in the heavily trawled areas and only two specimens of the Big Belly Seahorse were captured at moderate intensity trawl sites.

In addition to industry self-imposed closures and trawling depth restrictions to >10 m, which help provide protection for syngnathids and their habitats (Mayfield *et al.*, 2014), reporting of interactions with protected species was introduced in 2007/08. This reporting aligned closely with the recommendation of Currie *et al.* (2009) that fishery-independent and fishery-dependent observing could be implemented to obtain information on interactions with syngnathids. Reports of interactions within the SGPF have been steadily rising from 0 in 2008/09 to 195 in 2012/13 (Tsolos and Boyle, 2014). While these trends may reflect an increasing interaction rate, it is more likely that they reflect an increase in reporting rate following an education program (Mayfield *et al.*, 2014). In addition, fishery-independent observers from SARDI Aquatic Sciences have been recording interactions in Spencer Gulf during November, February and April surveys each year. While the abundance of syngnathids varies both temporally and spatially, currently few clear trends are evident (Mayfield *et al.*, 2014). In the future, this information could be combined to potentially provide spatial and temporal likelihood ratings for interactions within different fishing blocks, and examine depletion rates associated with commercial trawling.

The ecological consequences of trawling for syngnathid species remain unclear. While logbook reports now contain explicit references to the release state of individual syngnathids (i.e. dead, damaged or released alive), as recommended during the MSC assessment report (Moody Marine, 2011), their subsequent fate remains uncertain. Of the 406 reported catches of syngnathids from fishery-dependent data within the SGPF between 2008-2013, 84% of individuals were returned to the water alive after trawling (Tsolos and Boyle, 2014). Syngnathids are known prey of several fish species (Whitley and Allan, 1958; Jordan and Gilbert, 1982) and as Currie *et al.* (2009) suggested they may be particularly vulnerable to predation after release. Physiological stress associated with trawl capture and release may also result in mortality (Thomas and Chick, 2007). As was recommended by Currie *et al.* (2009), additional studies, such as survival experiments, could be conducted to improve understanding of discard mortality.

4.4. Species of interest

The lower abundance of three species of interest captured in 2013, in part, reflects the reduction in the number of survey sites. These species were encountered primarily at low intensity trawl sites, which were reduced in number from 75 (2007) to 32 sites (2013). For one species, the Giant Cuttlefish, decreasing abundance in by-catch was foreseeable, given 2012-13 yielded the lowest numbers ever recorded at known breeding grounds in northern Spencer Gulf (Steer, 2015). Further, Steer (2015) concluded recent prawn trawling activity has not adversely impacted the Giant Cuttlefish population in northern Spencer Gulf, given by-catch fractions of the breeding population are low (<7%) compared with harvesting levels implemented for other cephalopod fisheries (e.g. 40%). More information is required to interpret changes in by-catch for the other species of interest (i.e. Tiger Pipefish and Coastal Stingaree).

4.5. Future monitoring and research

Distinguishing long-term trawl related impacts from natural variation is inherently difficult, particularly where there is a lack of baseline information (Currie *et al*., 2009). Establishing a reliable baseline is further complicated by inter-annual variation of particular by-catch species, which are difficult to interpret from expansive, but infrequent, by-catch surveys. Thus, in the future Gulf-wide by-catch surveys are one of numerous possible ecosystem monitoring techniques that could be used. Alternatively, ecosystem impacts of the fishery may be mitigated by: 1) continued optimisation of fishing practices through spatial management of effort, in conjunction with 2) monitoring of selected by-catch species. Collaboration between the SGWCPFA, SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture will be key to developing effective ecosystem monitoring tools in the future.

In the SGPF, effort has declined to ~40% of its peak during the late 1970s. Real-time spatial monitoring of effort could be used to manage the overall footprint of the fishery and, consequently, mitigate the industry's impact on by-catch and the ecosystem in which it operates. This potentially could include a series of spatially related performance indicators, and reference points for informing fishing practices in real time.

By-catch reporting of selected indicator species could be integrated with existing tri-annual fishery-independent surveys, and/or commercial fishing operations. This is likely to be a more cost-effective option than the expensive Gulf-wide, but temporally limited by-catch surveys. If alternative methods are established for the on-going assessment of by-catch, priority should be given to selecting indicator species that: 1) occur in sufficient abundance to detect significant changes (Dixon *et al.*, 2005) and 2) are known to be vulnerable to the impacts of demersal trawling. This approach may also aid in resolving questions regarding intra- and inter-annual variation in by-catch composition. Regardless of how monitoring is maintained, temporal change in by-catch species composition will remain a key performance indicator for ecological assessment of the SGPF (Mayfield *et al.*, 2014).

A number of BRDs have been periodically trialed within the SGPF, most recently including Nordmøre grids (Kennelly and Broadhurst, 2014), 'wok' shaped grids (Dixon *et al.*, 2014) and different mesh configurations (i.e. T90) (Dixon *et al.*, 2014). While in most instances these are yet to satisfy all of the pre-trial performance indicators for adoption identified by the fishery (Dixon *et al.*, 2014), collaborative research between SGWCPFA and SARDI Aquatic Sciences is ongoing (FRDC Project No. 2015-019). Multiple trials using T90 mesh (similar to the design adopted within the Gulf St Vincent Prawn Fishery) had some promising results in terms of reductions in by-catch, but associated losses in prawn catch were unacceptable (Dixon *et al.*, 2014). If BRD technology can be developed that effectively minimises prawn loss in the SGPF, their implementation would have the potential to reduce by-catch of species targeted by other commercial fisheries (Blue Swimmer Crabs), mega-fauna (sharks and rays) and those of conservation concern (cuttlefish and syngnathids) (Dixon *et al.*, 2014; Kennelly and Broadhurst, 2014).

4.6. Implications for fisheries management

This project provides fisheries management with a quantitative comparison of by-catch from fishery-independent surveys between 2007 and 2013 to inform risk assessment of the SGPF. Significant changes in by-catch (i.e. species composition and overall abundance/biomass) during this period were minimal, which suggests that any current impacts of commercial trawling are difficult to detect from the initial baseline that was established in 2007. The strong regional structuring of benthic communities in Spencer Gulf again outweighed any trawl related differences. Similarly, the composition of the most abundant species on the primary trawl grounds has remained relatively stable since research surveys began in 1996. While overall abundance and biomass appeared lower in 2013 when compared with 2007, there is no evidence to suggest these declines were either statistically significant or associated with trawl effort. Definitive conclusions regarding the temporal effects of trawling will require ongoing research, in particular to develop a reliable baseline for trawl footprint and better understanding of how intra- and inter-annual variation can influence potential by-catch indicator species.

Protected species (i.e. syngnathids) continue to be captured within the fishery. While the species composition (current study) and spatial and temporal distribution of catches varies (Mayfield *et al.*, 2014), syngnathids will continue to be monitored through mandatory reporting of all interactions during fishing and surveys. This could be combined with on-board post-capture survival experiments to gain a clearer picture of overall impacts on these species of important conservation value.

5. CONCLUSION

This study assesses the spatial and temporal distribution of benthic by-catch organisms in Spencer Gulf, and builds on the baseline that was established during 2007. It highlights the pronounced regional influence on the structuring of the benthic communities, when compared to differences associated with trawl intensity, a pattern first identified for Spencer Gulf by Currie *et al.* (2009). Further to this, the most notable change to the by-catch composition since 2007 (i.e. decreasing fish biomass) appears to be unrelated to trawl intensity, but more likely a result of inter-annual variation in biomass in the lower part of the Gulf. These results highlight that discerning trawl related impacts from environmental factors is particularly complex for Spencer Gulf, due its strong latitudinal structuring of communities, as well as greater exposure to oceanic influences in the south and greater historical trawl intensity in the north. Thus, despite the known impacts of trawling on benthos (Jennings and Kaiser, 1998; Tanner, 2003), there is limited evidence for changing benthic by-catch communities in Spencer Gulf over the past six years.

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APPENDICES

A.1. Appendix 1

Quality control procedures for by-catch database validation

Shot nomenclature

- All shot names reconciled with deck and skipper logs and transcription errors removed. SB 18/10/2013.

Shot length

- Co-ordinates for start and end-points of shots indicated on skipper logs entered into database. SB 18/10/2013.
- Co-ordinates for ID 389 changed from 34.9588 to 34.4588. Error present on the original Skipper Log. OB 21/01/2015
- Distance of all shots calculated in meters trawled using GPS – Distance calculator \\cluscbdfs02\user26\Wild_Fisheries\Prawns\SpencerGulfPrawn\bycatch\Bycatch_Survey 2013\Database\Additional data\
- Min/sec not recorded on Vessel Marija L (ID: 25, 39, 46, 48, 54, 60, 63, 64, 69, 73, 74 & 81), therefore the skippers estimate of distance trawled utilised instead. Start co-ordinates for Marija L shots assumed to match those listed in ID master spreadsheet (file: shot table_SG_allshots_Id) \\cluscbdfs02\user26\Wild_Fisheries\Prawns\data\ALL SURVEY DATA_SG_GSV\sg\

Shots sampled

- Seventy-three by-catch shots were undertaken during the February 2013 survey. Six shots were abandoned due to risks to trawling gear, net damage or error (see 'Aborted shots' below). Therefore, a total of 67 samples were collected and processed in the laboratory.
- Two shots undertaken during the day time (ID: 542 & 544) were removed from the database. The electronic data for these shots has been archived at \\cluscbdfs02\user26\Wild_Fisheries\Prawns\SpencerGulfPrawn\bycatch\Bycatch_Survey 2013\Database\Additional data\ OB 20/01/2015
- One of the 'Aborted shots' (ID: 194) had a number of observations (i.e. approximate counts) included in the deck-log, which were retained in the access database, but were not included in any analyses.
- Shot ID 307 not sampled due to ship anchored on shot location. ID 306 sampled as a substitute.
- Shot ID 15 indicated as a by-catch shot on skipper log was erased on deck log. ID 22 was sampled in its place.

Aborted shots

- Shot ID 194 was not sampled. Deck log indicates small catch with one large ray (unidentified sp.); 18 Blue Swimmer Crabs *Portunus pelagicus*; 7 Sand Crabs *Ovalipes australiensis*.
- Shot ID 44 no by-catch sample collected.
- Shot ID 514 sample was not retained due to a large hole in net (approximately 7 to 10m in length). Observer on deck estimated the sample to consist predominantly of unidentified sea grass and unidentified crab species.

- Shot ID 530 aborted due to the weight of net and concerns for FV Cvita B gear.
- Shot ID 512 aborted due to an inability to complete trawl.
- Shot ID 516 deck log indicates that no sample was retained.

Catch Estimate

- One level nally bin of by-catch was to be taken from each shot. Of the six vessels five FV Mel B; FV Cvita B; FV Marija L; FV Night Stalker and FV Brianna Rene Adele retained average sized nally bin samples. The remaining vessel FV Kylie retained samples were larger than average.

Standardisation

- One level nally bin of by-catch was to be taken from each shot, however, the total catch landed on deck, and subsequently retained for laboratory analysis, was less than one (<1) nally bin for ID 534. To ensure proportional representation of these data, the catch standardisation variable (BinSTD) for each of these shots has been coded ‘1’ on the ‘Vessel’ table of the Access database.

Species Table

- Confirmed mis-identification of female Toothbrush Leatherjackets, *Acanthaluteres vittiger* (F021) as Bridled Leatherjackets, *Acanthaluteres spilomelanurus* (F011) due to the lack of bristles on either side of tail. First week of sampling affected. Species table updated accordingly. SB 7/08/2013.
- Incorrect visual identification guide discovered in relation to Ornate Cowfish, *Aracana ornata* (F025) and Shaws Cowfish, *Aracana aurita* (F038). Laboratory component was not affected. Species table updated accordingly. SB 16/08/2013.
- Incorrect species code (M003) used for Southern Keeled Octopus, *Octopus berrima* (M033). Code corrected and all corresponding data updated. SB 8/10/2013.
- Incorrect visual identification guide discovered in relation to Short Boarfish, *Parzanclistius hutchinsi* (F015). Visual aid was of that of a Yellowspotted Boarfish, *Paristiopterus gallipavo*. Species table updated and new code allocated to Yellowspotted Boarfish. SB 29/10/2013.

Laboratory Table

- Abbreviations and notes required for interpreting the Laboratory Table are listed in the Comments column of the Access database. The following acronyms and abbreviations are used. 1 EC = The number ‘1’ was added to the excess column to signify this catch was measured prior to laboratory processing; 1 RC = The number ‘1’ was added to the remainder column to ensure it was included in abundance counts because no length measurement was taken; PC = A power curve was used to calculate the weight of this specimen; ~0.005 = This sample was assigned an assumed average weight of 0.005 kg (or 5g), because there was insufficient data to derive a power relationship, and BC = The weight of a ≤7 kg bucket count from on-board was used to calculate prawn count.
- In 31 shots (i.e. ID: 25, 39, 46, 48, 54, 60, 63, 64, 69, 73, 74, 81, 87, 90, 92, 99, 100, 104, 105, 115, 119, 134, 147, 157, 163, 203, 209, 531, 535, 536 & 538) prawns were removed and weighed from the by-catch sample or by-catch net on-board (i.e. prior to laboratory processing). In these instances a smaller sub-sample of prawns (≤7 kg) was counted on-board and used to calculate total prawn numbers based on Equation 1.

$\text{Total Count}_{(\text{BC Net/Sample})} = \text{Total Weight}_{(\text{BC Net/Sample})} / (\text{Weight}_{(\text{Sub-sample})}/\text{Count}_{(\text{Sub-sample})})$……Eq 1.

- In 25 of these 31 instances (i.e. ID: 25, 39, 46, 48, 54, 60, 63, 64, 69, 73, 74, 81, 87, 90, 99, 100, 105, 115, 119, 134, 157, 531, 535, 536 & 538) prawns were weighed and the count calculated for the whole by-catch net. In these cases a '1' has been placed in the excess column in the Access database to ensure these prawn weights are added after the by-catch sampled is multiplied by the No. of Bins.
- Cross-referencing of C001 (King Prawn) weights in by-catch samples was undertaken with Skipper-Logs to ensure the weight of prawns in the by-catch samples were representative of total catch, as a means of detecting observer errors based on Equation 2

  Total Prawn Weight $_{\text{(Skipper Log)}}$ = Prawn Weight $_{\text{(BC Sample)}}$* No. of Bins $_{\text{(BC Sample)}}$ * No. of Nets $_{\text{(Skipper Log)}}$……………………Eq 2.

- For shot ID 111 the following data was collected: Total Prawn Weight $_{\text{(Skipper Log)}}$ = 92 kg, No. of Nets $_{\text{(Skipper Log)}}$ = 2, Prawn Weight $_{\text{(BC Sample)}}$ = 2.44 kg and No. of Bins $_{\text{(BC Sample)}}$ = 2. Based on the above equation the Prawn Weight $_{\text{(BC Sample)}}$ was an order of magnitude lower than expected (i.e. 2.44 kg not 23 kg). It appears the observer has forgotten to record the weight of prawns removed from the by-catch sample, therefore, 20.56 kg was added to Laboratory Table/by-catch sample so Prawn Weight $_{\text{(BC Sample)}}$ = 23 kg. OB 20/01/2015
- Shot ID 77 was blank on the original By-Catch Record Log for No. of Bins. Approximately 22 kg of by-catch was processed in the laboratory and there was no evidence to suggest the shot was abandoned. Therefore, it appears the observer has forgotten to record the No. of Bins. Based on the above equation the No. of Bins $_{\text{(BC Sample)}}$ was estimated to be 2.7, where Total Prawn Weight $_{\text{(Skipper Log)}}$ = 15.1 kg, No. of Nets $_{\text{(Skipper Log)}}$ = 2, Prawn Weight $_{\text{(BC Sample)}}$ = 2.84 kg. This value was also similar to the average for the Middlebank region of ca. 2bins. OB 20/01/2015
- Where no length measurement was recorded, '1' was added to the 'Remainder Count' column to facilitate abundance counts using summary/pivot tables, besides instances where recorded notes indicated the sample was only a fraction of a whole organism (i.e. prawn tails or bodies without heads, crab legs), in which case they were excluded from abundance counts.
- The only abiotic code in the laboratory table (Rubble; R001) was removed and archived at \\cluscbdfs02\user26\Wild Fisheries\Prawns\SpencerGulfPrawn\bycatch\Bycatch Survey 2013\Database\Additional data\ OB 20/01/2015
- Plots of length-weight relationship were examined for each species within the Laboratory Table and outliers used to find and correct data entry errors. OB 16/01/2015.
- Plots of length-weight relationship were examined for each species within the Laboratory Table and obvious mistakes in data recording corrected. OB 16/01/2015.
- Plots of remainder count and remainder weight relationship were examined for each species within the Laboratory Table and used to correct data entry errors and mistakes. OB 16/01/2015
- For all individual fauna with a weight recorded to be <10g a length-weight relationship was established from Currie *et al.*, 2009 to calculate weight (i.e. A001, A002, C001, C003, C005, C008, C010, C012, C013, C015, C017, E001, E003, F003, F004, F006, F008, F009, F011, F017, F019, F021, F023, F025, F028, F032, F044, F046, F048, F049, F052, F055, F072, F075, F095, F125, M001, M004, M005, M008, M011 & M019). Where few samples were available from previous by-catch surveys or only a weak relationship existed (i.e. n <10 or r^2 < 0.3) all values <10g were replaced with an assumed average of 5 g (i.e. A004, A011, C011, C016, C019, F027, F078, M006, M015, M016, M031, M033 & M038). Data for all power curves was archived at

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- Power curves were used to predict weights for excess megafauna that were measured on-deck and returned to the water. The formulae and reference for each species is given below. Where insufficient data were available from previous by-catch surveys (i.e. Currie *et al.*, 2009), relationships were sourced from available published literature. Note all ray lengths are based on disk widths, besides southern fiddler ray which is Total Length. OB 15/01/2015

Code	Common Name	Equation	Reference
F031	Port Jackson Shark	$W = 0.000001*L^{3.297}$	Currie *et al.*, 2009
F061	Eagle Ray	$W = 0.0000005*L_{width}^{3.515}$	Currie *et al.*, 2009
F073	Southern Fiddler Ray	$W = 0.000006*L^{2.9893}$	Currie *et al.*, 2009
F077	Angel Shark	$W = 0.000009*L^{3.004}$	Currie *et al.*, 2009
F085	Cobbler Wobbegong	$W = 0.0000004*L^{3.4005}$	Svane *et al.*, 2007
F088	Southern Shovelnose Ray	$W = 0.000006*L^{2.8875}$	Currie *et al.*, 2009
F097	Black Stingray	$W = 0.00001*L^{3.1184}$	Currie *et al.*, 2009
F098	Smooth Stingray	$W = 0.00001*L_{width}^{3.1184}$	Currie *et al.*, 2009
F099	Gummy Shark	$W = 0.000006*L^{3.012}$	Currie *et al.*, 2009
F100	Ornate Wobbegong - F	$W = 0.0000574*1.008*L^{2.69}$	Huveneers *et al.*, 2007
F100	Ornate Wobbegong - M	$W = 0.0000317*1.007*L^{2.78}$	Huveneers *et al.*, 2007
F147	Whiskery Shark	$W = 0.00001630*L^{2.733}$	Simpfendorfer & Unsworth 2000
F148	Gulf Wobbegong - F	$W = 0.00000652*1.008*L^{3.01}$	Huveneers *et al.*, 2007
F148	Gulf Wobbegong - M	$W = 0.0000736*1.008*L^{2.69}$	Huveneers *et al.*, 2007

- An incorrect technique was used to measure length for M033 (Southern Keeled Octopus) during the majority of the lab sampling. This error was realised and two techniques (i.e. correct and incorrect) were applied for the remaining nine individuals. A linear relationship was then established between the nine individuals with both measurements using Equation 3, which was then used to calculate the correct lengths for incorrectly measured individuals. OB 12/01/2015.

$$\text{Length}_{(correct)} = 0.83*\text{Length}_{(incorrect)} - 0.20\ (R^2 = 0.93)……………………..\text{Eq 3.}$$

- Three F016 (Spiky Globefish) do not have length measurements; Two were discarded at sea prior to measuring and one significantly exceeded the range of data available for establishing a power curve. OB 19/01/2015
- All non-unitary organisms from the same by-catch shot (i.e. colonial ascidians, plants, sponges and algae) were combined into a single data point. OB 21/01/2015
- One × F077 (Angel Shark) in ID 531 was recorded as 570mm and 9.2 kg. Impossible weight for individual of this length. Assumed observers have recorded width rather than length, as was protocol for rays. Power relationship applied to calculate revised length of 998 mm. OB 22/01/2015
- During and after lab processing 19 × F056 (Prickly Toadfish) were mis-identified (or had their ID changed retrospectively) as F042 (Orange-barred Pufferfish). This was evident from the two very distinct size classes of F042, including a cohort of larger specimens ~ 2-fold the maximum length for F042 (Gomon *et al.*, 2008). This cohort of larger

individuals had their ID changed to F056. This data has been archived in the Power Curves file at \\cluscbdfs02\user26\Wild Fisheries\Prawns\SpencerGulfPrawn\bycatch\Bycatch Survey 2013\Database\Additional data\ OB 23/01/2015

- Where specimens could not be identified from photographs or sub-samples that were kept, a general Phyla code was applied (A200 = Unidentified Ascidian; B200 = Unidentified Bryozoan; C200 = Unidentified Crustacean; E200 = Unidentified Echinoderm; F200 = Unidentified Chordate; G200 = Unidentified Magnoliophyte; H200 = Unidentified Cnidaria; M200 = Unidentified Mollusc; S200 = Unidentified Porifera; X201 = Unidentified Phaeophyte and X202 = Unidentified Rhodophyte. Algae that could not be assigned to a phyla were included as X200 = Unidentified Algae. One Unidentified Chordate was retained at family level (F201 = UnID Syngnathid), due to its potential status as a threatened and endangered species.
- The sample originally retained for “Sponge 4” in ID 25 (16 kg) appears to have been originally identified as a combination of S002 and S028. SS re-examined photo 21/1/2015 and was unable to conclude identification to species level, therefore 8 kg has been assigned to each S002 and S028.
- An unidentifiable mixture of roots and algae was recorded in ID 533 (1.94 kg). This sample was split into two records (G200 UnID Magnoliophyta and X200 UnID Algae) of equal weight (i.e. 0.97 kg each).
- A mixture of weed and algae (G001 and X031) was weighed together in ID 54 (0.05 kg). This sample was split into two records (G001 UnID Magnoliophyta and X031 Gelidium sp. 1) of equal weight (i.e. 0.025 kg each).
- Two records were deleted form the database sand star leg - broken (ID 163) could not be identified and constituted only a fraction of an organism. Assorted sponges (ID 8) could not be identified and had no weight or count recorded.
- One species (F109 Toothy Flathead) showed significantly different geographic range between 2007 and 2013 survey, indicating a species mis-identification is very likely. While no changes were made to this survey result, particular care should be taken in any future survey regarding identification of all flathead species.

Aggregation of Abundance and Biomass

- Abundance and biomass information from the Laboratory table were aggregated by site (ID column) and species (i.e. code column):
  1. Data lines for non-excess species (i.e. Excess not equal to 1) extracted and summary table produced with 2329 records.
  2. Weight for non-excess species calculated as (SumofWeight column + Sumof Remainder Weight column)*AveofBins STD.
  3. Count for non-excess species calculated as (CountofLength column + Sumof Remainder Count column)*AveofBins STD.
  4. Data lines for excess species (i.e. Excess equal to 1) extracted and summary table produced (97 records) with total weights and total counts.
  5. Weight STD and Count STD calculated by dividing respective totals by hectares trawled.
  6. The final aggregated catch table for each site has been added to the access database.

A.2. Appendix 2

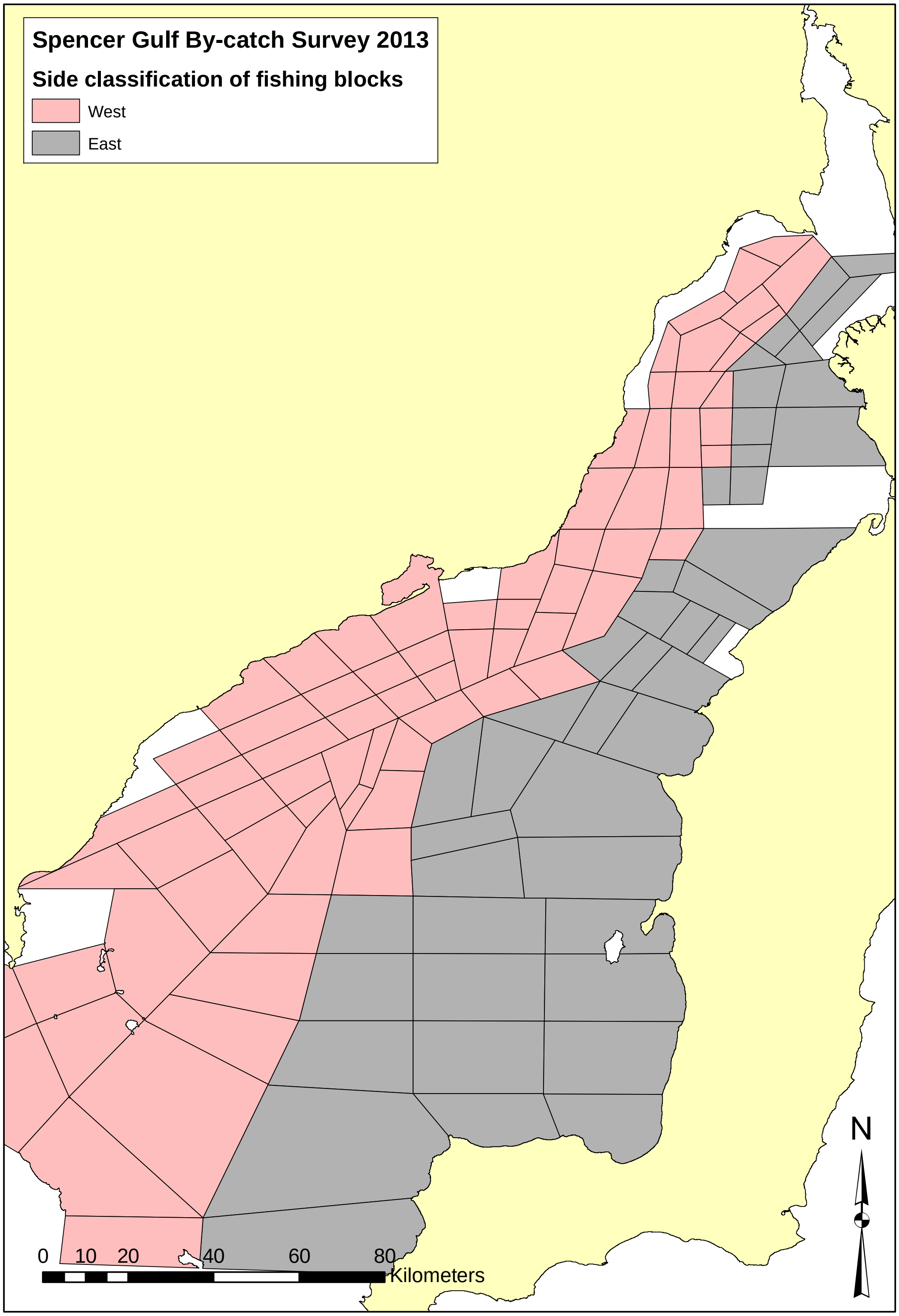


Figure A.2. Classification of Spencer Gulf fishing blocks by side (East or West).

A.3. Appendix 3

Mean (5-year average) prawn trawling effort (hours fished / km^2) reported for 119 fishing bocks in Spencer Gulf between 1987 and 2012.

Block	1988 - 1992	1993 - 1997	1998 - 2002	2003 - 2007	2008 - 2012	Intensity Class (2008-2012)
31	21.853	29.567	19.066	14.933	18.626	High
43	39.367	59.048	26.948	24.615	18.496	High
46	6.789	6.239	6.229	9.318	14.466	High
36	20.149	14.113	17.056	18.324	13.680	High
44	14.449	13.441	20.956	17.439	13.385	High
47	1.005	0.819	2.887	11.792	12.143	High
38	4.296	1.586	9.655	12.655	10.266	High
52	9.377	7.803	5.816	6.814	7.591	Moderate
39	10.415	6.775	7.465	8.752	6.763	Moderate
42	9.007	5.523	5.499	5.445	4.838	Moderate
40	0.360	0.027	3.167	3.903	4.611	Moderate
26	6.083	5.910	1.151	0.980	3.409	Moderate
45	1.453	2.274	1.988	2.281	3.109	Moderate
29	3.970	1.709	0.987	2.531	2.743	Moderate
87	2.065	2.390	4.319	3.950	2.618	Moderate
35	1.698	0.307	3.867	5.609	2.373	Moderate
51	7.660	8.839	5.316	2.773	2.357	Moderate
17	3.161	3.869	0.818	0.509	2.343	Moderate
24	1.280	2.773	2.175	0.606	2.060	Moderate
50	0.042	0.000	3.579	1.655	1.899	Moderate
23	17.192	12.108	3.442	0.448	1.883	Moderate
18	2.384	11.501	4.811	1.547	1.522	Moderate
65	2.088	5.810	3.291	2.746	1.491	Moderate
37	0.073	0.010	0.886	1.688	1.471	Moderate
73	0.949	0.393	0.315	0.164	1.448	Moderate
27	10.097	6.163	3.231	1.615	1.372	Moderate
32	0.604	0.144	1.128	1.347	1.258	Moderate
59	0.020	2.492	1.129	0.790	1.134	Moderate
64	2.551	2.932	2.418	1.647	1.126	Moderate
15	8.777	12.938	2.537	2.261	1.043	Moderate
57	0.086	1.455	0.849	0.368	0.877	Low
53	3.508	2.440	3.789	1.389	0.830	Low
25	5.095	1.749	1.235	0.343	0.813	Low
102	0.505	0.906	0.204	0.179	0.799	Low
49	0.022	0.018	2.277	1.047	0.766	Low
22	2.155	1.716	0.303	0.061	0.740	Low
124	0.250	0.345	1.621	0.855	0.722	Low
113	0.123	0.431	0.407	0.064	0.711	Low
84	1.294	0.879	1.133	1.024	0.680	Low
110	0.091	1.096	0.747	0.188	0.665	Low
69	0.508	0.478	0.919	0.876	0.659	Low
111	0.162	2.532	0.649	0.173	0.583	Low
70	0.162	0.472	0.229	0.182	0.497	Low
112	1.597	2.459	1.681	1.011	0.486	Low
9	9.463	19.552	1.939	1.642	0.468	Low
101	0.133	1.790	0.260	0.194	0.442	Low
94	0.151	0.072	0.340	0.490	0.427	Low
28	2.046	1.272	0.698	0.328	0.384	Low
54	2.069	1.659	0.833	1.013	0.256	Low
117	5.623	3.467	2.236	1.578	0.255	Low
125	0.079	0.000	0.222	0.013	0.231	Low
8	4.473	6.737	1.377	0.598	0.218	Low
68	0.512	0.979	0.256	0.318	0.210	Low
55	1.429	2.472	2.304	1.709	0.202	Low
83	0.091	0.032	0.018	0.008	0.194	Low
109	0.019	0.027	0.185	0.054	0.193	Low
103	0.095	0.252	0.139	0.025	0.171	Low
14	10.957	20.365	2.253	3.596	0.160	Low
34	0.078	0.070	0.135	0.025	0.149	Low

Block	1988 - 1992	1993 - 1997	1998 - 2002	2003 - 2007	2008 - 2012	Intensity Class (2008-2012)
92	1.146	0.651	0.770	0.197	0.145	Low
48	0.001	0.058	0.019	0.040	0.127	Low
56	0.683	4.012	1.947	0.338	0.124	Low
58	0.245	3.766	3.145	0.812	0.124	Low
82	0.000	0.021	0.006	0.041	0.116	Low
60	0.004	0.537	0.144	0.091	0.099	Low
74	0.008	0.053	0.009	0.002	0.090	Low
93	0.244	0.067	0.221	0.078	0.086	Low
62	0.017	0.575	0.286	0.178	0.085	Low
16	0.067	0.134	0.166	0.015	0.083	Low
19	13.336	6.047	1.604	0.126	0.080	Low
63	0.103	0.418	0.245	0.301	0.079	Low
66	0.009	0.057	0.063	0.017	0.065	Low
116	0.701	0.437	1.488	0.142	0.062	Low
67	0.009	0.000	0.283	0.112	0.059	Low
89	0.024	0.002	0.013	0.009	0.049	Low
10	2.794	3.637	0.034	0.034	0.046	Low
122	0.047	0.000	0.161	0.000	0.040	Low
98	0.626	0.133	0.396	0.068	0.037	Low
21	0.005	0.000	0.000	0.021	0.034	Low
118	3.638	1.361	1.197	0.379	0.033	Low
7	0.553	0.273	0.321	0.323	0.033	Low
123	0.284	1.093	0.307	0.076	0.030	Low
105	0.000	0.021	0.000	0.000	0.029	Low
72	0.153	0.127	0.106	0.027	0.027	Low
91	0.021	0.001	0.007	0.005	0.023	Low
30	0.008	0.002	0.011	0.029	0.021	Low
33	0.000	0.010	0.004	0.035	0.019	Low
71	0.077	0.005	0.133	0.020	0.019	Low
90	0.002	0.001	0.009	0.000	0.017	Low
77	0.000	0.001	0.000	0.002	0.014	Low
86	0.042	0.080	0.048	0.009	0.014	Low
13	5.122	3.029	0.353	0.033	0.013	Low
4	0.148	0.065	0.014	0.001	0.012	Low
88	0.000	0.049	0.032	0.045	0.011	Low
95	0.001	0.000	0.000	0.000	0.010	Low
81	0.000	0.004	0.009	0.000	0.009	Low
114	0.004	0.019	0.040	0.017	0.007	Low
75	0.000	0.007	0.005	0.000	0.007	Low
106	0.000	0.033	0.001	0.000	0.006	Low
85	0.050	0.118	0.044	0.016	0.005	Low
80	0.002	0.026	0.001	0.001	0.004	Low
96	0.008	0.004	0.010	0.003	0.001	Low
1	0.000	0.000	0.002	0.000	0.000	Low
2	0.040	0.000	0.002	0.000	0.000	Low
3	0.013	0.024	0.023	0.001	0.000	Low
5	0.060	0.161	0.103	0.049	0.000	Low
6	0.002	0.019	0.001	0.002	0.000	Low
11	0.014	0.005	0.000	0.000	0.000	Low
12	0.006	0.008	0.002	0.000	0.000	Low
20	0.117	0.000	0.015	0.049	0.000	Low
61	0.000	0.110	0.058	0.008	0.000	Low
76	0.000	0.023	0.000	0.000	0.000	Low
79	0.000	0.013	0.000	0.000	0.000	Low
97	0.000	0.006	0.009	0.003	0.000	Low
100	0.043	0.005	0.000	0.000	0.000	Low
108	0.000	0.002	0.000	0.000	0.000	Low
115	0.220	0.074	0.229	0.001	0.000	Low
119	0.357	0.289	0.046	0.142	0.000	Low
121	0.000	0.000	0.043	0.000	0.000	Low

A.4. Appendix 4

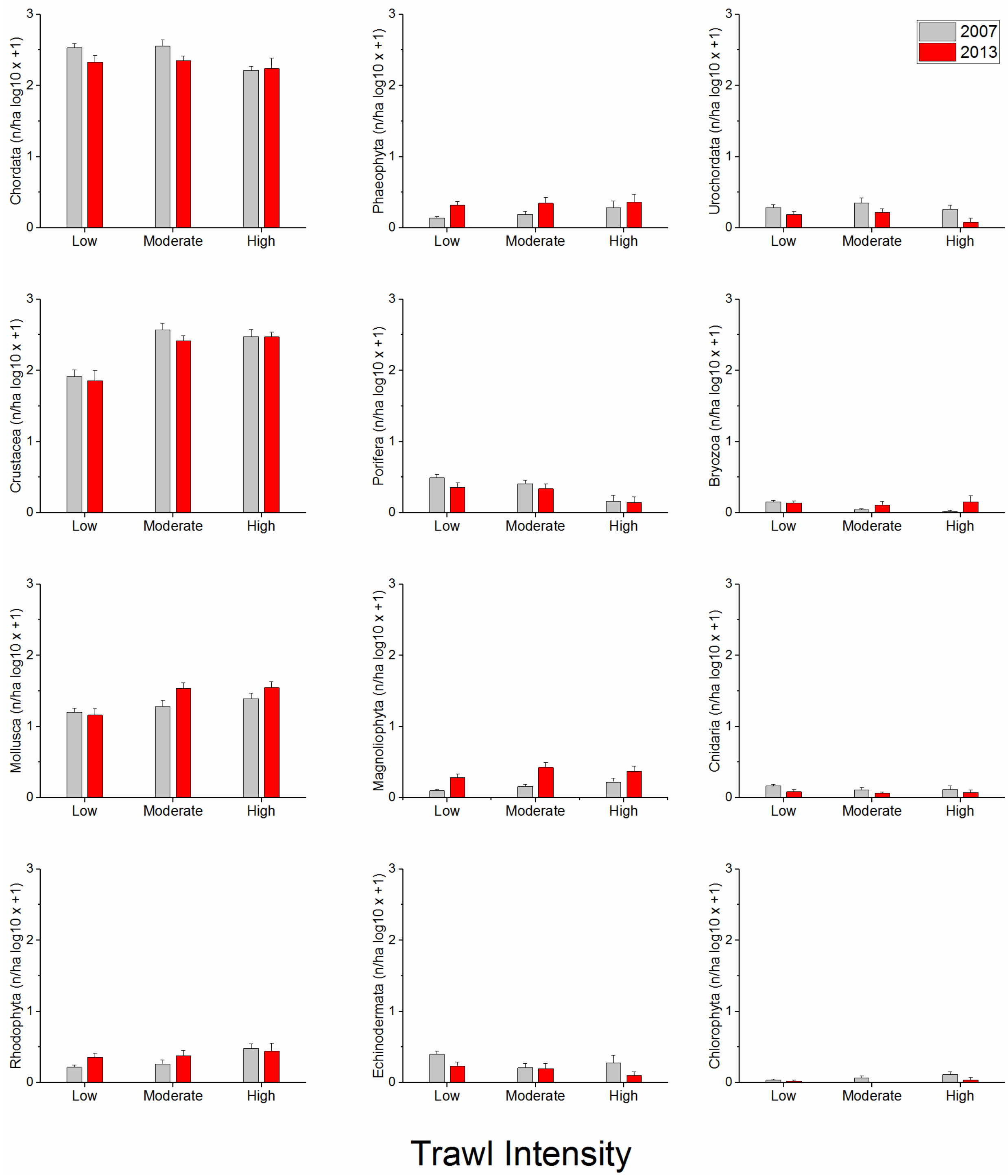


Figure A.4.1. Mean abundance (log_{10} (x+1)) + s.e. of species grouped by phylum from three areas of the Spencer Gulf subject to low (<1 hour trawling per km^2; n = 83 (2007), n = 32 (2013)), moderate (1-10 hours trawling per km^2; n = 27 (2007), n = 23 (2013)) and high levels (>10 hours trawling per km^2; n = 10 (2007), n = 10 (2013)) of prawn trawling effort over the periods 2003-2007 and 2008-2012.

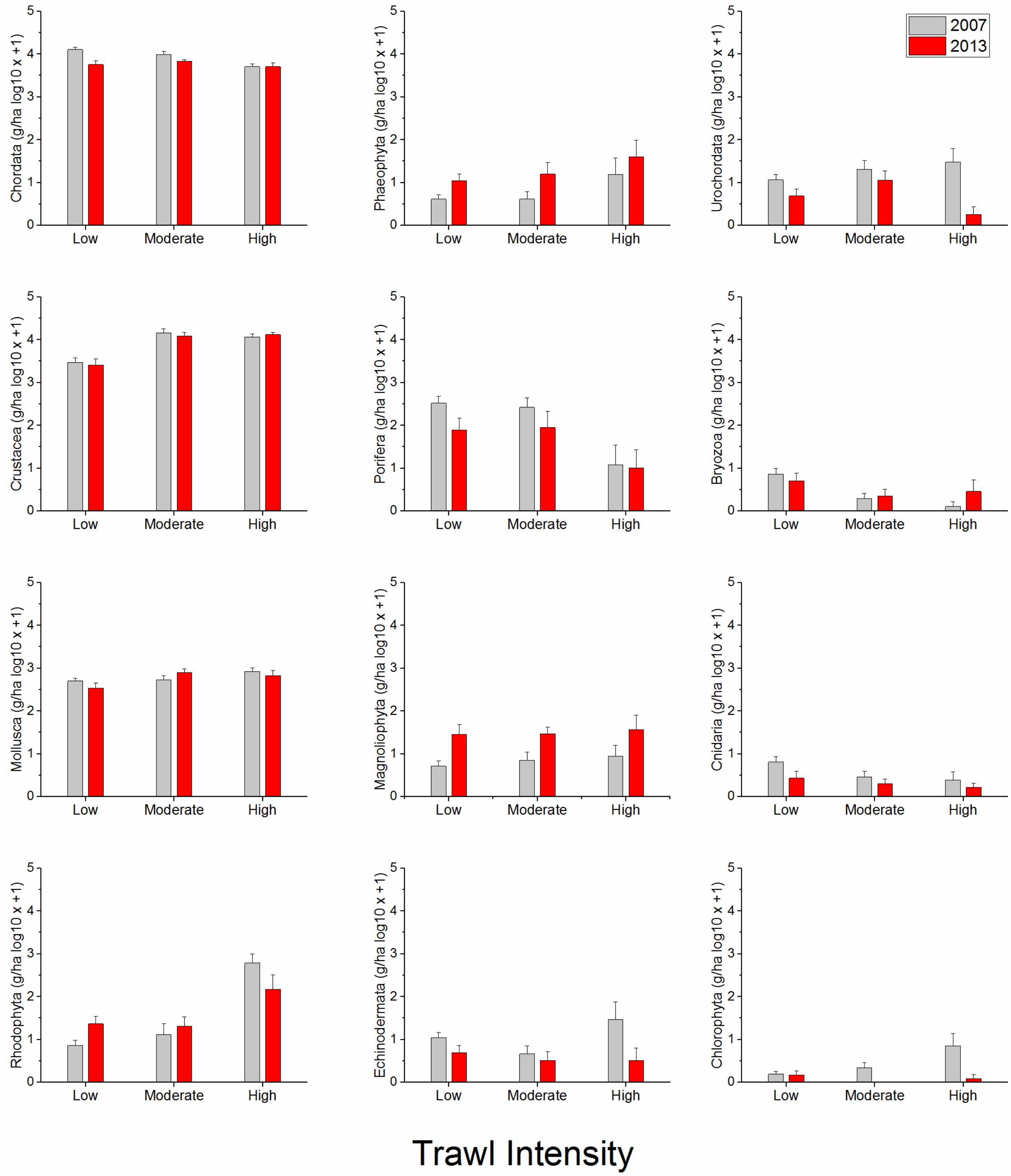


Figure A.4.2. Mean biomass ($\log_{10}(x+1)$) + s.e. of species grouped by phylum from three areas of the Spencer Gulf subject to low (<1 hour trawling per km^2; n = 83 (2007), n = 32 (2013)), moderate (1-10 hours trawling per km^2; n = 27 (2007), n = 23 (2013)) and high levels (>10 hours trawling per km^2; n = 10 (2007), n = 10 (2013)) of prawn trawling effort over the periods 2003-2007 and 2008-2012.

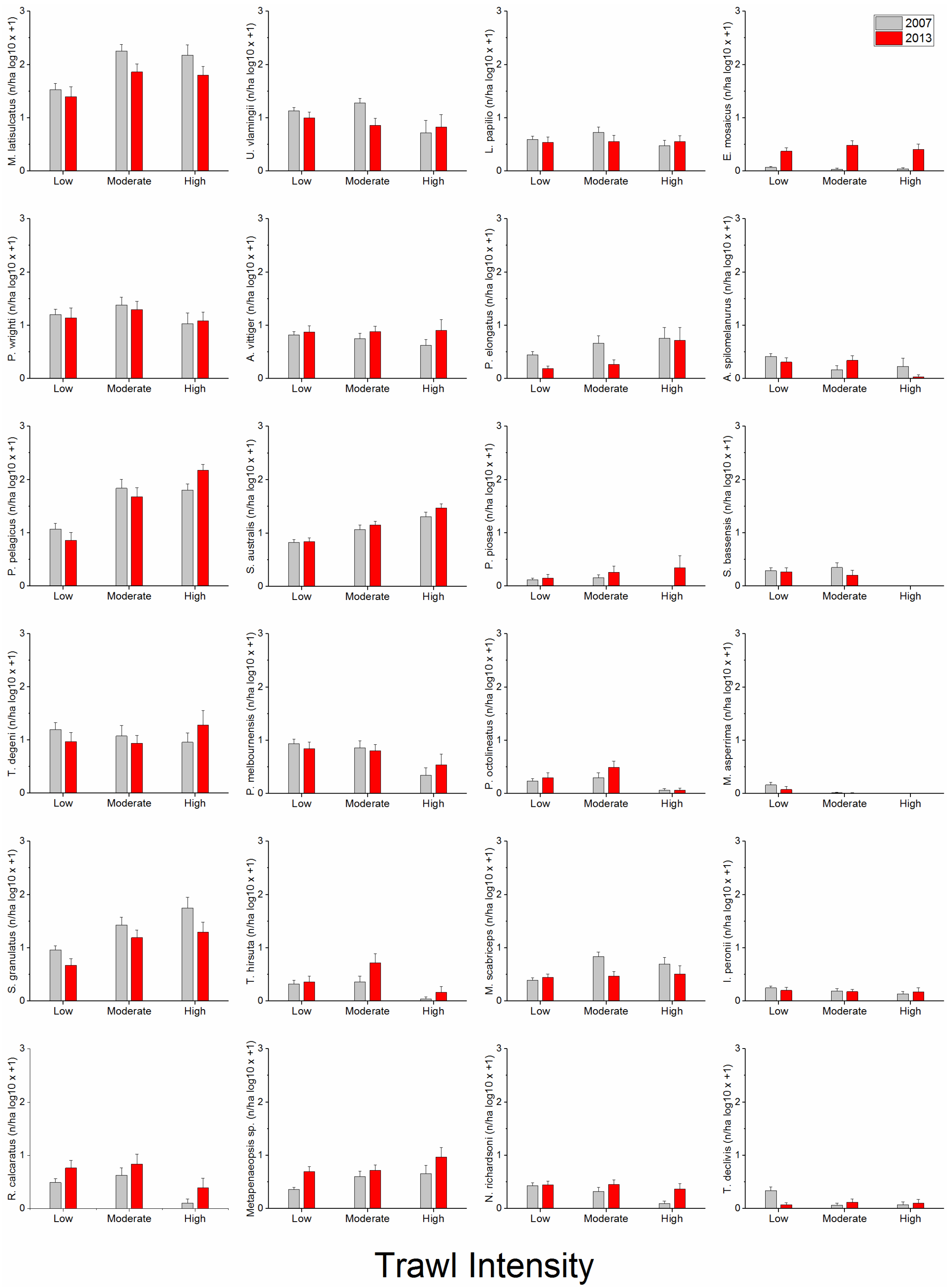


Figure A.4.3. Mean abundance ($\log_{10}(x+1)$) + s.e. of the 20 most abundant species collected from three areas of the Spencer Gulf subject to low (<1 hour trawling per km^2; n = 83 (2007), n = 32 (2013)), moderate (1-10 hours trawling per km^2; n = 27 (2007), n = 23 (2013)) and high levels (>10 hours trawling per km^2; n = 10 (2007), n = 10 (2013)) of prawn trawling effort over the periods 2003-07 and 2008-12.

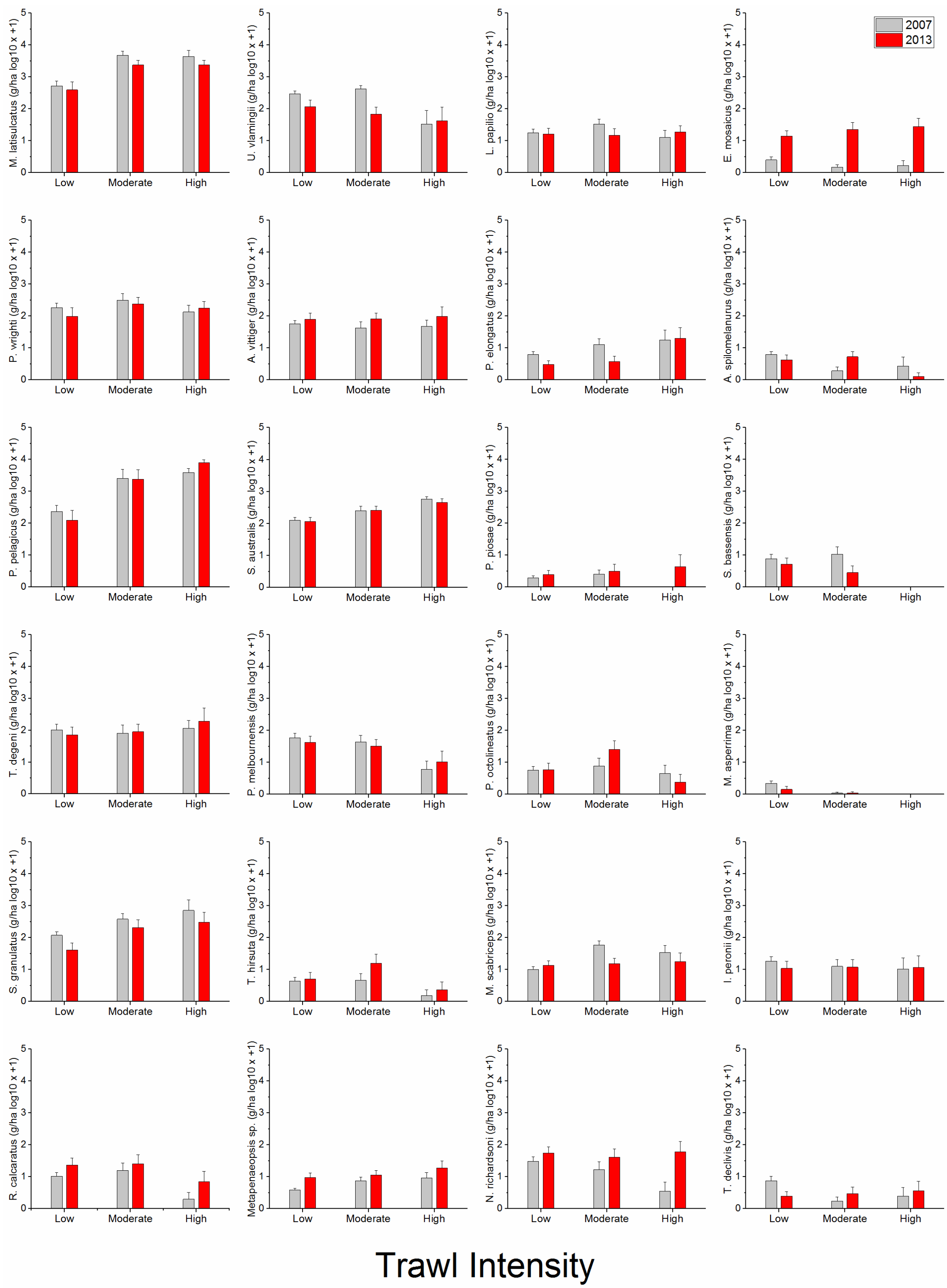
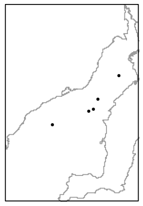


Figure A.4.4. Mean biomass ($\log_{10}(x + 1)$) + s.e. of the 20 most abundant species collected from three areas of the Spencer Gulf subject to low (<1 hour trawling per km^2; n = 83 (2007), n = 32 (2013)), moderate (1-10 hours trawling per km^2; n = 27 (2007), n = 23 (2013)) and high levels (>10 hours trawling per km^2; n = 10 (2007), n = 10 (2013)) of prawn trawling effort over the periods 2003-07 and 2008-12.

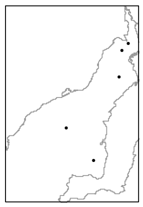
A.5. Appendix 5. Distribution of 286 species collected during Spencer Gulf prawn trawl survey in 2013.

A001 *Pyura gibbosa* (Heller, 1878) (Urochordata, Pyuridae) CAAB 35 032028



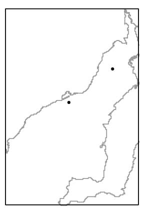
Common name = Sea Tulip
Length = To 38 mm
Depth range = 17.9 - 26.1 m
Stations = 104, 445, 508, 509, 517
Average biomass = 2.72 g/ha Rank biomass = 161
Average abundance = 0.14/ha Rank abundance = 85

A002 *Ascidia sydneiensis* (Stimpson, 1855) (Urochordata, Ascididae) CAAB 35 002018



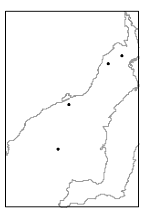
Common name = Blue Ascidian
Length = To 132 mm
Depth range = 17.9 - 35.2 m
Stations = 1, 8, 147, 445, 533
Average biomass = 8.16 g/ha Rank biomass = 122
Average abundance = 0.12/ha Rank abundance = 93

A003 *Herdmania momus* (Savigny, 1816) (Urochordata, Pyuridae) CAAB 35 032008



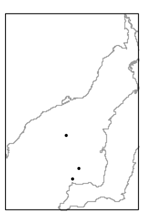
Common name = Spined Ascidian
Length = Not recorded
Depth range = 18.9 - 20.1 m
Stations = 39, 166
Average biomass = 7.07 g/ha Rank biomass = 130
Average abundance = 0.02/ha Rank abundance = 207

A004 *Polycarpa pedunculata* (Heller, 1878) (Urochordata, Styelidae) CAAB 35 033086



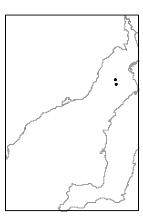
Common name = Polycarpa
Length = To 61 mm
Depth range = 18.9 - 42.2 m
Stations = 8, 25, 166, 389
Average biomass = 0.96 g/ha Rank biomass = 198
Average abundance = 0.05/ha Rank abundance = 129

A008 *Pyura australis* (Quoy & Gaimard, 1834) (Urochordata, Pyuridae) CAAB 35 032022



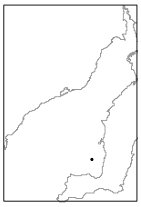
Common name = Sea Tulip sp. 2
Length = To 48 mm
Depth range = 35.2 - 38.9 m
Stations = 147, 203, 209
Average biomass = 2.12 g/ha Rank biomass = 174
Average abundance = 0.12/ha Rank abundance = 91

A010 *Halocynthia dumosa* (Stimpson, 1855) (Urochordata, Pyuridae) CAAB 35 032004



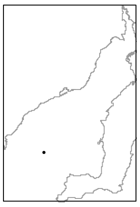
Common name = Christmas Tree Ascidian
Length = Not recorded
Depth range = 18.3 - 19.4 m
Stations = 51, 62
Average biomass = 8.64 g/ha Rank biomass = 118
Average abundance = 0.02/ha Rank abundance = 180

A011 *Cnemidocarpa radicosa* (Herdman, 1882) (Urochordata, Pyuridae) CAAB 35 033059

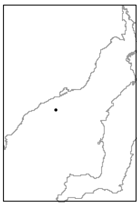
Common name = Cnemidocarpa
Length = To 24 mm
Depth range = 19.2 - 19.2 m
Stations = 533
Average biomass = 0.04 g/ha Rank biomass = 283
Average abundance = 0.01/ha Rank abundance = 250

A013 *Polyclinum marsupiale* (Kott, 1963) (Urochordata, Polyclinidae) CAAB 35 019056

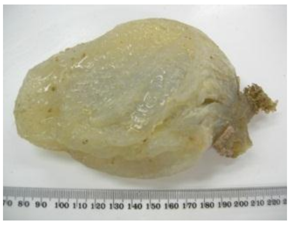
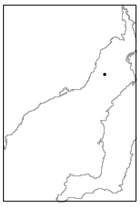
Common name = Polyclinum
Length = Not recorded
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.19 g/ha Rank biomass = 250
Average abundance = 0.005/ha Rank abundance = 275

A015 *Polysyncraton aspiculatum* (Tokioka, 1949) (Urochordata, Didemnidae) CAAB 35 013000

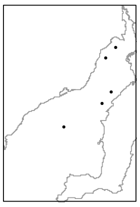
Common name = Polysyncraton
Length = To 54 mm
Depth range = 26.9 - 26.9 m
Stations = 184
Average biomass = 0.17 g/ha Rank biomass = 255
Average abundance = 0.02/ha Rank abundance = 210

A016 *Sigillina cyanea* (Herdman, 1899) (Urochordata, Holozoidae) CAAB 35 015023

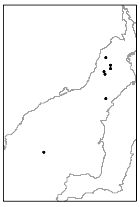
Common name = Sigillina
Length = Not recorded
Depth range = 26.9 - 26.9 m
Stations = 60
Average biomass = 0.56 g/ha Rank biomass = 217
Average abundance = 0.01/ha Rank abundance = 263

A017 *Phallusia obesa* (Herdman, 1880) (Urochordata, Ascidiidae) CAAB 35 002025

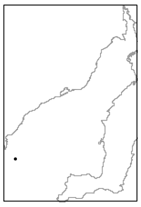
Common name = Phallusia
Length = To 77 mm
Depth range = 19.9 - 35.2 m
Stations = 25, 87, 115, 147, 306
Average biomass = 3.01 g/ha Rank biomass = 158
Average abundance = 0.11/ha Rank abundance = 96

A018 *Pyura stolonifera* (Heller, 1878) (Urochordata, Pyuridae) CAAB 35 032041

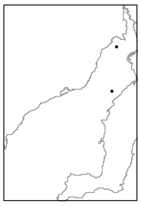
Common name = Cunjuvoi
Length = To 94 mm
Depth range = 20.1 - 44.7 m
Stations = 25, 39, 48, 54, 60, 99, 531
Average biomass = 14.71 g/ha Rank biomass = 100
Average abundance = 0.07/ha Rank abundance = 113

A025 Speckled Compound Ascidian (species unknown) (Urochordata) CAAB 35 000000



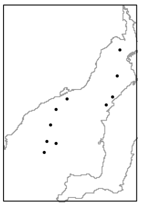
Common name = Speckled compound ascidian
Length = To 23 mm
Depth range = 27.4 - 27.4 m
Stations = 534
Average biomass = 0.30 g/ha Rank biomass = 236
Average abundance = 0.005/ha Rank abundance = 272

A030 Large leathery solitary ascidian (species unknown) (Urochordata) CAAB 35 000000



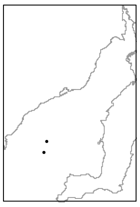
Common name = Large leathery solitary ascidian
Length = To 107 mm
Depth range = 19.9 - 21.0 m
Stations = 87, 306
Average biomass = 8.00 g/ha Rank biomass = 123
Average abundance = 0.11/ha Rank abundance = 95

B001 *Celleporaria fusca* (Busk, 1854) (Bryozoa, Lepraliellidae) CAAB 20 418004



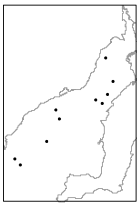
Common name = Celleporaria
Length = Not recorded
Depth range = 17.9 - 44.7 m
Stations = 8, 100, 119, 166, 184, 389, 445, 517, 525, 531
Average biomass = 32.04 g/ha Rank biomass = 70
Average abundance = 0.21/ha Rank abundance = 72

B002 *Adeona grisea* (Lamouroux, 1816) (Bryozoa, Adeonidae) CAAB 20 405006



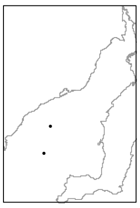
Common name = Adeona
Length = Not recorded
Depth range = 34.2 - 44.7 m
Stations = 525, 531
Average biomass = 0.34 g/ha Rank biomass = 230
Average abundance = 0.02/ha Rank abundance = 199

B003 *Steginoporella chartacea* (Lamarck, 1816) (Bryozoa, Steginoporellidae) CAAB 20 354006



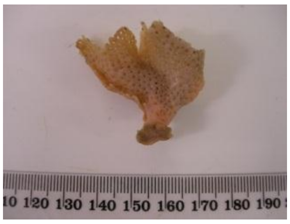
Common name = Steginoporella
Length = Not recorded
Depth range = 18.9 - 37.4 m
Stations = 25, 90, 104, 115, 152, 184, 502, 525, 534, 538
Average biomass = 39.64 g/ha Rank biomass = 62
Average abundance = 0.16/ha Rank abundance = 78

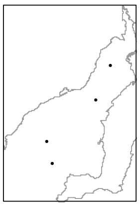
B004 *Cigclisula verticalis* (Maplestone, 1910) (Bryozoa, Stomachetosellidae) CAAB 20 460005



Common name = Cigclisula
Length = Not recorded
Depth range = 26.1 - 44.7 m
Stations = 517, 531
Average biomass = 0.38 g/ha Rank biomass = 226
Average abundance = 0.06/ha Rank abundance = 117

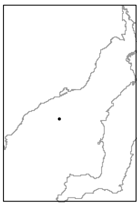
B005 *Triphyllozoon moniliferum* (MacGillivray, 1860) (Bryozoa, Phidoloporidae) CAAB 20 487002





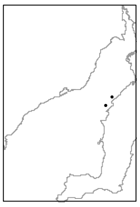
Common name = Lace Bryozoan
Length = Not recorded
Depth range = 20.1 - 43.4 m
Stations = 39, 104, 525, 536
Average biomass = 12.39 g/ha Rank biomass = 106
Average abundance = 0.06/ha Rank abundance = 123

B007 *Amathia wilsoni* (Kirkpatrick, 1888) (Bryozoa, Vesiculariidae) CAAB 20 231014



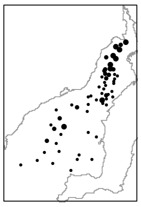
Common name = Amathia sp. 2
Length = Not recorded
Depth range = 30.7 - 30.7 m
Stations = 152
Average biomass = 0.05 g/ha Rank biomass = 280
Average abundance = 0.01/ha Rank abundance = 234

B013 *Triphyllozoon* sp. 2 (Bryozoa, Phidoloporidae) CAAB 20 487000



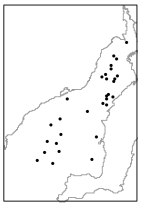
Common name = Triphyllozoon
Length = Not recorded
Depth range = 21.1 - 22.5 m
Stations = 100, 119
Average biomass = 1.12 g/ha Rank biomass = 196
Average abundance = 0.07/ha Rank abundance = 115

C001 *Melicertus latisulcatus* (Kishinouye, 1896) (Crustacea, Penaeidae) CAAB 28 711047



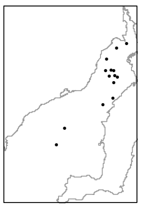
Common name = King Prawn
Length = To 60 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 134, 147, 152, 157, 163, 178, 184, 197, 199, 203, 209, 302, 306, 384, 389, 445, 501, 502, 503, 505, 509, 517, 525, 529, 531, 533, 535, 536, 538
Average biomass = 4646.49 g/ha Rank biomass = 2
Average abundance = 194.49/ha Rank abundance = 1

C002 *Ibacus* spp. (Leach, 1815) (Crustacea, Scyllaridae) CAAB 28 821004



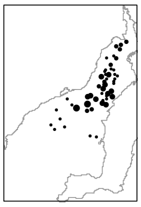
Common name = Slipper lobster (Eastern Balmain Bug)
Length = To 134 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 22, 29, 39, 48, 60, 64, 69, 90, 99, 100, 105, 115, 119, 152, 163, 166, 384, 389, 445, 501, 502, 509, 517, 525, 529, 531, 533, 535, 536
Average biomass = 168.04 g/ha Rank biomass = 24
Average abundance = 1.00/ha Rank abundance = 31

C003 *Pilumnidae* sp. (Leach, 1816) (Crustacea, Pilumnidae) CAAB 28 926000



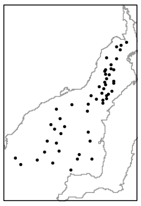
Common name = Hairy Shore Crab
Length = To 28 mm
Depth range = 17.9 - 42.2 m
Stations = 1, 25, 46, 48, 51, 62, 63, 100, 115, 147, 306, 389, 445, 502
Average biomass = 1.62 g/ha Rank biomass = 180
Average abundance = 0.36/ha Rank abundance = 53

C004 *Portunus (Portunus) pelagicus* (Linnaeus, 1758) (Crustacea, Portunidae) CAAB 28 911005

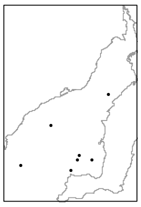
Common name = Blue Swimmer crab
Length = To 180 mm
Depth range = 16.6 - 35.2 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 134, 147, 152, 157, 166, 178, 184, 194, 302, 306, 383, 384, 445, 501, 502, 503, 505, 508, 509, 517
Average biomass = 7699.40 g/ha Rank biomass = 1
Average abundance = 96.15/ha Rank abundance = 3

C005 *Metapenaeopsis* sp. (Crustacea, Penaeidae) CAAB 28 711913



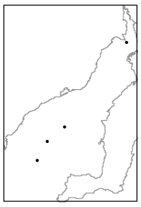
Common name = Strawberry Prawn
Length = To 17 mm
Depth range = 18.6 - 44.7 m
Stations = 1, 8, 25, 29, 39, 46, 48, 51, 54, 60, 63, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 104, 105, 111, 115, 128, 147, 152, 157, 163, 178, 184, 197, 199, 203, 209, 302, 306, 389, 502, 503, 509, 517, 525, 526, 529, 531, 533, 534, 535, 536, 538
Average biomass = 36.19 g/ha Rank biomass = 65
Average abundance = 10.67/ha Rank abundance = 12

C006 *Ovalipes australiensis* (Stephenson & Rees, 1968) (Crustacea, Portunidae) CAAB 28 911003

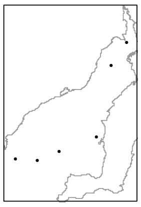
Common name = Sand Crab
Length = To 106 mm
Depth range = 19.2 - 38.9 m
Stations = 90, 194, 199, 203, 209, 517, 533, 538
Average biomass = 40.75 g/ha Rank biomass = 59
Average abundance = 0.32/ha Rank abundance = 58

C008 *Paguristes frontalis* (Milne Edwards, 1836) (Crustacea, Diogenidae) CAAB 28 827003

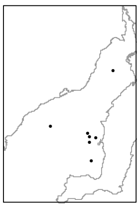
Common name = Common Hermit crab
Length = To 18 mm
Depth range = 22.0 - 44.3 m
Stations = 1, 147, 525, 535
Average biomass = 0.34 g/ha Rank biomass = 229
Average abundance = 0.05/ha Rank abundance = 136

C009 *Lamarckdromia globosa* (Lamarck, 1818) (Crustacea, Dromiidae) CAAB 28 852002

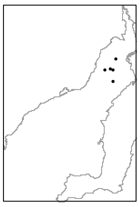
Common name = Shaggy Sponge Crab
Length = To 72 mm
Depth range = 20.1 - 44.3 m
Stations = 1, 39, 384, 529, 534, 535
Average biomass = 3.46 g/ha Rank biomass = 154
Average abundance = 0.10/ha Rank abundance = 102

C010 *Nectocarcinus integrifrons* (Latreille, 1825) (Crustacea, Portunidae) CAAB 28 911010

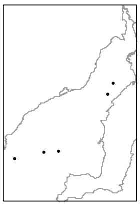
Common name = Rock Crab (Rough Rock Crab)
Length = To 63 mm
Depth range = 19.2 - 26.1 m
Stations = 51, 197, 383, 384, 517, 526, 533
Average biomass = 10.20 g/ha Rank biomass = 113
Average abundance = 0.55/ha Rank abundance = 43

C011 *Alpheus villosus* (Olivier, 1811) (Crustacea, Alpheidae) CAAB 28 765001

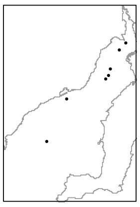
Common name = Snapping Prawn (Hairy Pistol Prawn)
Length = To 19 mm
Depth range = 18.6 - 26.4 m
Stations = 29, 46, 48, 51, 502
Average biomass = 0.89 g/ha Rank biomass = 200
Average abundance = 0.10/ha Rank abundance = 99

C012 *Leptomithrax gaimardii* (Milne Edwards, 1834) (Crustacea, Majidae) CAAB 28 880010

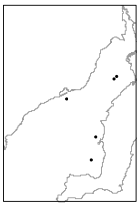
Common name = Great Spider Crab
Length = To 113 mm
Depth range = 19.5 - 44.7 m
Stations = 90, 503, 529, 531, 534
Average biomass = 16.66 g/ha Rank biomass = 96
Average abundance = 0.06/ha Rank abundance = 125

C013 *Actaea calculosa* (Milne Edwards, 1834) (Crustacea, Xanthidae) CAAB 28 920002

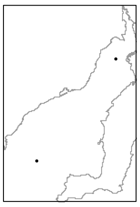
Common name = Facetted Crab
Length = To 16 mm
Depth range = 18.9 - 34.2 m
Stations = 1, 8, 48, 63, 69, 166, 525
Average biomass = 0.18 g/ha Rank biomass = 253
Average abundance = 0.10/ha Rank abundance = 98

C015 *Naxia aries* (Guérin-Méneville, 1834) (Crustacea, Majidae) CAAB 28 880089

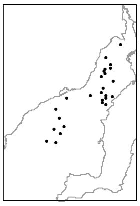
Common name = Spider Crab (Ramshorn Crab)
Length = To 43 mm
Depth range = 17.9 - 20.7 m
Stations = 166, 384, 445, 501, 533
Average biomass = 0.54 g/ha Rank biomass = 219
Average abundance = 0.05/ha Rank abundance = 144

C016 *Alpheus lottini* (Guérin-Méneville, 1829) (Crustacea, Alpheidae) CAAB 28 765006

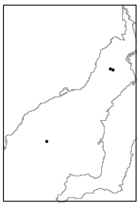
Common name = Pistol Shrimp (Coral Snapping Shrimp)
Length = To 10 mm
Depth range = 18.6 - 44.3 m
Stations = 29, 535
Average biomass = 0.12 g/ha Rank biomass = 265
Average abundance = 0.02/ha Rank abundance = 183

C017 *Erugosquilla grahami* (Ahyong & Manning, 1998) (Crustacea, Squillidae) CAAB 28 051032

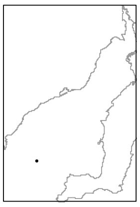
Common name = Mantis Shrimp
Length = To 27 mm
Depth range = 16.6 - 42.2 m
Stations = 25, 39, 46, 48, 54, 60, 64, 81, 84, 92, 99, 100, 105, 111, 115, 119, 147, 152, 157, 163, 166, 184, 302, 389, 502, 525
Average biomass = 8.32 g/ha Rank biomass = 121
Average abundance = 0.84/ha Rank abundance = 34

C019 *Austrodromidia australis* (Rathbun, 1923) (Crustacea, Dromiidae) CAAB 28 852015



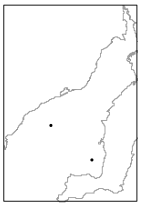
Common name = Southern Sponge Crab
Length = To 19 mm
Depth range = 19.4 - 34.2 m
Stations = 48, 51, 525
Average biomass = 0.18 g/ha Rank biomass = 252
Average abundance = 0.04/ha Rank abundance = 168

C020 *Naxia aurita* (Latreille, 1825) (Crustacea, Majidae) CAAB 28 880007



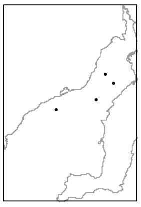
Common name = Smooth Seaweed Crab
Length = To 34 mm
Depth range = 44.3 - 44.3 m
Stations = 535
Average biomass = 0.16 g/ha Rank biomass = 259
Average abundance = 0.01/ha Rank abundance = 268

C021 *Gomeza bicornis* (Gray, 1831) (Crustacea, Corystidae) CAAB 28 900001



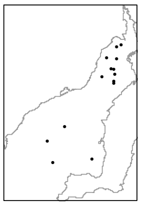
Common name = Masked Burrowing Crab
Length = To 21 mm
Depth range = 19.2 - 26.1 m
Stations = 517, 533
Average biomass = 0.62 g/ha Rank biomass = 213
Average abundance = 0.12/ha Rank abundance = 90

C026 *Lepas (Anatifa)* sp. (Crustacea, Pedunculata (Order)) CAAB 27 528000



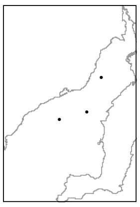
Common name = Goose barnacle
Length = To 56 mm
Depth range = 19.5 - 26.9 m
Stations = 60, 104, 184, 503
Average biomass = 0.58 g/ha Rank biomass = 214
Average abundance = 0.12/ha Rank abundance = 94

E001 *Ophiothrix* (*Ophiothrix*) *caespitosa* (Lyman, 1879) (Echinodermata, Ophiotrichidae) CAAB 25 192002



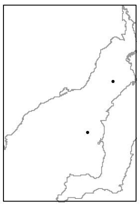
Common name = Ophiothrix caespitosa
Length = To 35 mm
Depth range = 16.6 - 43.4 m
Stations = 25, 29, 48, 51, 62, 64, 147, 302, 306, 502, 503, 525, 533, 536
Average biomass = 1.24 g/ha Rank biomass = 194
Average abundance = 0.67/ha Rank abundance = 39

E003 *Ptilometra macronema* (Müller, 1846) (Echinodermata, Ptilometridae) CAAB 25 047001



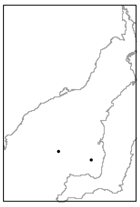
Common name = Passion Flower
Length = To 8 mm
Depth range = 16.6 - 30.7 m
Stations = 64, 152, 509
Average biomass = 0.09 g/ha Rank biomass = 271
Average abundance = 0.07/ha Rank abundance = 114

E005 *Amblypneustes pallidus* (Lamarck, 1816) (Echinodermata, Temnopleuridae) CAAB 25 241007



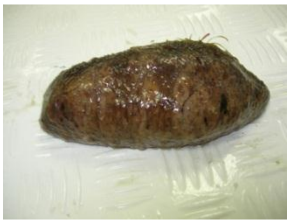
Common name = Sea Urchin
Length = To 48 mm
Depth range = 18.9 - 24.9 m
Stations = 197, 502
Average biomass = 5.20 g/ha Rank biomass = 140
Average abundance = 0.09/ha Rank abundance = 109

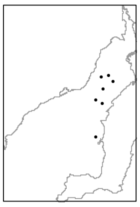
E009 *Centrostephanus tenuispinus* (Clark, 1914) (Echinodermata, Diadematidae) CAAB 25 211002



Common name = Longspine Sea Urchin
Length = To 112 mm
Depth range = 19.2 - 36.1 m
Stations = 529, 533
Average biomass = 9.30 g/ha Rank biomass = 115
Average abundance = 0.09/ha Rank abundance = 108

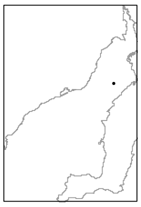
E010 *Holothuria* (*Thymiosycia*) *hartmeyeri* (Erwe, 1913) (Echinodermata, Holothuriidae) CAAB 25 416053





Common name = Handsome Sea Cucumber
Length = To 191 mm
Depth range = 16.6 - 24.0 m
Stations = 63, 64, 81, 104, 115, 384, 502
Average biomass = 41.97 g/ha Rank biomass = 57
Average abundance = 0.20/ha Rank abundance = 74

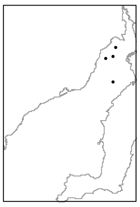
E014 *Coscinasterias muricata* (Verrill, 1867) (Echinodermata, Asteriidae) CAAB 25 154011



Common name = Eleven-armed Seastar
Length = To 24 mm
Depth range = 19.5 - 19.5 m
Stations = 503
Average biomass = 0.06 g/ha Rank biomass = 278
Average abundance = 0.01/ha Rank abundance = 225

Image courtesy of www.museum.vic.gov.au / Museum Victoria

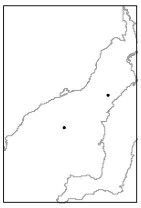
E015 *Australostichopus mollis* (Hutton, 1872) (Echinodermata, Stichopodidae) CAAB 25 417009



Common name = Sea cucumber
Length = To 260 mm
Depth range = 18.9 - 25.5 m
Stations = 22, 25, 306, 502
Average biomass = 29.57 g/ha Rank biomass = 75
Average abundance = 0.15/ha Rank abundance = 82

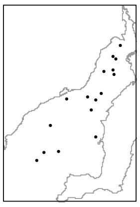
Image courtesy of www.austmarinverts.net

E016 *Tosia australis* (Gray, 1840) (Echinodermata, Goniasteridae) CAAB 25 122031



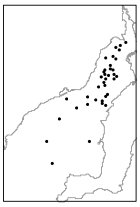
Common name = Biscuit Star
Length = To 56 mm
Depth range = 23.1 - 35.2 m
Stations = 90, 147
Average biomass = 0.14 g/ha Rank biomass = 261
Average abundance = 0.03/ha Rank abundance = 176

F001 *Sillaginodes punctata* (Cuvier, 1829) (Chordata, Sillaginidae) CAAB 37 330001



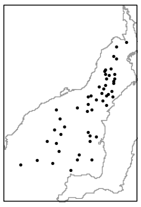
Common name = King George Whiting
Length = To 304 mm
Depth range = 17.8 - 44.7 m
Stations = 22, 29, 51, 54, 62, 92, 104, 166, 302, 384, 505, 508, 517, 529, 531, 535
Average biomass = 49.90 g/ha Rank biomass = 51
Average abundance = 0.45/ha Rank abundance = 48

F002 *Pseudorhombus jenynsii* (Bleeker, 1855) (Chordata, Paralichthyidae) CAAB 37 460002



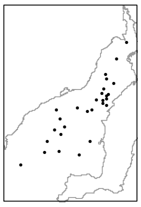
Common name = Small Tooth Flounder
Length = To 361 mm
Depth range = 16.6 - 43.4 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 90, 104, 105, 111, 115, 119, 128, 134, 152, 166, 302, 306, 445, 501, 505, 525, 526, 536
Average biomass = 287.85 g/ha Rank biomass = 14
Average abundance = 2.34/ha Rank abundance = 22

F003 *Maxillicosta scabriceps* (Whitley, 1935) (Chordata, Neosebastidae) CAAB 37 287007



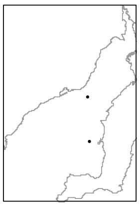
Common name = Little Scorpion Fish (Little Gurnard Perch)
Length = To 110 mm
Depth range = 17.8 - 44.3 m
Stations = 1, 22, 29, 46, 48, 54, 60, 62, 63, 69, 74, 77, 81, 84, 87, 90, 92, 100, 104, 105, 111, 119, 128, 134, 147, 152, 157, 163, 184, 197, 199, 203, 209, 306, 383, 384, 389, 501, 502, 503, 505, 508, 509, 525, 526, 529, 533, 535, 536, 538
Average biomass = 50.46 g/ha Rank biomass = 50
Average abundance = 3.77/ha Rank abundance = 17

F004 *Parapriacanthus elongatus* (McCulloch, 1911) (Chordata, Pempherididae) CAAB 37 357002



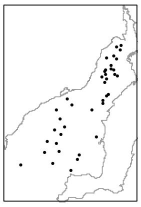
Common name = Slender Bullseye (Elongate Bullseye)
Length = To 106 mm
Depth range = 18.1 - 44.7 m
Stations = 1, 29, 60, 69, 81, 90, 92, 99, 104, 105, 111, 115, 119, 134, 147, 152, 157, 163, 184, 199, 503, 508, 509, 525, 526, 529, 531, 538
Average biomass = 49.42 g/ha Rank biomass = 52
Average abundance = 6.18/ha Rank abundance = 14

F005 *Siphonognathus radiatus* (Quoy & Gaimard, 1834) (Chordata, Odacidae) CAAB 37 385007



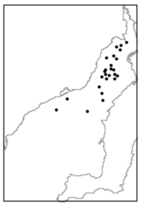
Common name = Longray Rock Whiting
Length = To 128 mm
Depth range = 17.8 - 22.8 m
Stations = 505, 526
Average biomass = 1.73 g/ha Rank biomass = 179
Average abundance = 0.05/ha Rank abundance = 143

F006 *Repomucenus calcaratus* (Macleay, 1881) (Chordata, Callionymidae) CAAB 37 427015



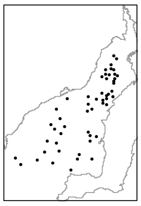
Common name = Spotted Stinkfish (Spotted Dragonet)
Length = To 153 mm
Depth range = 16.6 - 44.7 m
Stations = 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 64, 69, 73, 90, 105, 111, 115, 147, 152, 157, 163, 166, 178, 184, 199, 203, 209, 302, 306, 384, 389, 445, 508, 525, 529, 531, 536, 538
Average biomass = 296.65 g/ha Rank biomass = 13
Average abundance = 23.92/ha Rank abundance = 6

F007 *Pelates octolineatus* (Jenyns, 1840) (Chordata, Terapontidae) CAAB 37 321020



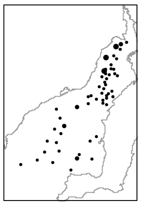
Common name = Striped Perch (Western Striped Grunter)
Length = To 200 mm
Depth range = 16.6 - 27.1 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 77, 92, 111, 166, 184, 302, 306, 445, 501, 509
Average biomass = 178.81 g/ha Rank biomass = 23
Average abundance = 4.49/ha Rank abundance = 16

F008 *Upeneichthys vlamingii* (Cuvier, 1829) (Chordata, Mullidae) CAAB 37 355029



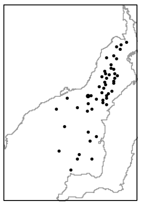
Common name = Red Mullet (Bluespotted Goatfish)
Length = To 145 mm
Depth range = 16.6 - 44.7 m
Stations = 22, 29, 39, 46, 48, 51, 60, 62, 63, 64, 69, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 147, 152, 157, 163, 166, 184, 197, 199, 203, 209, 383, 384, 389, 445, 501, 502, 503, 505, 508, 509, 517, 525, 526, 529, 531, 533, 534, 535, 536, 538
Average biomass = 534.72 g/ha Rank biomass = 8
Average abundance = 19.60/ha Rank abundance = 7

F009 *Pseudocaranx wrighti* (Whitley, 1931) (Chordata, Carangidae) CAAB 37 337063



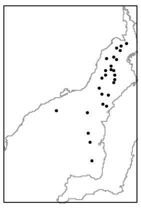
Common name = Skipjack Trevally
Length = To 136 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 134, 147, 152, 157, 163, 184, 199, 203, 209, 302, 306, 384, 389, 445, 505, 525, 526, 529, 531, 533, 535, 536, 538
Average biomass = 1753.19 g/ha Rank biomass = 3
Average abundance = 97.88/ha Rank abundance = 2

F010 *Scobinichthys granulatus* (Shaw, 1790) (Chordata, Monacanthidae) CAAB 37 465007



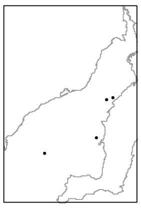
Common name = Rough Leatherjacket
Length = To 169 mm
Depth range = 16.6 - 38.9 m
Stations = 1, 8, 22, 25, 29, 39, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 104, 105, 111, 115, 119, 128, 134, 147, 166, 184, 197, 199, 203, 209, 302, 306, 384, 445, 501, 502, 503, 505, 508, 509, 526, 529, 533
Average biomass = 593.26 g/ha Rank biomass = 7
Average abundance = 24.00/ha Rank abundance = 5

F011 *Acanthaluteres spilomelanurus* (Quoy & Gaimard, 1824) (Chordata,Monacanthidae) CAAB 37 465043



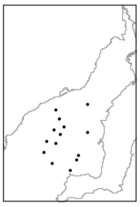
Common name = Bridled Leatherjacket
Length = To 101 mm
Depth range = 16.6 - 26.9 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 60, 62, 64, 77, 90, 92, 115, 119, 184, 197, 302, 306, 501, 502, 509, 526, 533
Average biomass = 19.96 g/ha Rank biomass = 87
Average abundance = 2.37/ha Rank abundance = 20

F012 *Kathetostoma laeve* (Bloch & Schneider, 1801) (Chordata, Uranoscopidae) CAAB 37 400003



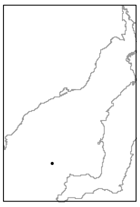
Common name = Common Stargazer
Length = To 235 mm
Depth range = 20.7 - 44.7 m
Stations = 99, 100, 384, 531
Average biomass = 16.63 g/ha Rank biomass = 97
Average abundance = 0.42/ha Rank abundance = 50

F013 *Sillago bassensis* (Cuvier, 1829) (Chordata, Sillaginidae) CAAB 37 330002



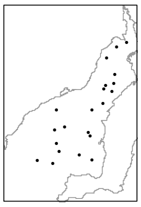
Common name = Silver Whiting (Sthn. School Whiting)
Length = To 210 mm
Depth range = 24.9 - 44.7 m
Stations = 128, 147, 152, 157, 163, 184, 197, 199, 203, 209, 389, 525, 531, 536
Average biomass = 74.21 g/ha Rank biomass = 39
Average abundance = 2.34/ha Rank abundance = 21

F015 *Parazanclistius hutchinsi* (Hardy, 1983) (Chordata, Pentacerotidae) CAAB 37 367010



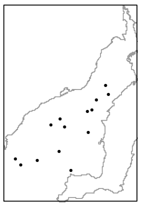
Common name = Short Boarfish
Length = To 122 mm
Depth range = 43.4 - 43.4 m
Stations = 536
Average biomass = 0.33 g/ha Rank biomass = 231
Average abundance = 0.01/ha Rank abundance = 246

F016 *Diodon nicthemerus* (Cuvier, 1818) (Chordata, Diodontidae) CAAB 37 469001



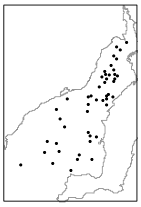
Common name = Spikey Globefish
Length = To 440 mm
Depth range = 18.1 - 44.3 m
Stations = 1, 25, 62, 74, 81, 87, 115, 147, 157, 184, 197, 199, 306, 383, 389, 503, 508, 529, 533, 535, 536
Average biomass = 47.80 g/ha Rank biomass = 54
Average abundance = 0.36/ha Rank abundance = 54

F017 *Omegophora armilla* (Waite & McCulloch, 1915) (Chordata, Tetraodontidae) CAAB 37 467002



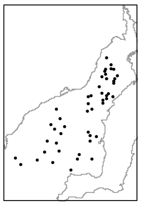
Common name = Ringed Toadfish
Length = To 180 mm
Depth range = 18.1 - 44.3 m
Stations = 74, 90, 104, 147, 152, 197, 209, 508, 509, 517, 529, 534, 535, 538
Average biomass = 20.39 g/ha Rank biomass = 86
Average abundance = 0.29/ha Rank abundance = 61

F018 *Neoplatycephalus richardsoni* (Castelnau, 1872) (Chordata, Platycephalidae) CAAB 37 296001



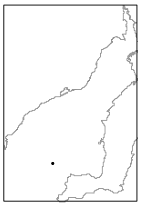
Common name = Tiger Flathead
Length = To 305 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 8, 22, 29, 39, 51, 54, 60, 62, 63, 64, 69, 73, 77, 84, 90, 99, 100, 104, 105, 111, 119, 128, 147, 152, 166, 184, 197, 199, 203, 209, 306, 383, 384, 389, 445, 501, 502, 505, 509, 525, 526, 529, 531, 533, 536, 538
Average biomass = 262.11 g/ha Rank biomass = 16
Average abundance = 3.22/ha Rank abundance = 18

F019 *Parequula melbournensis* (Castelnau, 1872) (Chordata, Gerreidae) CAAB 37 349001



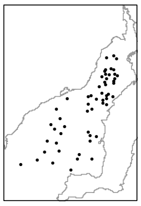
Common name = Silverbelly
Length = To 118 mm
Depth range = 16.6 - 44.7 m
Stations = 25, 39, 46, 48, 51, 54, 60, 64, 69, 77, 84, 90, 92, 99, 100, 105, 111, 115, 128, 147, 152, 157, 163, 184, 197, 199, 203, 209, 383, 384, 389, 445, 501, 502, 503, 505, 508, 509, 517, 525, 526, 529, 531, 533, 534, 535, 536, 538
Average biomass = 184.32 g/ha Rank biomass = 22
Average abundance = 14.60/ha Rank abundance = 10

F020 *Meuschenia scaber* (Forster, 1801) (Chordata, Monacanthidae) CAAB 37 465005



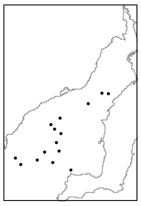
Common name = Velvet Leatherjacket
Length = To 167 mm
Depth range = 43.4 - 43.4 m
Stations = 536
Average biomass = 0.66 g/ha Rank biomass = 209
Average abundance = 0.01/ha Rank abundance = 246

F021 *Acanthaluteres vittiger* (Castelnau, 1873) (Chordata, Monacanthidae) CAAB 37 465002



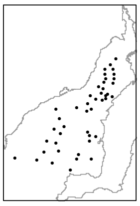
Common name = Toothbrush Leatherjacket
Length = To 135 mm
Depth range = 16.6 - 44.7 m
Stations = 22, 25, 29, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 84, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 147, 152, 157, 163, 166, 184, 197, 199, 203, 209, 383, 384, 389, 445, 501, 502, 503, 505, 508, 509, 517, 525, 526, 529, 531, 533, 535, 536, 538
Average biomass = 346.25 g/ha Rank biomass = 11
Average abundance = 16.71/ha Rank abundance = 8

F022 *Foetorepus calauropomus* (Richardson, 1844) (Chordata, Callionymidae) CAAB 37 427001



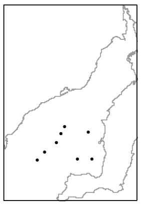
Common name = Common Stink Fish
Length = To 298 mm
Depth range = 22.3 - 44.7 m
Stations = 90, 92, 128, 152, 157, 163, 209, 389, 517, 529, 531, 534, 535, 536, 538
Average biomass = 41.43 g/ha Rank biomass = 58
Average abundance = 0.73/ha Rank abundance = 38

F023 *Lepidotrigla papilio* (Cuvier, 1829) (Chordata, Triglidae) CAAB 37 288002



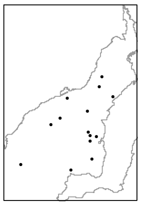
Common name = Spiny Gurnard
Length = To 139 mm
Depth range = 18.1 - 44.7 m
Stations = 29, 39, 46, 51, 60, 62, 69, 73, 77, 81, 84, 90, 92, 99, 100, 104, 105, 111, 128, 134, 147, 152, 157, 163, 184, 197, 199, 203, 209, 383, 384, 389, 501, 503, 508, 509, 525, 526, 529, 531, 533, 534, 535, 536
Average biomass = 85.32 g/ha Rank biomass = 34
Average abundance = 6.28/ha Rank abundance = 13

F024 *Parapercis ramsayi* (Steindachner, 1884) (Chordata, Pinguipedidae) CAAB 37 390002



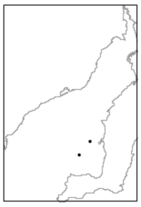
Common name = Spotted Grubfish
Length = To 131 mm
Depth range = 19.2 - 44.7 m
Stations = 147, 163, 197, 203, 389, 531, 533, 535
Average biomass = 1.56 g/ha Rank biomass = 183
Average abundance = 0.10/ha Rank abundance = 101

F025 *Aracana ornata* (Gray, 1838) (Chordata, Ostraciidae) CAAB 37 466001



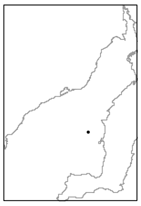
Common name = Ornate Cowfish
Length = To 107 mm
Depth range = 16.6 - 38.9 m
Stations = 64, 77, 100, 152, 166, 197, 209, 383, 384, 509, 517, 526, 533, 538
Average biomass = 21.97 g/ha Rank biomass = 84
Average abundance = 0.42/ha Rank abundance = 49

F026 *Taratretis derwentensis* (Last, 1978) (Chordata, Pleuronectidae) CAAB 37 461011

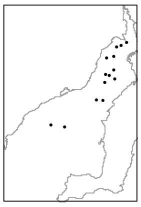
Common name = Derwent Flounder
Length = To 170 mm
Depth range = 22.8 - 33.8 m
Stations = 199, 526
Average biomass = 0.88 g/ha Rank biomass = 201
Average abundance = 0.02/ha Rank abundance = 212

F027 *Filicampus tigris* (Castelnau, 1879) (Chordata, Syngnathidae) CAAB 37 282064

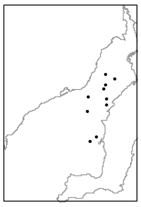
Common name = Tiger Pipefish
Length = To 395 mm
Depth range = 24.9 - 24.9 m
Stations = 197
Average biomass = 0.13 g/ha Rank biomass = 262
Average abundance = 0.02/ha Rank abundance = 188

F028 *Parapercis haackei* (Steindachner, 1884) (Chordata, Pinguipedidae) CAAB 37 390004

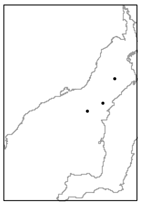
Common name = Wavy Grubfish
Length = To 87 mm
Depth range = 18.7 - 35.2 m
Stations = 1, 22, 25, 51, 60, 63, 73, 104, 111, 147, 302, 306, 501, 517
Average biomass = 2.58 g/ha Rank biomass = 165
Average abundance = 0.63/ha Rank abundance = 42

F029 *Thysanophrys cirronasa* (Richardson, 1848) (Chordata, Platycephalidae) CAAB 37 296045

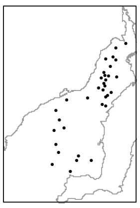
Common name = Rock Flathead
Length = To 259 mm
Depth range = 17.8 - 26.9 m
Stations = 60, 74, 81, 99, 119, 384, 501, 505, 509, 526
Average biomass = 14.48 g/ha Rank biomass = 101
Average abundance = 0.23/ha Rank abundance = 70

F030 *Platycephalus speculator* (Klunzinger, 1872) (Chordata, Platycephalidae) CAAB 37 296037

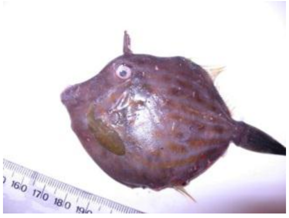
Common name = Yank Flathead
Length = To 302 mm
Depth range = 18.7 - 24.0 m
Stations = 115, 501, 509
Average biomass = 7.46 g/ha Rank biomass = 126
Average abundance = 0.05/ha Rank abundance = 142

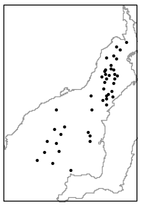
F031 *Heterodontus portusjacksoni* (Meyer, 1793) (Chordata, Heterodontidae) CAAB 37 007001

Common name = Port Jackson Shark
Length = To 1000 mm
Depth range = 16.6 - 43.4 m
Stations = 1, 22, 25, 29, 39, 54, 60, 63, 64, 69, 73, 74, 77, 81, 87, 90, 105, 115, 119, 147, 152, 157, 166, 184, 199, 203, 209, 306, 389, 445, 505, 529, 533, 536
Average biomass = 386.38 g/ha Rank biomass = 10
Average abundance = 0.42/ha Rank abundance = 51

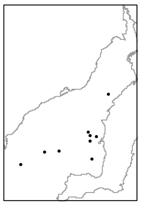
F032 *Eubalichthys mosaicus* (Ramsay & Ogilby, 1886) (Chordata, Monacanthidae) CAAB 37 465003





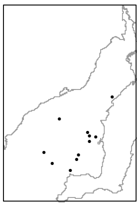
Common name = Mosaic Leatherjacket
Length = To 138 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 81, 84, 87, 90, 99, 100, 105, 111, 119, 147, 157, 163, 184, 197, 209, 306, 383, 389, 445, 501, 503, 508, 525, 526, 529, 531, 535, 536
Average biomass = 75.45 g/ha   Rank biomass = 38
Average abundance = 2.79/ha   Rank abundance = 19

F033 *Pempheris klunzingeri* (McCulloch, 1911) (Chordata, Pempherididae) CAAB 37 357003



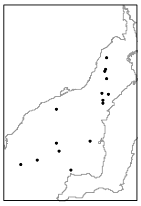
Common name = Rough bullseye
Length = To 181 mm
Depth range = 19.2 - 44.7 m
Stations = 90, 197, 383, 384, 526, 529, 531, 533, 538
Average biomass = 31.61 g/ha   Rank biomass = 71
Average abundance = 0.79/ha   Rank abundance = 36

F034 *Lophonectes gallus* (Günther, 1880) (Chordata, Bothidae) CAAB 37 460001



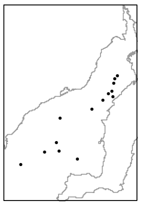
Common name = Crested Flounder
Length = To 225 mm
Depth range = 20.7 - 44.7 m
Stations = 100, 152, 197, 199, 203, 209, 383, 384, 526, 531, 536
Average biomass = 13.72 g/ha   Rank biomass = 103
Average abundance = 0.32/ha   Rank abundance = 57

F035 *Trachurus declivis* (Jenyns, 1841) (Chordata, Carangidae) CAAB 37 337002



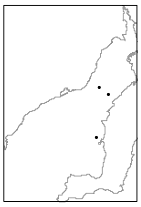
Common name = Jack Mackerel
Length = To 203 mm
Depth range = 22.3 - 44.3 m
Stations = 25, 46, 54, 69, 90, 92, 111, 115, 184, 209, 389, 526, 529, 535, 538
Average biomass = 45.62 g/ha   Rank biomass = 55
Average abundance = 0.64/ha   Rank abundance = 40

F036 *Neosebastes bougainvillii* (Cuvier, 1829) (Chordata, Neosebastidae) CAAB 37 287004



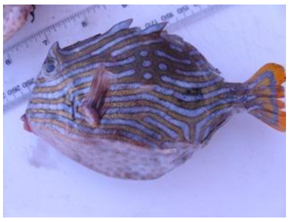
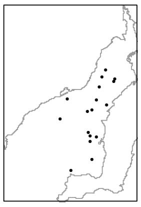
Common name = Gulf Gurnard Perch
Length = To 285 mm
Depth range = 17.9 - 44.7 m
Stations = 87, 90, 100, 111, 152, 203, 389, 445, 501, 503, 508, 529, 531, 538
Average biomass = 27.69 g/ha   Rank biomass = 77
Average abundance = 0.52/ha   Rank abundance = 45

F037 *Sphyraena novaehollandiae* (Günther, 1860) (Chordata, Sphyraenidae) CAAB 37 382002



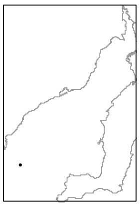
Common name = Snook(Shortfin seapike)
Length = To 451 mm
Depth range = 19.7 - 23.1 m
Stations = 77, 90, 384
Average biomass = 7.40 g/ha   Rank biomass = 127
Average abundance = 0.04/ha   Rank abundance = 170

F038 *Aracana aurita* (Shaw, 1798) (Chordata, Ostraciidae) CAAB 37 466003

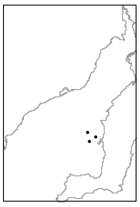
Common name = Shaws Cowfish
Length = To 187 mm
Depth range = 16.6 - 38.9 m
Stations = 46, 64, 77, 104, 119, 152, 166, 197, 209, 383, 384, 501, 502, 508, 509, 526, 533
Average biomass = 69.77 g/ha Rank biomass = 41
Average abundance = 1.11/ha Rank abundance = 28

F039 *Urolophus orarius* (Last & Gommon, 1987) (Chordata, Urolophidae) CAAB 37 038022

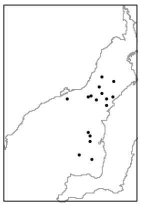
Common name = Coastal Stingaree
Length = To 209 mm
Depth range = 37.4 - 37.4 m
Stations = 538
Average biomass = 1.44 g/ha Rank biomass = 187
Average abundance = 0.01/ha Rank abundance = 230

F040 *Odax acroptilus* (Richardson, 1846) (Chordata, Odacidae) CAAB 37 385010

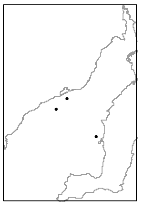
Common name = Rainbow Cale
Length = To 157 mm
Depth range = 20.7 - 24.9 m
Stations = 197, 384, 526
Average biomass = 1.26 g/ha Rank biomass = 192
Average abundance = 0.04/ha Rank abundance = 150

F042 *Polyspina piosae* (Whitley, 1955) (Chordata, Tetraodontidae) CAAB 37 467049

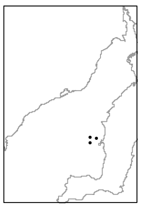
Common name = Orangebarred Puffer fish
Length = To 90 mm
Depth range = 16.6 - 33.8 m
Stations = 64, 77, 84, 92, 99, 100, 104, 119, 166, 197, 199, 383, 502, 505, 526, 533
Average biomass = 77.70 g/ha Rank biomass = 37
Average abundance = 4.90/ha Rank abundance = 15

F044 *Leptoichthys fistularius* (Kaup, 1853) (Chordata, Syngnathidae) CAAB 37 282013

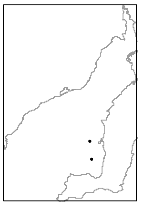
Common name = Brushtail Pipefish
Length = To 357 mm
Depth range = 18.9 - 26.9 m
Stations = 166, 184, 384
Average biomass = 0.16 g/ha Rank biomass = 258
Average abundance = 0.05/ha Rank abundance = 148

F045 *Phycodurus eques* (Günther, 1865) (Chordata, Syngnathidae) CAAB 37 282001

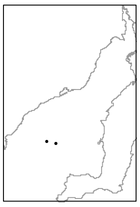
Common name = Leafy Seadragon
Length = To 257 mm
Depth range = 20.7 - 24.2 m
Stations = 383, 384, 526
Average biomass = 0.43 g/ha Rank biomass = 223
Average abundance = 0.02/ha Rank abundance = 197

F046 *Phyllopteryx taeniolatus* (Lacépède, 1804) (Chordata, Syngnathidae) CAAB 37 282002

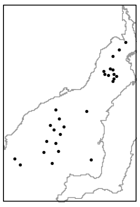
Common name = Common Seadragon
Length = To 200 mm
Depth range = 19.2 - 22.8 m
Stations = 526, 533
Average biomass = 0.12 g/ha Rank biomass = 266
Average abundance = 0.01/ha Rank abundance = 222

F047 *Eubalichthys gunnii* (Günther, 1870) (Chordata, Monacanthidae) CAAB 37 465034

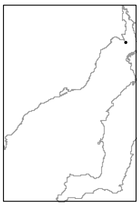
Common name = Gunn's Leatherjacket
Length = To 127 mm
Depth range = 34.2 - 42.2 m
Stations = 389, 525
Average biomass = 0.86 g/ha Rank biomass = 202
Average abundance = 0.02/ha Rank abundance = 187

F048 *Vincentia conspersa* (Klunzinger, 1872) (Chordata, Apogonidae) CAAB 37 327033

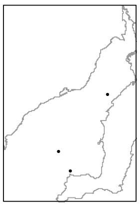
Common name = Southern Gobbleguts(Southern cardinalfish)
Length = To 108 mm
Depth range = 17.9 - 44.7 m
Stations = 1, 8, 22, 48, 51, 54, 60, 62, 63, 147, 152, 157, 163, 184, 389, 445, 501, 502, 509, 517, 525, 529, 531, 533, 534, 536, 538
Average biomass = 11.77 g/ha Rank biomass = 108
Average abundance = 1.39/ha Rank abundance = 25

F049 *Vincentia macrocauda* (Allen, 1987) (Chordata, Apogonidae) CAAB 37 327122

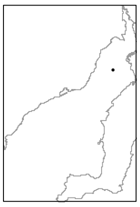
Common name = Smooth Cardinal fish
Length = To 56 mm
Depth range = 22.0 - 22.0 m
Stations = 1
Average biomass = 0.06 g/ha Rank biomass = 279
Average abundance = 0.05/ha Rank abundance = 149

F050 *Thyrsites atun* (Euphrasen, 1791) (Chordata, Gempylidae) CAAB 37 439001

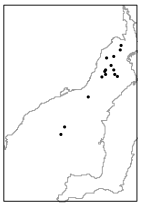
Common name = Barracouta
Length = To 295 mm
Depth range = 23.1 - 38.9 m
Stations = 90, 209, 529
Average biomass = 5.16 g/ha Rank biomass = 142
Average abundance = 0.06/ha Rank abundance = 127

F051 *Cristiceps australis* (Valenciennes, 1836) (Chordata, Clinidae) CAAB 37 416007

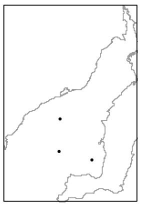
Common name = Southern Crested Weed Fish
Length = To 195 mm
Depth range = 19.4 - 19.4 m
Stations = 51
Average biomass = 0.70 g/ha Rank biomass = 207
Average abundance = 0.01/ha Rank abundance = 228

F052 *Gymnapistes marmoratus* (Cuvier, 1829) (Chordata, Tetrarogidae) CAAB 37 287018

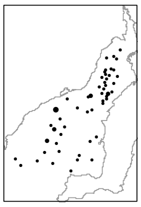
Common name = Soldier Fish
Length = To 119 mm
Depth range = 16.6 - 38.0 m
Stations = 8, 22, 25, 39, 46, 51, 54, 60, 62, 64, 147, 163, 302, 445, 505
Average biomass = 14.25 g/ha Rank biomass = 102
Average abundance = 1.03/ha Rank abundance = 29

F053 *Urolophus paucimaculatus* (Dixon, 1969) (Chordata, Urolophidae) CAAB 37 038004

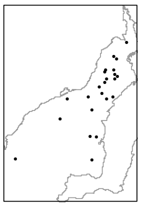
Common name = Sparsely-Spotted Stingaree
Length = To 241 mm
Depth range = 19.2 - 36.1 m
Stations = 152, 529, 533
Average biomass = 3.72 g/ha Rank biomass = 151
Average abundance = 0.04/ha Rank abundance = 158

F054 *Thamnaconus degeni* (Regan, 1903) (Chordata, Monacanthidae) CAAB 37 465037

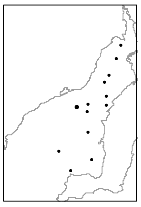
Common name = Degens Leatherjacket (Bluefin)
Length = To 142 mm
Depth range = 16.6 - 44.7 m
Stations = 8, 22, 25, 29, 46, 48, 51, 54, 60, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 105, 111, 115, 134, 147, 152, 157, 163, 166, 184, 199, 203, 209, 384, 389, 445, 503, 505, 508, 509, 517, 525, 526, 529, 531, 533, 534, 535, 536, 538
Average biomass = 1105.99 g/ha Rank biomass = 4
Average abundance = 65.64/ha Rank abundance = 4

F055 *Brachaluteres jacksonianus* (Quoy & Gaimard, 1824) (Chordata, Monacanthidae) CAAB 37 465025

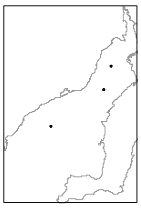
Common name = Sthn. Pygmy Leatherjacket
Length = To 66 mm
Depth range = 17.8 - 30.7 m
Stations = 1, 22, 29, 46, 51, 54, 62, 69, 73, 77, 92, 99, 100, 152, 166, 383, 384, 445, 501, 505, 508, 533, 534
Average biomass = 4.07 g/ha Rank biomass = 149
Average abundance = 0.54/ha Rank abundance = 44

F056 *Contusus brevicaudus* (Hardy, 1981) (Chordata, Tetraodontidae) CAAB 37 467044

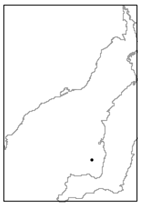
Common name = Prickly Toadfish
Length = To 241 mm
Depth range = 18.6 - 38.9 m
Stations = 29, 63, 73, 105, 119, 128, 134, 197, 209, 302, 509, 529, 533
Average biomass = 195.44 g/ha Rank biomass = 21
Average abundance = 1.27/ha Rank abundance = 27

F057 *Hypnos monopterygium* (Shaw & Nodder, 1795) (Chordata, Hypnidae) CAAB 37 028001

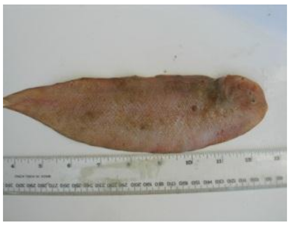
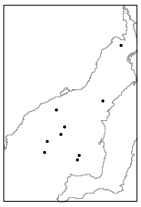
Common name = Australian Numbfish (Coffin Ray)
Length = To 380 mm
Depth range = 20.1 - 26.1 m
Stations = 39, 81, 517
Average biomass = 80.70 g/ha Rank biomass = 35
Average abundance = 0.09/ha Rank abundance = 111

F059 *Neoodax balteatus* (Valenciennes, 1840) (Chordata, Odacidae) CAAB 37 385005

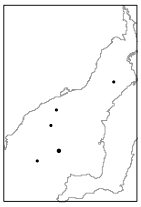
Common name = Little Rock Whiting
Length = To 106 mm
Depth range = 19.2 - 19.2 m
Stations = 533
Average biomass = 0.08 g/ha Rank biomass = 275
Average abundance = 0.01/ha Rank abundance = 250

F060 *Cynoglossus broadhursti* (Waite, 1905) (Chordata, Cynoglossidae) CAAB 37 463015

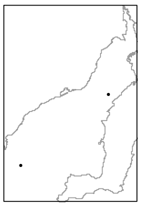
Common name = Southern Tongue Sole
Length = To 210 mm
Depth range = 20.1 - 44.7 m
Stations = 111, 147, 163, 184, 199, 203, 302, 525, 531
Average biomass = 4.13 g/ha Rank biomass = 147
Average abundance = 0.14/ha Rank abundance = 87

F061 *Myliobatis australis* (Macleay, 1881) (Chordata, Myliobatidae) CAAB 37 039001

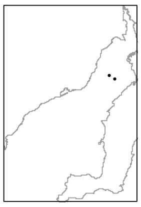
Common name = Eagle Ray
Length = To 1000 mm
Depth range = 18.9 - 44.3 m
Stations = 184, 502, 517, 529, 535
Average biomass = 283.16 g/ha Rank biomass = 15
Average abundance = 0.04/ha Rank abundance = 156

F062 *Centroberyx lineatus* (Cuvier, 1829) (Chordata, Berycidae) CAAB 37 258003

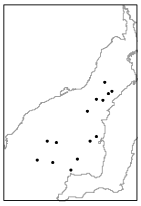
Common name = Nannygai (Red fish)
Length = To 124 mm
Depth range = 23.1 - 37.4 m
Stations = 90, 538
Average biomass = 4.79 g/ha Rank biomass = 145
Average abundance = 0.09/ha Rank abundance = 106

F063 *Pagrus auratus* (Bloch & Schneider, 1801) (Chordata, Sparidae) CAAB 37 353001

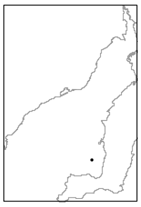
Common name = Snapper
Length = To 199 mm
Depth range = 18.7 - 22.0 m
Stations = 63, 501
Average biomass = 3.48 g/ha Rank biomass = 153
Average abundance = 0.03/ha Rank abundance = 177

F064 *Gonorynchus greyi* (Richardson, 1845) (Chordata, Gonorynchidae) CAAB 37 141001

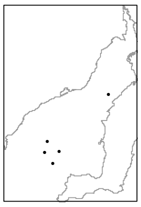
Common name = Beaked Salmon
Length = To 365 mm
Depth range = 19.9 - 44.3 m
Stations = 73, 87, 90, 104, 111, 203, 209, 384, 389, 509, 525, 526, 535, 536
Average biomass = 19.50 g/ha Rank biomass = 89
Average abundance = 0.33/ha Rank abundance = 56

F065 *Trachichthys australis* (Shaw, 1799) (Chordata, Trachichthyidae) CAAB 37 255015

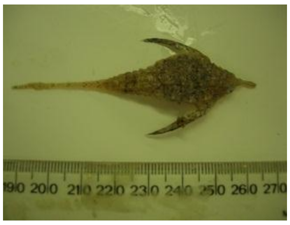
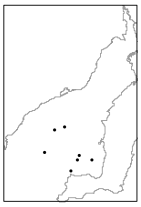
Common name = Roughy (Southern Roughy)
Length = To 121 mm
Depth range = 19.2 - 19.2 m
Stations = 533
Average biomass = 0.32 g/ha Rank biomass = 232
Average abundance = 0.01/ha Rank abundance = 250

F071 *Neosebastes pandus* (Richardson, 1842) (Chordata, Neosebastidae) CAAB 37 287003

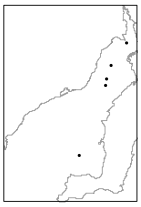
Common name = Gurnard Perch
Length = To 308 mm
Depth range = 23.1 - 44.7 m
Stations = 90, 525, 529, 531, 536
Average biomass = 17.74 g/ha Rank biomass = 93
Average abundance = 0.14/ha Rank abundance = 83

F072 *Pegasus lancifer* (Kaup, 1861) (Chordata, Pegasidae) CAAB 37 309003

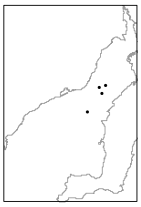
Common name = Sculptured Seamoth
Length = To 94 mm
Depth range = 19.2 - 44.7 m
Stations = 147, 157, 199, 203, 209, 531, 533
Average biomass = 0.32 g/ha Rank biomass = 233
Average abundance = 0.09/ha Rank abundance = 103

F073 *Trygonorrhina dumerilii* (Castelnau, 1873) (Chordata, Rhinobatidae) CAAB 37 027002

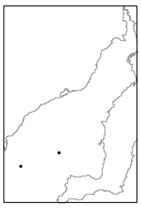
Common name = Southern Fiddler Ray
Length = To 1030 mm
Depth range = 20.1 - 33.8 m
Stations = 1, 39, 69, 74, 199
Average biomass = 32.24 g/ha Rank biomass = 69
Average abundance = 0.02/ha Rank abundance = 182

F075 *Hyporhamphus melanochir* (Valenciennes, 1847) (Chordata, Hemiramphidae) CAAB 37 234001

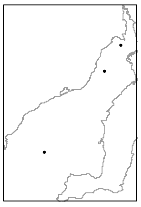
Common name = Southern Garfish
Length = To 214 mm
Depth range = 19.7 - 24.4 m
Stations = 74, 77, 92, 509
Average biomass = 0.79 g/ha Rank biomass = 204
Average abundance = 0.04/ha Rank abundance = 164

F076 *Enoplosus armatus* (White, 1790) (Chordata, Enoplosidae) CAAB 37 366001

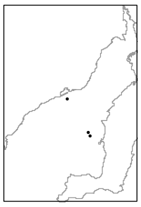
Common name = Old Wife
Length = To 200 mm
Depth range = 36.1 - 37.4 m
Stations = 529, 538
Average biomass = 1.38 g/ha Rank biomass = 188
Average abundance = 0.02/ha Rank abundance = 186

F077 *Squatina australis* (Regan, 1906) (Chordata, Squatinidae) CAAB 37 024001



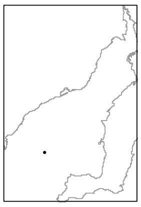
Common name = Angel Shark
Length = To 998 mm
Depth range = 20.1 - 44.7 m
Stations = 54, 302, 531
Average biomass = 52.90 g/ha Rank biomass = 48
Average abundance = 0.02/ha Rank abundance = 179

F078 *Stigmatopora argus* (Richardson, 1840) (Chordata, Syngnathidae) CAAB 37 282017



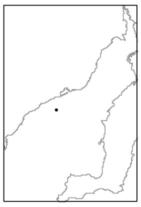
Common name = Spotted Pipefish
Length = To 223 mm
Depth range = 18.9 - 24.9 m
Stations = 166, 197, 383
Average biomass = 0.25 g/ha Rank biomass = 246
Average abundance = 0.05/ha Rank abundance = 140

F079 *Callorhinchus milii* (Bory de Saint-Vincent, 1823) (Chordata, Callorhinchidae) CAAB 37 043001



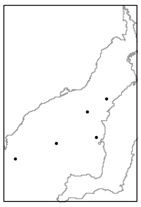
Common name = Elephant Fish
Length = To 202 mm
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.24 g/ha Rank biomass = 248
Average abundance = 0.005/ha Rank abundance = 275

F080 *Hyperlophus vittatus* (Castelnau, 1875) (Chordata, Clupeidae) CAAB 37 085005



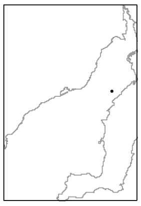
Common name = Sandy Spratt
Length = Not recorded
Depth range = 26.9 - 26.9 m
Stations = 184
Average biomass = 0.08 g/ha Rank biomass = 273
Average abundance = 0.02/ha Rank abundance = 210

F081 *Genypterus tigerinus* (Klunzinger, 1872) (Chordata, Ophidiidae) CAAB 37 228008



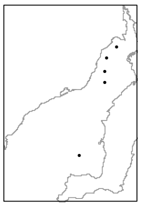
Common name = Rock Ling
Length = To 400 mm
Depth range = 20.7 - 27.4 m
Stations = 99, 384, 509, 526, 534
Average biomass = 5.65 g/ha Rank biomass = 135
Average abundance = 0.04/ha Rank abundance = 154

F085 *Sutorectus tentaculatus* (Peters, 1865) (Chordata, Orectolobidae) CAAB 37 013012



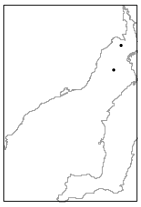
Common name = Cobbler Wobbegong
Length = To 650 mm
Depth range = 19.9 - 19.9 m
Stations = 87
Average biomass = 6.58 g/ha Rank biomass = 131
Average abundance = 0.004/ha Rank abundance = 283

F088 *Aptychotrema vincentiana* (Haacke, 1885) (Chordata, Rhinobatidae) CAAB 37 027001

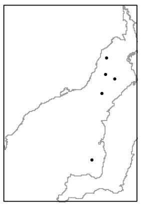
Common name = Southern Shovelnose Ray
Length = To 678 mm
Depth range = 21.0 - 33.8 m
Stations = 25, 54, 73, 199, 306
Average biomass = 31.54 g/ha Rank biomass = 72
Average abundance = 0.05/ha Rank abundance = 135

F094 *Cnidoglanis macrocephalus* (Valenciennes, 1840) (Chordata, Plotosidae) CAAB 37 192001

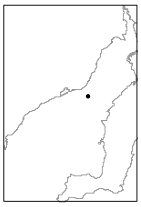
Common name = Estuary Catfish
Length = To 309 mm
Depth range = 19.4 - 20.1 m
Stations = 51, 302
Average biomass = 4.21 g/ha Rank biomass = 146
Average abundance = 0.05/ha Rank abundance = 138

F095 *Hippocampus abdominalis* (Lesson, 1827) (Chordata, Syngnathidae) CAAB 37 282120

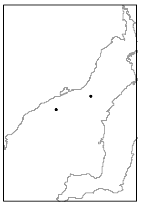
Common name = Bigbelly Seahorse
Length = To 126 mm
Depth range = 18.7 - 26.9 m
Stations = 25, 60, 92, 501, 533
Average biomass = 0.29 g/ha Rank biomass = 239
Average abundance = 0.05/ha Rank abundance = 131

F097 *Dasyatis thetidis* (Ogilby, 1899) (Chordata, Dasyatidae) CAAB 37 035002

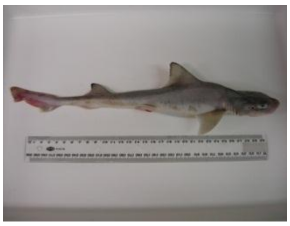
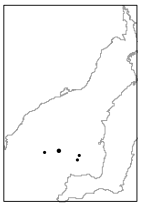
Common name = Black Stingray
Length = To 990 mm
Depth range = 17.8 - 17.8 m
Stations = 505
Average biomass = 102.24 g/ha Rank biomass = 30
Average abundance = 0.005/ha Rank abundance = 281

F098 *Dasyatis brevicaudata* (Hutton, 1875) (Chordata, Dasyatidae) CAAB 37 035001

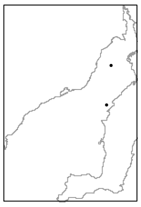
Common name = Smooth Stingray
Length = To 900 mm
Depth range = 19.3 - 26.9 m
Stations = 84, 184
Average biomass = 89.20 g/ha Rank biomass = 31
Average abundance = 0.01/ha Rank abundance = 255

F099 *Mustelus antarcticus* (Günther, 1870) (Chordata, Triakidae) CAAB 37 017001

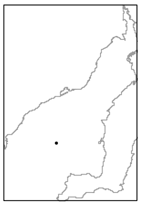
Common name = Gummy Shark
Length = To 1200 mm
Depth range = 33.8 - 44.7 m
Stations = 199, 203, 529, 531
Average biomass = 135.57 g/ha Rank biomass = 27
Average abundance = 0.04/ha Rank abundance = 159

F100 *Orectolobus maculatus* (Bonnaterre, 1788) (Chordata, Orectolobidae) CAAB 37 013003

Common name = Ornate Wobbegong
Length = To 690 mm
Depth range = 20.1 - 21.1 m
Stations = 39, 119
Average biomass = 23.92 g/ha Rank biomass = 81
Average abundance = 0.01/ha Rank abundance = 224

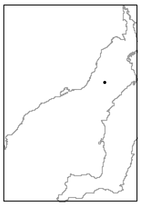
F102 *Dipturus cerva* (Whitley, 1939) (Chordata, Rajidae) CAAB 37 031003

Common name = White Spotted Skate
Length = To 344 mm
Depth range = 42.2 - 42.2 m
Stations = 389
Average biomass = 2.25 g/ha Rank biomass = 171
Average abundance = 0.01/ha Rank abundance = 256

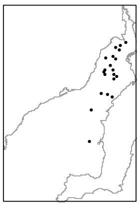
Image courtesy of www.fishesofaustralia.net.au / CSIRO

F108 *Kanekonia queenslandica* (Whitley, 1952) (Chordata, Aploactinidae) CAAB 37 290007



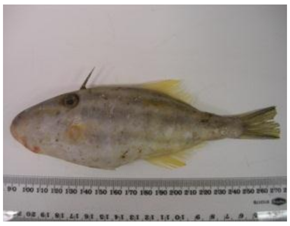
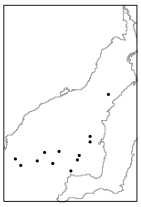
Common name = Deep Velvet fish
Length = To 32 mm
Depth range = 27.7 - 27.7 m
Stations = 73
Average biomass = 0.03 g/ha Rank biomass = 285
Average abundance = 0.01/ha Rank abundance = 262

F109 *Neoplatycephalus aurimaculatus* (Knapp, 1987) (Chordata, Platycephalidae) CAAB 37 296035

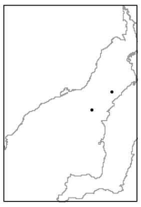
Common name = Toothy Flathead
Length = To 495 mm
Depth range = 17.9 - 26.9 m
Stations = 1, 8, 22, 25, 29, 39, 46, 51, 54, 60, 62, 90, 92, 100, 302, 306, 445, 501, 508, 526
Average biomass = 139.35 g/ha Rank biomass = 26
Average abundance = 0.79/ha Rank abundance = 35

F111 *Nelusetta ayraudi* (Quoy & Gaimard, 1824) (Chordata, Monacanthidae) CAAB 37 465006

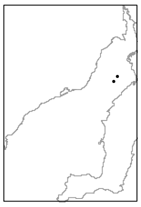
Common name = Chinaman Leather Jacket
Length = To 183 mm
Depth range = 22.8 - 44.7 m
Stations = 90, 199, 203, 209, 383, 526, 529, 531, 534, 535, 536, 538
Average biomass = 15.21 g/ha Rank biomass = 99
Average abundance = 0.35/ha Rank abundance = 55

F112 *Glyptauchen panduratus* (Richardson, 1850) (Chordata, Tetrarogidae) CAAB 37 287023



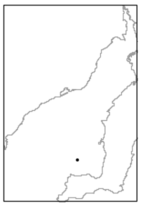
Common name = Goblin Fish
Length = To 120 mm
Depth range = 18.1 - 19.9 m
Stations = 87, 508
Average biomass = 1.47 g/ha Rank biomass = 185
Average abundance = 0.04/ha Rank abundance = 152

F114 *Meuschenia freycineti* (Quoy & Gaimard, 1824) (Chordata, Monacanthidae) CAAB 37 465036

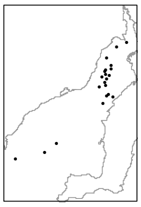
Common name = Six-spine Leather Jacket
Length = To 259 mm
Depth range = 17.9 - 18.9 m
Stations = 445, 502
Average biomass = 7.35 g/ha Rank biomass = 128
Average abundance = 0.04/ha Rank abundance = 161

F123 *Optivus agrammus* (Gomon, 2004) (Chordata, Trachichthyidae) CAAB 37 255016

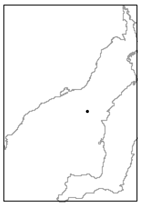
Common name = Western Roughy
Length = To 83 mm
Depth range = 37.4 - 37.4 m
Stations = 203
Average biomass = 0.07 g/ha Rank biomass = 276
Average abundance = 0.01/ha Rank abundance = 258

F125 *Engraulis australis* (Shaw, 1790) (Chordata, Engraulidae) CAAB 37 086001

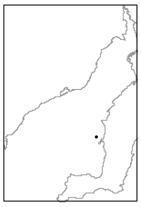
Common name = Australian Anchovy
Length = To 130 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 25, 39, 46, 48, 54, 60, 63, 64, 69, 73, 74, 77, 90, 100, 105, 115, 306, 389, 531, 534
Average biomass = 11.31 g/ha Rank biomass = 109
Average abundance = 1.32/ha Rank abundance = 26

F127 *Rhycherus filamentosus* (Castelnau, 1872) (Chordata, Antennariidae) CAAB 37 210006

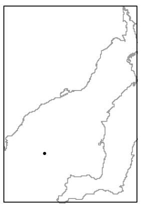
Common name = Tasselled Anglerfish
Length = To 119 mm
Depth range = 22.0 - 22.0 m
Stations = 509
Average biomass = 0.76 g/ha Rank biomass = 206
Average abundance = 0.01/ha Rank abundance = 232

F134 *Urolophus cruciatus* (Lacépède, 1804) (Chordata, Urolophidae) CAAB 37 038002

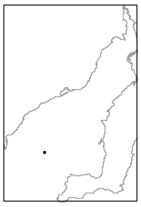
Common name = Banded Stingaree
Length = To 276 mm
Depth range = 20.7 - 20.7 m
Stations = 384
Average biomass = 2.23 g/ha Rank biomass = 172
Average abundance = 0.01/ha Rank abundance = 253

F135 *Asymbolus vincenti* (Zietz, 1908) (Chordata, Scyliorhinidae) CAAB 37 015003

Common name = Gulf Catshark
Length = To 288 mm
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.42 g/ha Rank biomass = 224
Average abundance = 0.005/ha Rank abundance = 275

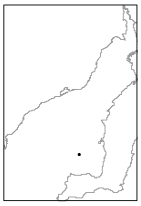
F137 *Seriolella brama* (Gunther, 1860) (Chordata, Centrolophidae) CAAB 37 445005

Common name = Blue Warehou
Length = To 136 mm
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.19 g/ha Rank biomass = 250
Average abundance = 0.005/ha Rank abundance = 275

Image courtesy of www.fishesofaustralia.net.au / CSIRO

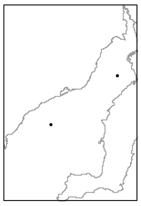
F138 *Ammotretis rostratus* (Gunther, 1862) (Chordata, Pleuronectidae) CAAB 37 461001

Common name = Longsnout Flounder
Length = To 239 mm
Depth range = 33.8 - 33.8 m
Stations = 199
Average biomass = 2.14 g/ha Rank biomass = 173
Average abundance = 0.02/ha Rank abundance = 194

Image courtesy of www.fishesofaustralia.net.au / CSIRO

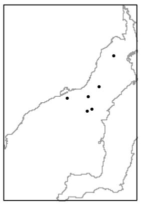
F139 *Heteroclinus heptaeolus* (Ogilby, 1885) (Chordata, Clinidae) CAAB 37 416010

Common name = Ogilby's Weedfish
Length = To 108 mm
Depth range = 17.9 - 26.1 m
Stations = 445, 517
Average biomass = 2.72 g/ha Rank biomass = 160
Average abundance = 0.24/ha Rank abundance = 66

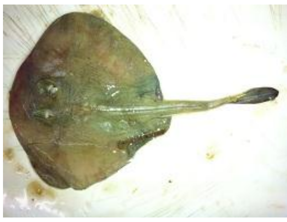
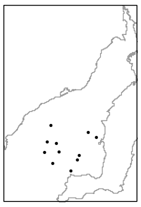
Image courtesy of www.fishesofaustralia.net.au / John E. Randall

F140 *Torquigener pleurogramma* (Regan, 1903) (Chordata, Tetraodontidae) CAAB 37 467030

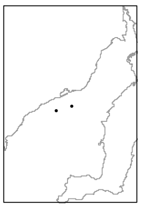
Common name = Banded (Weeping) toadfish
Length = To 230 mm
Depth range = 17.8 - 22.0 m
Stations = 22, 77, 166, 505, 508, 509
Average biomass = 40.74 g/ha Rank biomass = 60
Average abundance = 0.24/ha Rank abundance = 67

F141 *Trygonoptera mucosa* (Whitley, 1939) (Chordata, Urolophidae) CAAB 37 038015

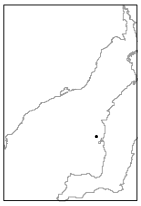
Common name = Western Shovelnose Stingaree
Length = To 290 mm
Depth range = 20.7 - 44.7 m
Stations = 197, 199, 203, 209, 384, 389, 517, 525, 529, 531, 536
Average biomass = 31.27 g/ha Rank biomass = 73
Average abundance = 0.20/ha Rank abundance = 73

F144 *Hypselognathus rostratus* (Waite & Hale, 1921) (Chordata, Syngnathidae) CAAB 37 282012

Common name = Kinfesnout Pipefish
Length = To 266 mm
Depth range = 21.3 - 26.9 m
Stations = 178, 184
Average biomass = 0.29 g/ha Rank biomass = 240
Average abundance = 0.06/ha Rank abundance = 120

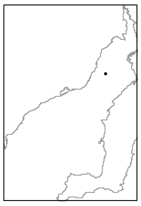
F146 *Trygonoptera imitata* (Yearsley, Last & Gomon, 2008) (Chordata, Urolophidae) CAAB 37 038014



Common name = Eastern Shovelnose Stingaree
Length = To 295 mm
Depth range = 20.7 - 20.7 m
Stations = 384
Average biomass = 2.62 g/ha Rank biomass = 163
Average abundance = 0.01/ha Rank abundance = 253

Image courtesy of www.fishesofaustralia.net.au / Andrew J Green

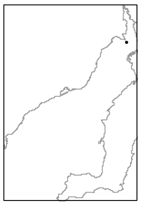
F147 *Furgaleus macki* (Whitley, 1943) (Chordata, Triakidae) CAAB 37 017003



Common name = Whiskery Shark
Length = To 460 mm
Depth range = 26.9 - 26.9 m
Stations = 60
Average biomass = 1.30 g/ha Rank biomass = 190
Average abundance = 0.004/ha Rank abundance = 285

Image courtesy of www.fishesofaustralia.net.au / Rudie H Kuiter

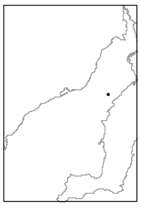
F148 *Orectolobus halei* (Whitley, 1940) (Chordata, Orectolobidae) CAAB 37 013020



Common name = Gulf Wobbegong
Length = To 650 mm
Depth range = 22.0 - 22.0 m
Stations = 1
Average biomass = 8.74 g/ha Rank biomass = 117
Average abundance = 0.005/ha Rank abundance = 282

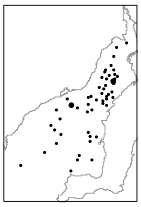
Image courtesy of www.fishesofaustralia.net.au / CSIRO

F149 *Neosebastes scorpaenoides* (Guichenot, 1867) (Chordata, Neosebastidae) CAAB 37 287005



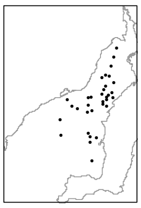
Common name = Common Gurnard Perch
Length = To 95 mm
Depth range = 23.1 - 23.1 m
Stations = 90
Average biomass = 0.37 g/ha Rank biomass = 227
Average abundance = 0.02/ha Rank abundance = 201

G001 *Posidonia* sp. (Magnoliophyta, Posidoniaceae) CAAB 63 617000



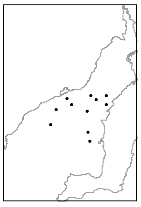
Common name = Strapweed
Length = Not recorded
Depth range = 16.6 - 44.7 m
Stations = 1, 22, 39, 46, 51, 54, 62, 63, 64, 69, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 134, 152, 157, 163, 166, 178, 184, 197, 199, 203, 209, 306, 383, 384, 389, 445, 501, 502, 503, 505, 508, 509, 517, 526, 531, 533, 538
Average biomass = 689.16 g/ha Rank biomass = 5
Average abundance = 0.89/ha Rank abundance = 33

G002 *Amphibolis antartica* (Labill.) Asch. (Magnoliophyta, Cymodoceaceae) CAAB 63 618004



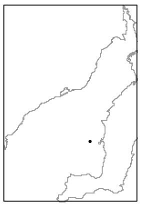
Common name = Amphibolis
Length = Not recorded
Depth range = 16.6 - 38.0 m
Stations = 22, 39, 60, 63, 64, 74, 81, 84, 87, 90, 92, 99, 100, 105, 111, 115, 119, 128, 134, 152, 163, 166, 178, 197, 306, 383, 384, 502, 505, 508, 509, 526, 533
Average biomass = 63.85 g/ha Rank biomass = 43
Average abundance = 0.63/ha Rank abundance = 41

G003 *Halophila australis* (Doty & B.C. Stone) (Magnoliophyta, Hydrocharitaceae) CAAB 63 605001



Common name = Halophila
Length = Not recorded
Depth range = 18.9 - 26.9 m
Stations = 84, 104, 105, 119, 166, 178, 184, 197, 509, 517, 526
Average biomass = 2.00 g/ha Rank biomass = 175
Average abundance = 0.23/ha Rank abundance = 69

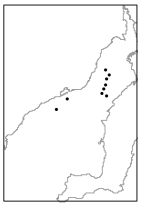
G004 *Zostera sp.* (Magnoliophyta, Hydrocharitaceae) CAAB 63 619900



Common name = Zostera
Length = Not recorded
Depth range = 22.8 - 22.8 m
Stations = 526
Average biomass = 0.30 g/ha Rank biomass = 237
Average abundance = 0.005/ha Rank abundance = 273

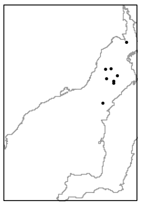
Image courtesy of www.portphillipmarinelife.net.au

H001 *Halopteris campanula* (Busk, 1852) (Cnidaria, Halopterididae) CAAB 11 063001



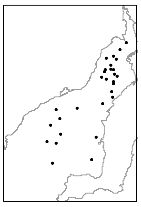
Common name = Halopteris sp. 1
Length = Not recorded
Depth range = 18.9 - 27.1 m
Stations = 46, 63, 69, 74, 81, 92, 105, 166, 184
Average biomass = 0.64 g/ha Rank biomass = 211
Average abundance = 0.11/ha Rank abundance = 97

M001 *Lima vulgaris* (Link, 1807) (Mollusca, Limidae) CAAB 23 250020



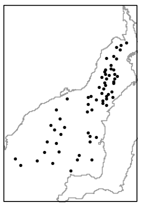
Common name = Lima Lima
Length = To 38 mm
Depth range = 17.9 - 27.1 m
Stations = 1, 46, 48, 69, 115, 445, 502, 503
Average biomass = 3.09 g/ha Rank biomass = 157
Average abundance = 0.39/ha Rank abundance = 52

M002 *Malleus* (*Malleus*) *meridianus* (Cotton, 1930) (Mollusca, Malleidae) CAAB 23 237001



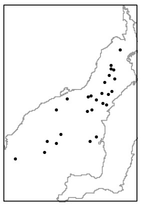
Common name = Southern Hammer Oyster
Length = To 147 mm
Depth range = 16.6 - 43.4 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 62, 64, 69, 87, 100, 115, 134, 152, 163, 184, 384, 389, 445, 502, 503, 517, 525, 533, 536
Average biomass = 78.66 g/ha Rank biomass = 36
Average abundance = 2.13/ha Rank abundance = 23

M004 *Sepioteuthis australis* (Quoy & Gaimard, 1832) (Mollusca, Loliginidae) CAAB 23 617005



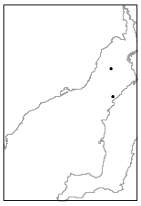
Common name = Southern Calamary
Length = To 155 mm
Depth range = 16.6 - 44.7 m
Stations = 1, 8, 22, 25, 29, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 111, 115, 119, 128, 147, 152, 157, 163, 166, 184, 197, 199, 203, 209, 302, 306, 383, 384, 389, 445, 501, 502, 503, 505, 508, 509, 517, 525, 526, 529, 531, 533, 534, 535, 536, 538
Average biomass = 388.77 g/ha Rank biomass = 9
Average abundance = 15.66/ha Rank abundance = 9

M005 *Sepia novaehollandae* (Hoyle, 1909) (Mollusca, Sepiidae) CAAB 23 607005

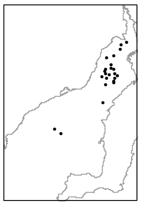
Common name = Nova Cuttlefish
Length = To 131 mm
Depth range = 17.8 - 44.7 m
Stations = 8, 39, 48, 51, 63, 73, 84, 87, 90, 92, 104, 115, 119, 163, 166, 184, 384, 389, 501, 505, 508, 509, 525, 526, 531, 534
Average biomass = 39.99 g/ha Rank biomass = 61
Average abundance = 0.97/ha Rank abundance = 32

M006 *Ischnochiton* (*Heterozona*) *cariosus* (Pilsbry, 1892) (Mollusca, Ischnochitonidae) CAAB 23 115023

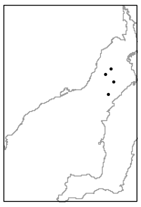
Common name = Chiton
Length = To 60 mm
Depth range = 21.1 - 22.5 m
Stations = 48, 100
Average biomass = 0.30 g/ha Rank biomass = 235
Average abundance = 0.05/ha Rank abundance = 141

M008 *Trichomya hirsuta* (Lamarck, 1819) (Mollusca, Mytilidae) CAAB 23 220006

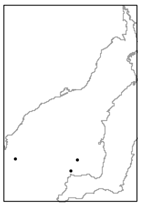
Common name = Hairy Mussel
Length = To 74 mm
Depth range = 16.6 - 38.0 m
Stations = 1, 8, 22, 25, 39, 46, 48, 51, 54, 60, 62, 63, 64, 69, 74, 115, 157, 163, 302, 445, 501, 502, 503
Average biomass = 200.39 g/ha Rank biomass = 20
Average abundance = 11.84/ha Rank abundance = 11

M009 *Barbatia* (*Barbatia*) *pistachia* (Lamarck, 1819) (Mollusca, Arcidae) CAAB 23 226006

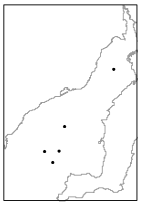
Common name = Ark Shell
Length = To 37 mm
Depth range = 18.9 - 26.9 m
Stations = 48, 60, 90, 502
Average biomass = 0.63 g/ha Rank biomass = 212
Average abundance = 0.13/ha Rank abundance = 89

M010 *Nototodarus gouldi* (McCoy, 1888) (Mollusca, Ommastrephidae) CAAB 23 636004

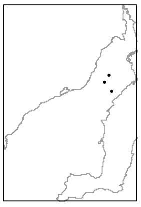
Common name = Red Arrow Squid
Length = To 185 mm
Depth range = 27.4 - 38.9 m
Stations = 203, 209, 534
Average biomass = 1.88 g/ha Rank biomass = 177
Average abundance = 0.03/ha Rank abundance = 175

M011 *Mimachlamys asperrima* (Lamarck, 1819) (Mollusca, Pectinidae) CAAB 23 270006

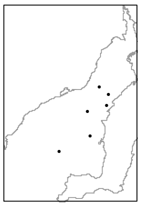
Common name = Doughboy Scallop (Sponge Scallop)
Length = To 55 mm
Depth range = 19.4 - 44.7 m
Stations = 51, 147, 529, 531, 536
Average biomass = 8.90 g/ha Rank biomass = 116
Average abundance = 1.01/ha Rank abundance = 30

M013 *Acrosterigma cygnorum* (Deshayes, 1855) (Mollusca, Cardiidae) CAAB 23 335019



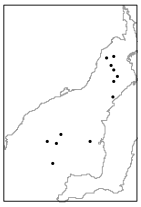
Common name = Cockle
Length = To 44 mm
Depth range = 19.9 - 27.7 m
Stations = 63, 73, 87
Average biomass = 1.49 g/ha Rank biomass = 184
Average abundance = 0.04/ha Rank abundance = 169

M014 *Sepia apama* (Gray, 1849) (Mollusca, Sepiidae) CAAB 23 607001

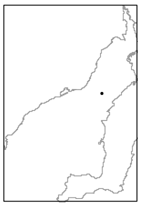
Common name = Giant Cuttlefish
Length = To 224 mm
Depth range = 19.7 - 36.1 m
Stations = 77, 90, 119, 383, 509, 529
Average biomass = 86.15 g/ha Rank biomass = 33
Average abundance = 0.22/ha Rank abundance = 71

M015 *Ostrea* (*Eostrea*) *angasi* (Sowerby, 1871) (Mollusca, Ostreidae) CAAB 23 257002

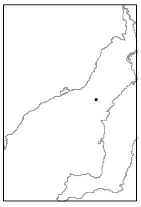
Common name = Mud Oyster (Native Oyster)
Length = To 96 mm
Depth range = 17.9 - 43.4 m
Stations = 22, 25, 39, 51, 100, 163, 389, 445, 502, 525, 526, 536
Average biomass = 13.52 g/ha Rank biomass = 104
Average abundance = 0.48/ha Rank abundance = 46

M016 *Sepiadarium austrinum* (Berry, 1921) (Mollusca, Sepiadariidae) CAAB 23 608003



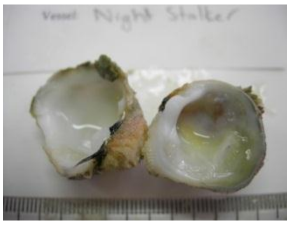
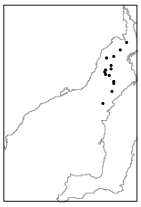
Common name = Southern Bottletail Squid
Length = To 24 mm
Depth range = 22.3 - 22.3 m
Stations = 92
Average biomass = 0.04 g/ha Rank biomass = 281
Average abundance = 0.01/ha Rank abundance = 242

M017 *Clanculus flagellatus* (Philippi, 1848) (Mollusca, Trochidae) CAAB 24 046124

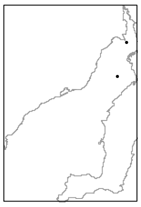
Common name = Clanculus
Length = To 36 mm
Depth range = 22.5 - 22.5 m
Stations = 104
Average biomass = 0.81 g/ha Rank biomass = 203
Average abundance = 0.06/ha Rank abundance = 118

M019 *Cleidothaerus albidus* (Lamarck, 1819) (Mollusca, Cleidothaeridae) CAAB 23 423001

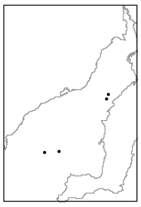
Common name = Rock Shell
Length = To 34 mm
Depth range = 18.9 - 26.9 m
Stations = 1, 8, 22, 25, 39, 46, 48, 54, 60, 63, 87, 115, 502, 503
Average biomass = 12.52 g/ha Rank biomass = 105
Average abundance = 1.53/ha Rank abundance = 24

M020 *Pinna bicolor* (Gmelin, 1791) (Mollusca, Pinnidae) CAAB 23 245001

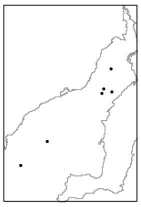
Common name = Razor Clam (Razor Fish)
Length = To 176 mm
Depth range = 17.9 - 22.0 m
Stations = 1, 445
Average biomass = 6.18 g/ha Rank biomass = 133
Average abundance = 0.03/ha Rank abundance = 172

M022 *Pecten fumatus* (Reeve, 1852) (Mollusca, Pectinidae) CAAB 23 270007

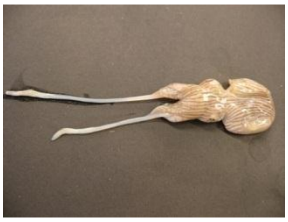
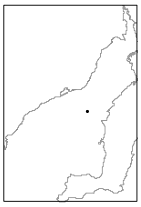
Common name = Commercial Scallop
Length = To 83 mm
Depth range = 23.1 - 44.7 m
Stations = 90, 99, 529, 531
Average biomass = 1.46 g/ha Rank biomass = 186
Average abundance = 0.04/ha Rank abundance = 162

M023 *Equichlamys bifrons* (Lamarck, 1819) (Mollusca, Pectinidae) CAAB 23 270005

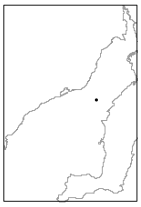
Common name = Queen Scallop
Length = To 67 mm
Depth range = 19.9 - 37.4 m
Stations = 48, 81, 87, 92, 525, 538
Average biomass = 2.64 g/ha Rank biomass = 162
Average abundance = 0.09/ha Rank abundance = 105

M024 *Sepioloidea lineolata* (Quoy & Gaimard, 1832) (Mollusca, Sepiadariidae) CAAB 23 608001

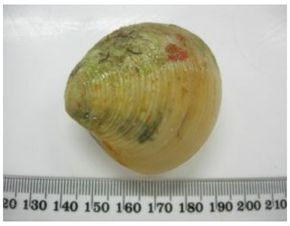
Common name = Striped Pyjama Squid
Length = To 27 mm
Depth range = 22.0 - 22.0 m
Stations = 509
Average biomass = 0.11 g/ha Rank biomass = 268
Average abundance = 0.01/ha Rank abundance = 232

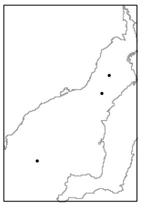
M030 *Glycymeris* (*Glycymeris*) *striatularis* (Lamarck, 1819) (Mollusca, Glycymerididae) CAAB 23 231001

Common name = Dog Cockle
Length = To 25 mm
Depth range = 22.5 - 22.5 m
Stations = 104
Average biomass = 0.20 g/ha Rank biomass = 249
Average abundance = 0.02/ha Rank abundance = 191

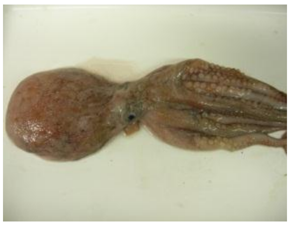
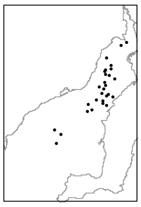
M031 *Dosinia victoriae* (Gatliff & Gabriel, 1914) (Mollusca, Veneridae) CAAB 23 380013





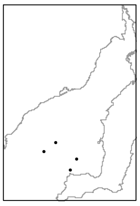
Common name = Venus Shell
Length = To 39 mm
Depth range = 22.0 - 44.3 m
Stations = 63, 92, 535
Average biomass = 0.29 g/ha Rank biomass = 241
Average abundance = 0.04/ha Rank abundance = 167

M033 *Octopus berrima* (Stranks & Norman, 1993) (Mollusca, Octopodidae) CAAB 23 659002

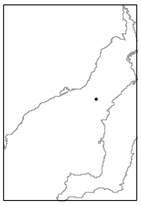
Common name = Southern Keeled Octopus
Length = To 68 mm
Depth range = 18.1 - 42.2 m
Stations = 1, 25, 39, 46, 48, 54, 60, 63, 73, 74, 77, 81, 90, 92, 100, 104, 105, 111, 115, 119, 128, 157, 163, 302, 389, 501, 508, 509
Average biomass = 32.93 g/ha Rank biomass = 68
Average abundance = 0.77/ha Rank abundance = 37

M038 *Sepia braggi* (Verco, 1907) (Mollusca, Sepiidae) CAAB 23 607014

Common name = Braggi's Cuttle
Length = To 53 mm
Depth range = 37.4 - 44.7 m
Stations = 203, 209, 389, 531
Average biomass = 0.50 g/ha Rank biomass = 221
Average abundance = 0.06/ha Rank abundance = 126

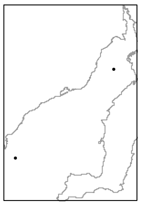
M040 *Octopus kaurna* (Stranks, 1990) (Mollusca, Octopodidae) CAAB 23 659026

Common name = Southern Sand Octopus
Length = To 115 mm
Depth range = 22.5 - 22.5 m
Stations = 104
Average biomass = 2.44 g/ha Rank biomass = 168
Average abundance = 0.02/ha Rank abundance = 191

Image courtesy of www.portphillipmarinelife.net.au / Julian Finn / Museum Victoria

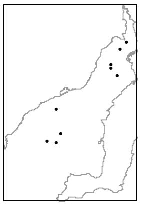
M042 *Octopus pallidus* (Hoyle, 1885) (Mollusca, Octopodidae) CAAB 23 659004

Common name = Pale Octopus
Length = To 67 mm
Depth range = 19.4 - 27.4 m
Stations = 51, 534
Average biomass = 1.57 g/ha Rank biomass = 181
Average abundance = 0.03/ha Rank abundance = 174

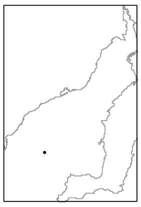
Image courtesy of www.portphillipmarinelife.net.au / Julian Finn / Museum Victoria

O001 *Carijoa multiflora* (Laackmann, 1909) (Cnidaria, Clavulariidae) CAAB 11 181002

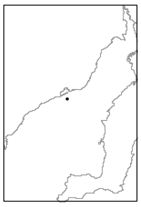
Common name = Carijoa
Length = Not recorded
Depth range = 17.9 - 42.2 m
Stations = 1, 8, 39, 48, 163, 184, 389, 445, 525
Average biomass = 38.13 g/ha Rank biomass = 64
Average abundance = 0.14/ha Rank abundance = 84

O004 *Capnella gaboensis* (Verseveldt, 1977) (Cnidaria, Nephtheidae) CAAB 11 191002

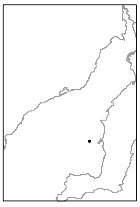
Common name = Capnella
Length = Not recorded
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.02 g/ha Rank biomass = 286
Average abundance = 0.005/ha Rank abundance = 275

O006 *Mopsella zimmeri* (Kükenthal, 1908) (Cnidaria, Melithaeidae) CAAB 11 190001



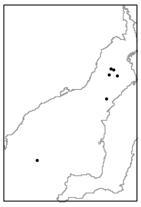
Common name = Mopsella
Length = Not recorded
Depth range = 18.9 - 18.9 m
Stations = 166
Average biomass = 0.04 g/ha Rank biomass = 282
Average abundance = 0.01/ha Rank abundance = 245

P001 *Sipunculan* sp. (Sipuncula) CAAB 17 000000



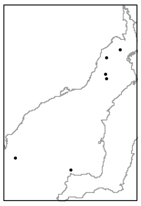
Common name = Sipunculan sp
Length = To 365 mm
Depth range = 22.8 - 22.8 m
Stations = 526
Average biomass = 0.30 g/ha Rank biomass = 237
Average abundance = 0.005/ha Rank abundance = 273

S001 *Clathria* sp. 1 (Porifera, Microcionidae) CAAB 10 066000



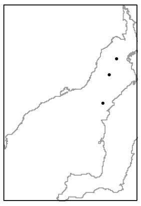
Common name = Clathria sp. 1
Length = Not recorded
Depth range = 17.9 - 44.3 m
Stations = 63, 48, 51, 99, 445, 535
Average biomass = 52.07 g/ha Rank biomass = 49
Average abundance = 0.05/ha Rank abundance = 137

S002 *Ecionemia* sp. 1 (Porifera, Ancorinidae) CAAB 10 009000



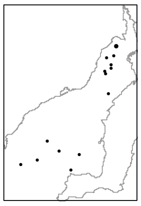
Common name = Cannon Ball Sponge
Length = Not recorded
Depth range = 22.0 - 38.9 m
Stations = 8, 25, 60, 69, 209, 534
Average biomass = 104.33 g/ha Rank biomass = 29
Average abundance = 0.05/ha Rank abundance = 147

S003 *Ircinia* sp. (Porifera, Irciniidae) CAAB 10 112000



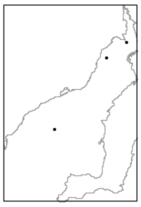
Common name = Ircinia sp. 1
Length = Not recorded
Depth range = 18.6 - 24.0 m
Stations = 29, 63, 115
Average biomass = 64.55 g/ha Rank biomass = 42
Average abundance = 0.05/ha Rank abundance = 133

S004 *Poecilosclerid* sp. 1 (Porifera, Poecilosclerida (Order)) CAAB 10 000000



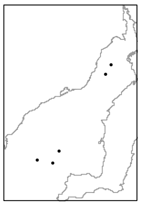
Common name = Poecilosclerid sp. 1
Length = Not recorded
Depth range = 19.2 - 44.3 m
Stations = 22, 25, 39, 48, 54, 60, 90, 199, 209, 306, 525, 529, 535, 538
Average biomass = 204.93 g/ha Rank biomass = 19
Average abundance = 0.19/ha Rank abundance = 75

S005 *Dictyoceratid* sp. 1 (Porifera, Dictyoceratida (Order)) CAAB 10 000000

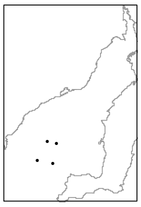
Common name = Dictyoceratid sp. 1
Length = Not recorded
Depth range = 22.0 - 33.4 m
Stations = 1, 25, 157
Average biomass = 62.25 g/ha Rank biomass = 44
Average abundance = 0.04/ha Rank abundance = 163

S007 *Chondropsid* sp. 1 (Porifera, Chondropsidae) CAAB 10 078000

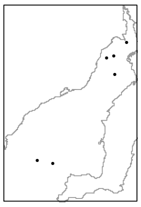
Common name = Chondropsid sp. 1
Length = Not recorded
Depth range = 20.1 - 44.3 m
Stations = 39, 60, 529, 535, 536
Average biomass = 27.89 g/ha Rank biomass = 76
Average abundance = 0.04/ha Rank abundance = 153

S009 *Holopsamma laminaefavosa* (Carter, 1885) (Porifera, Microcionidae) CAAB 10 066142

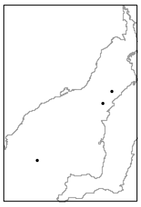
Common name = Honey Comb Sponge
Length = Not recorded
Depth range = 34.2 - 44.3 m
Stations = 389, 525, 535, 536
Average biomass = 16.33 g/ha Rank biomass = 98
Average abundance = 0.03/ha Rank abundance = 171

S010 *Demosponge* sp. 1 (Porifera, Demospongiae (Class)) CAAB 10 000000

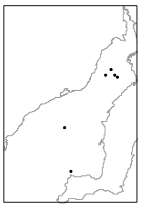
Common name = Demosponge sp. 1
Length = Not recorded
Depth range = 18.3 - 44.3 m
Stations = 1, 22, 25, 62, 535, 536
Average biomass = 73.42 g/ha Rank biomass = 40
Average abundance = 0.09/ha Rank abundance = 107

S012 *Demosponge* sp. 3 (Porifera, Demospongiae (Class)) CAAB 10 000000

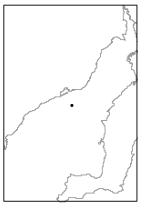
Common name = Demosponge sp. 3
Length = Not recorded
Depth range = 19.9 - 44.3 m
Stations = 87, 115, 535
Average biomass = 56.10 g/ha Rank biomass = 46
Average abundance = 0.05/ha Rank abundance = 145

S016 *Haplosclerid* sp. 2 (Porifera, Haplosclerida (Order)) CAAB 10 000000

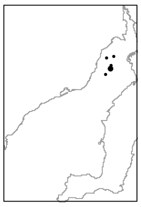
Common name = Haplosclerid sp. 2
Length = Not recorded
Depth range = 17.9 - 38.9 m
Stations = 48, 60, 62, 147, 209, 445
Average biomass = 5.21 g/ha Rank biomass = 139
Average abundance = 0.05/ha Rank abundance = 130

S017 *Demosponge* sp. 5 (Porifera, Demospongiae (Class)) CAAB 10 000000



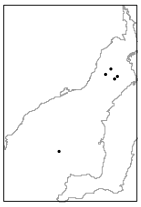
Common name = Demosponge sp. 5
Length = Not recorded
Depth range = 21.3 - 21.3 m
Stations = 178
Average biomass = 0.42 g/ha   Rank biomass = 225
Average abundance = 0.04/ha   Rank abundance = 155

S019 *Dictyoceratid* sp. 2 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



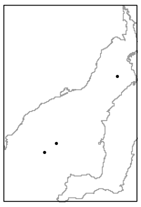
Common name = Dictyoceratid sp. 2
Length = Not recorded
Depth range = 19.2 - 26.9 m
Stations = 22, 25, 39, 48, 60
Average biomass = 333.92 g/ha   Rank biomass = 12
Average abundance = 0.05/ha   Rank abundance = 134

S020 *Poecilosclerid* sp. 2 (Porifera, Poecilosclerida (Order)) CAAB 10 000000



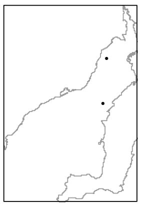
Common name = Poecilosclerid sp. 2
Length = Not recorded
Depth range = 17.9 - 36.1 m
Stations = 48, 60, 445, 501, 529
Average biomass = 49.20 g/ha   Rank biomass = 53
Average abundance = 0.05/ha   Rank abundance = 146

S022 *Clathria* sp. 2 (Porifera, Microcionidae) CAAB 10 066000



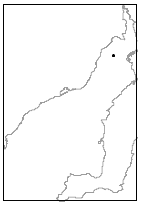
Common name = Clathria sp. 2
Length = Not recorded
Depth range = 17.9 - 44.7 m
Stations = 389, 445, 531
Average biomass = 5.24 g/ha   Rank biomass = 138
Average abundance = 0.02/ha   Rank abundance = 184

S024 *Dictyoceratid* sp. 4 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



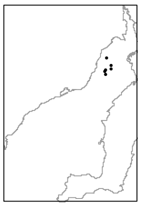
Common name = Dictyoceratid sp. 4
Length = Not recorded
Depth range = 24.0 - 25.5 m
Stations = 25, 115
Average biomass = 17.25 g/ha   Rank biomass = 95
Average abundance = 0.04/ha   Rank abundance = 157

S026 *Chalinid* sp. 1 (Porifera, Chalinidae) CAAB 10 099000



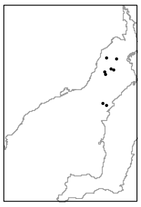
Common name = Chalinid sp. 1
Length = Not recorded
Depth range = 19.2 - 19.2 m
Stations = 22
Average biomass = 10.65 g/ha   Rank biomass = 111
Average abundance = 0.02/ha   Rank abundance = 189

S028 *Ecionemia* sp. 2 (Porifera, Ancorinidae) CAAB 10 009000



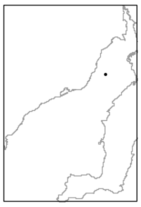
Common name = Ecionemia sp. 2
Length = Not recorded
Depth range = 20.1 - 26.9 m
Stations = 25, 39, 46, 48, 60, 54
Average biomass = 261.71 g/ha Rank biomass = 17
Average abundance = 0.03/ha Rank abundance = 173

S029 *Spongiid* sp. 2 (Porifera, Spongiidae) CAAB 10 114000



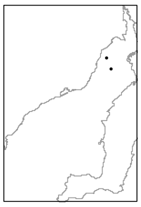
Common name = Bath Sponge
Length = Not recorded
Depth range = 18.6 - 26.9 m
Stations = 25, 29, 48, 51, 54, 60, 115, 119
Average biomass = 115.15 g/ha Rank biomass = 28
Average abundance = 0.12/ha Rank abundance = 92

S032 *Demosponge* sp. 9 (Porifera, Demospongiae (Class)) CAAB 10 000000



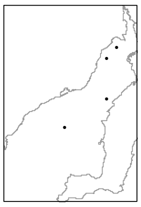
Common name = Demosponge sp. 9
Length = Not recorded
Depth range = 26.9 - 26.9 m
Stations = 60
Average biomass = 1.96 g/ha Rank biomass = 176
Average abundance = 0.01/ha Rank abundance = 263

S034 *Dictyoceratid* sp. 6 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



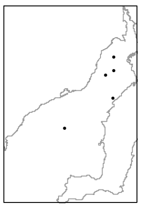
Common name = Dictyoceratid sp. 6
Length = Not recorded
Depth range = 21.1 - 25.5 m
Stations = 25, 48
Average biomass = 44.17 g/ha Rank biomass = 56
Average abundance = 0.02/ha Rank abundance = 185

S035 *Dictyoceratid* sp. 7 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



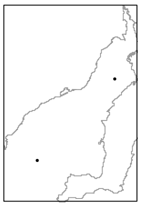
Common name = Dictyoceratid sp. 7
Length = Not recorded
Depth range = 21.0 - 35.2 m
Stations = 25, 99, 147, 306
Average biomass = 33.38 g/ha Rank biomass = 67
Average abundance = 0.06/ha Rank abundance = 122

S040 *Demosponge* sp. 12 (Porifera, Demospongiae (Class)) CAAB 10 000000



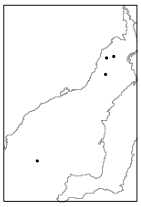
Common name = Demosponge sp. 12
Length = Not recorded
Depth range = 19.2 - 35.2 m
Stations = 22, 51, 60, 100, 147
Average biomass = 60.75 g/ha Rank biomass = 45
Average abundance = 0.09/ha Rank abundance = 110

S042 *Demosponge* sp. 14 (Porifera, Demospongiae (Class)) CAAB 10 000000

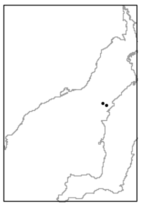
Common name = Demosponge sp. 14
Length = Not recorded
Depth range = 18.7 - 44.3 m
Stations = 501, 535
Average biomass = 4.81 g/ha Rank biomass = 144
Average abundance = 0.02/ha Rank abundance = 198

S043 *Verongid* sp. 1 (Porifera, Verongida (Order)) CAAB 10 000000

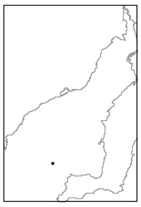
Common name = Verongid sp. 1
Length = Not recorded
Depth range = 19.2 - 44.3 m
Stations = 22, 25, 60, 535
Average biomass = 21.91 g/ha Rank biomass = 85
Average abundance = 0.05/ha Rank abundance = 139

S044 *Dictyoceratid* sp. 8 (Porifera, Dictyoceratida (Order)) CAAB 10 000000

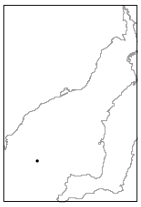
Common name = Dictyoceratid sp. 8
Length = Not recorded
Depth range = 21.1 - 24.0 m
Stations = 115, 119
Average biomass = 19.85 g/ha Rank biomass = 88
Average abundance = 0.06/ha Rank abundance = 124

S046 *Siphonochalina* sp. (Porifera, Haplosclerida (Order)) CAAB 10 000000

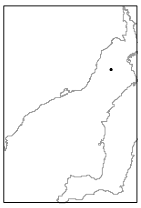
Common name = Siphonochalina sp. 1
Length = Not recorded
Depth range = 43.4 - 43.4 m
Stations = 536
Average biomass = 0.08 g/ha Rank biomass = 274
Average abundance = 0.01/ha Rank abundance = 246

S048 *Demosponge* sp. 17 (Porifera, Demospongiae (Class)) CAAB 10 000000

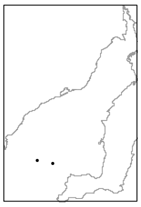
Common name = Demosponge sp. 17
Length = Not recorded
Depth range = 44.3 - 44.3 m
Stations = 535
Average biomass = 3.82 g/ha Rank biomass = 150
Average abundance = 0.01/ha Rank abundance = 268

S051 *Demosponge* sp. 20 (Porifera, Demospongiae (Class)) CAAB 10 000000

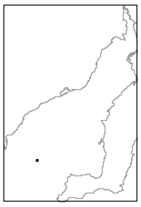
Common name = Demosponge sp. 20
Length = Not recorded
Depth range = 21.1 - 21.1 m
Stations = 48
Average biomass = 0.10 g/ha Rank biomass = 269
Average abundance = 0.01/ha Rank abundance = 240

S052 *Echinodictyum mesenterinum* (Lamarck, 1814) (Porifera, Raspailiidae) CAAB 10 067020



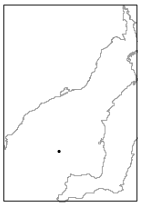
Common name = Echinodictyum
Length = Not recorded
Depth range = 43.4 - 44.3 m
Stations = 535, 536
Average biomass = 8.49 g/ha Rank biomass = 120
Average abundance = 0.01/ha Rank abundance = 218

S053 *Shpeciospongia papillosa* (Ridley & Dendy, 1886) (Porifera, Clionaidae) CAAB 10 021023



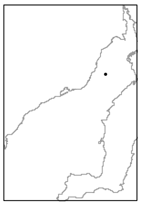
Common name = Spheciospongia
Length = Not recorded
Depth range = 44.3 - 44.3 m
Stations = 535
Average biomass = 19.14 g/ha Rank biomass = 90
Average abundance = 0.01/ha Rank abundance = 268

S054 *Callyspongia bilamellata* (Lamarck, 1814) (Porifera, Callyspongiidae) CAAB 10 098010



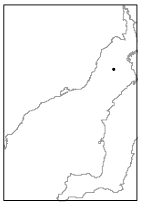
Common name = Callyspongia
Length = Not recorded
Depth range = 36.1 - 36.1 m
Stations = 529
Average biomass = 17.81 g/ha Rank biomass = 92
Average abundance = 0.01/ha Rank abundance = 236

S063 *Demosponge* sp. 23 (Porifera, Demospongiae (Class)) CAAB 10 000000



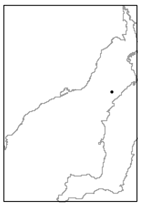
Common name = Demosponge sp. 23
Length = Not recorded
Depth range = 26.9 - 26.9 m
Stations = 60
Average biomass = 33.65 g/ha Rank biomass = 66
Average abundance = 0.004/ha Rank abundance = 285

S069 *Demosponge* sp. 29 (Porifera, Demospongiae (Class)) CAAB 10 000000



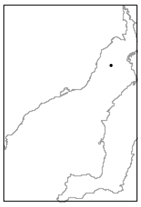
Common name = Demosponge sp. 29
Length = Not recorded
Depth range = 19.4 - 19.4 m
Stations = 51
Average biomass = 5.00 g/ha Rank biomass = 143
Average abundance = 0.01/ha Rank abundance = 228

S071 *Demosponge* sp. 31 (Porifera, Demospongiae (Class)) CAAB 10 000000



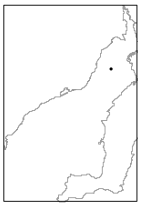
Common name = Demosponge sp. 31
Length = Not recorded
Depth range = 19.9 - 19.9 m
Stations = 87
Average biomass = 7.34 g/ha Rank biomass = 129
Average abundance = 0.02/ha Rank abundance = 204

S077 *Demosponge* sp. 36 (Porifera, Demospongiae (Class)) CAAB 10 000000



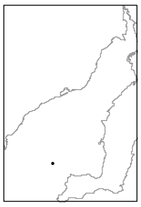
Common name = Demosponge sp. 36
Length = Not recorded
Depth range = 20.1 - 20.1 m
Stations = 39
Average biomass = 1.21 g/ha Rank biomass = 195
Average abundance = 0.01/ha Rank abundance = 217

S081 *Demosponge* sp. 39 (Porifera, Demospongiae (Class)) CAAB 10 000000



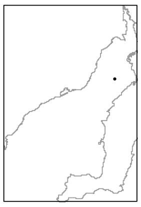
Common name = Demosponge sp. 39
Length = Not recorded
Depth range = 21.1 - 21.1 m
Stations = 48
Average biomass = 0.10 g/ha Rank biomass = 269
Average abundance = 0.01/ha Rank abundance = 240

S083 *Demosponge* sp. 41 (Porifera, Demospongiae (Class)) CAAB 10 000000



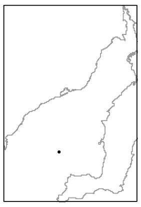
Common name = Demosponge sp. 41
Length = Not recorded
Depth range = 43.4 - 43.4 m
Stations = 536
Average biomass = 3.46 g/ha Rank biomass = 155
Average abundance = 0.01/ha Rank abundance = 246

S084 *Poecilosclerid* sp. 3 (Porifera, Poecilosclerida (Order)) CAAB 10 000000



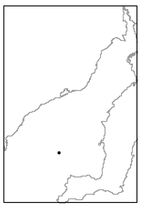
Common name = Poecilosclerid sp. 3
Length = Not recorded
Depth range = 18.7 - 18.7 m
Stations = 501
Average biomass = 0.47 g/ha Rank biomass = 222
Average abundance = 0.01/ha Rank abundance = 216

S085 *Haplosclerid* sp. 3 (Porifera, Haplosclerida (Order)) CAAB 10 000000



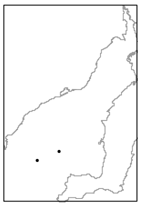
Common name = Haplosclerid sp. 3
Length = Not recorded
Depth range = 36.1 - 36.1 m
Stations = 529
Average biomass = 3.25 g/ha Rank biomass = 156
Average abundance = 0.01/ha Rank abundance = 236

S086 *Poecilosclerid* sp. 4 (Porifera, Poecilosclerida (Order)) CAAB 10 000000



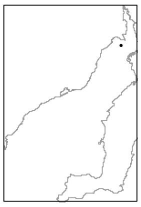
Common name = Poecilosclerid sp. 4
Length = Not recorded
Depth range = 36.1 - 36.1 m
Stations = 529
Average biomass = 5.24 g/ha Rank biomass = 137
Average abundance = 0.01/ha Rank abundance = 236

S088 *Demosponge* sp. 42 (Porifera, Demospongiae (Class)) CAAB 10 000000



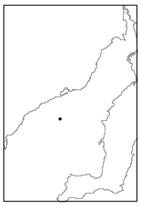
Common name = Demosponge sp. 42
Length = Not recorded
Depth range = 36.1 - 44.3 m
Stations = 529, 535
Average biomass = 53.96 g/ha Rank biomass = 47
Average abundance = 0.01/ha Rank abundance = 239

S091 *Demosponge* sp. 45 (Porifera, Demospongiae (Class)) CAAB 10 000000



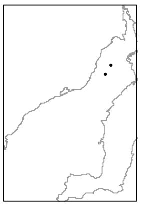
Common name = Demosponge sp. 45
Length = Not recorded
Depth range = 20.1 - 20.1 m
Stations = 302
Average biomass = 18.42 g/ha Rank biomass = 91
Average abundance = 0.02/ha Rank abundance = 213

S093 *Chondrilla* sp. (Porifera, Chondrillidae) CAAB 10 020000



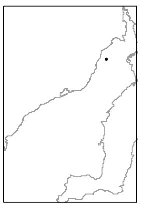
Common name = Chondrilla sp. 1
Length = Not recorded
Depth range = 30.7 - 30.7 m
Stations = 152
Average biomass = 0.65 g/ha Rank biomass = 210
Average abundance = 0.01/ha Rank abundance = 234

S097 *Dictyoceratid* sp. 9 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



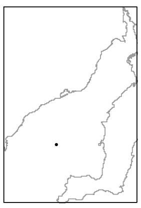
Common name = Dictyoceratid sp. 9
Length = Not recorded
Depth range = 20.1 - 26.9 m
Stations = 39, 60
Average biomass = 1.57 g/ha Rank biomass = 182
Average abundance = 0.02/ha Rank abundance = 200

S099 *Verongid* sp. 2 (Porifera, Verongida (Order)) CAAB 10 000000



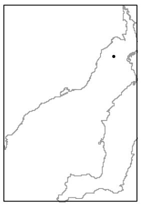
Common name = Verongid sp. 2
Length = Not recorded
Depth range = 25.5 - 25.5 m
Stations = 25
Average biomass = 0.53 g/ha Rank biomass = 220
Average abundance = 0.02/ha Rank abundance = 206

S100 *Demosponge* sp. 50 (Porifera, Demospongiae (Class)) CAAB 10 000000



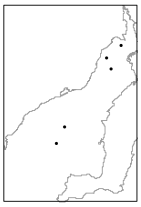
Common name = Demosponge sp. 50
Length = Not recorded
Depth range = 42.2 - 42.2 m
Stations = 389
Average biomass = 0.77 g/ha Rank biomass = 205
Average abundance = 0.01/ha Rank abundance = 256

S101 *Demosponge* sp. 51 (Porifera, Demospongiae (Class)) CAAB 10 000000



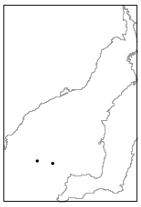
Common name = Demosponge sp. 51
Length = Not recorded
Depth range = 19.2 - 19.2 m
Stations = 22
Average biomass = 2.56 g/ha Rank biomass = 166
Average abundance = 0.02/ha Rank abundance = 189

S104 *Demosponge* sp. 54 (Porifera, Demospongiae (Class)) CAAB 10 000000



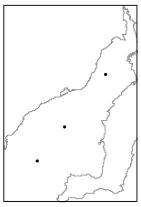
Common name = Demosponge sp. 54
Length = Not recorded
Depth range = 20.1 - 42.2 m
Stations = 25, 48, 147, 302, 389
Average biomass = 8.49 g/ha Rank biomass = 119
Average abundance = 0.06/ha Rank abundance = 119

S106 *Demosponge* sp. 56 (Porifera, Demospongiae (Class)) CAAB 10 000000



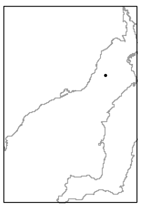
Common name = Demosponge sp. 56
Length = Not recorded
Depth range = 43.4 - 44.3 m
Stations = 535, 536
Average biomass = 2.95 g/ha Rank biomass = 159
Average abundance = 0.01/ha Rank abundance = 218

S107 *Dictyoceratid* sp. 10 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



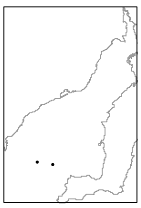
Common name = Dictyoceratid sp. 10
Length = Not recorded
Depth range = 26.9 - 44.3 m
Stations = 60, 147, 535
Average biomass = 1.00 g/ha Rank biomass = 197
Average abundance = 0.02/ha Rank abundance = 193

S110 *Demosponge* sp. 59 (Porifera, Demospongiae (Class)) CAAB 10 000000



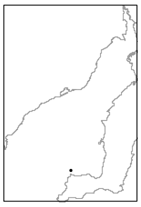
Common name = Demosponge sp. 59
Length = Not recorded
Depth range = 26.9 - 26.9 m
Stations = 60
Average biomass = 0.17 g/ha Rank biomass = 254
Average abundance = 0.01/ha Rank abundance = 263

S115 *Demosponge* sp. 63 (Porifera, Demospongiae (Class)) CAAB 10 000000



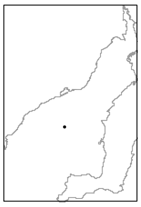
Common name = Demosponge sp. 63
Length = Not recorded
Depth range = 43.4 - 44.3 m
Stations = 535, 536
Average biomass = 2.51 g/ha Rank biomass = 167
Average abundance = 0.01/ha Rank abundance = 218

S118 *Dendrilla rosea* (Lendenfeld, 1883) (Porifera, Darwinellidae) CAAB 10 120014



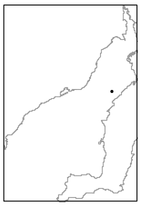
Common name = Dendrilla
Length = Not recorded
Depth range = 38.9 - 38.9 m
Stations = 209
Average biomass = 0.16 g/ha Rank biomass = 257
Average abundance = 0.01/ha Rank abundance = 267

S121 *Demosponge* sp. 65 (Porifera, Demospongiae (Class)) CAAB 10 000000



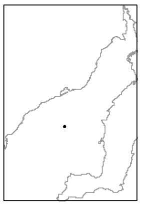
Common name = Demosponge sp. 65
Length = Not recorded
Depth range = 35.2 - 35.2 m
Stations = 147
Average biomass = 2.61 g/ha Rank biomass = 164
Average abundance = 0.01/ha Rank abundance = 243

S130 *Calcarea* (Porifera, Calcarea (Class)) CAAB 10 000000



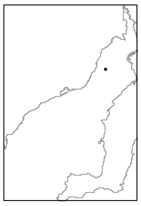
Common name = Calcarea
Length = Not recorded
Depth range = 19.9 - 19.9 m
Stations = 87
Average biomass = 17.72 g/ha Rank biomass = 94
Average abundance = 0.02/ha Rank abundance = 204

S133 *Verongid* sp. 3 (Porifera, Verongida (Order)) CAAB 10 000000



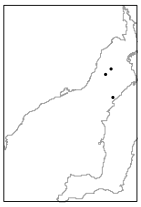
Common name = Verongid sp. 3
Length = Not recorded
Depth range = 35.2 - 35.2 m
Stations = 147
Average biomass = 38.35 g/ha Rank biomass = 63
Average abundance = 0.01/ha Rank abundance = 243

S137 *Aplysina lendenfeldi* (Bergquist, 1980) (Porifera, Aplysinidae) CAAB 10 125007



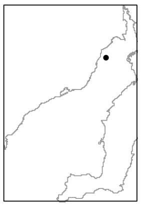
Common name = Aplysina lendenfeldi
Length = Not recorded
Depth range = 26.4 - 26.4 m
Stations = 46
Average biomass = 22.14 g/ha Rank biomass = 83
Average abundance = 0.004/ha Rank abundance = 284

S138 *Stelletta* sp. (Porifera, Ancorinidae) CAAB 10 009000



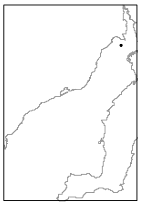
Common name = Stelletta sp.
Length = Not recorded
Depth range = 21.1 - 26.9 m
Stations = 48, 60, 100
Average biomass = 0.55 g/ha Rank biomass = 218
Average abundance = 0.06/ha Rank abundance = 128

S140 *Dictyoceratid* sp. 11 (Porifera, Dictyoceratida (Order)) CAAB 10 000000



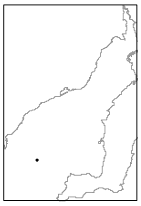
Common name = Dictyoceratid sp. 11
Length = Not recorded
Depth range = 25.5 - 25.5 m
Stations = 25
Average biomass = 687.77 g/ha Rank biomass = 6
Average abundance = 0.01/ha Rank abundance = 266

S141 *Halichondrid* (Porifera, Halichondridae) CAAB 10 093000



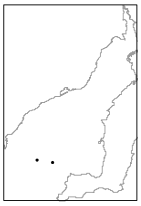
Common name = Halichondrid
Length = Not recorded
Depth range = 20.1 - 20.1 m
Stations = 302
Average biomass = 10.57 g/ha Rank biomass = 112
Average abundance = 0.02/ha Rank abundance = 213

S142 *Demosponge* sp. 73 (Porifera, Demospongiae (Class)) CAAB 10 000000



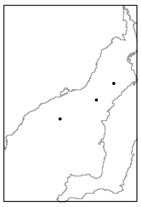
Common name = Demosponge sp. 73
Length = Not recorded
Depth range = 44.3 - 44.3 m
Stations = 535
Average biomass = 0.58 g/ha Rank biomass = 216
Average abundance = 0.01/ha Rank abundance = 268

S143 *Thorectid* sp. 2 (Porifera, Thorectidae) CAAB 10 113000



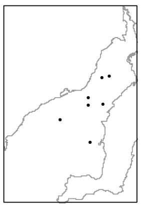
Common name = Thorectid sp.2
Length = Not recorded
Depth range = 43.4 - 44.3 m
Stations = 535, 536
Average biomass = 12.19 g/ha Rank biomass = 107
Average abundance = 0.01/ha Rank abundance = 218

X001 *Caulerpa cactoides* (Turner) C.Agardh (Chlorophyta, Caulerpaceae) CAAB 56 197003



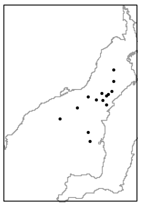
Common name = Caulerpa
Length = Not recorded
Depth range = 19.5 - 30.7 m
Stations = 104, 152, 503
Average biomass = 0.67 g/ha Rank biomass = 208
Average abundance = 0.04/ha Rank abundance = 151

X003 *Hormophysa cuneiformis* (J.F.Gmelin) P.C.Silva (Phaeophyta, Cystoseiraceae) CAAB 54 103033



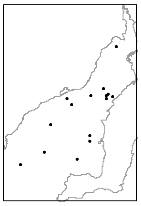
Common name = Hormophysa
Length = Not recorded
Depth range = 16.6 - 30.7 m
Stations = 63, 64, 115, 128, 152, 505, 526
Average biomass = 3.50 g/ha Rank biomass = 152
Average abundance = 0.18/ha Rank abundance = 77

X004 *Zonaria angustata* (Kützing) Papenfuss (Phaeophyta, Dictyotaceae) CAAB 54 025010

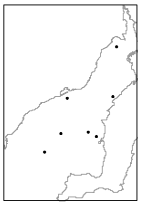
Common name = Zonaria sp. 1
Length = Not recorded
Depth range = 17.8 - 30.7 m
Stations = 51, 87, 90, 92, 104, 105, 111, 119, 134, 152, 197, 502, 505, 526
Average biomass = 30.29 g/ha Rank biomass = 74
Average abundance = 0.3/ha Rank abundance = 60

X006 *Gracilaria secundata* Harvey (Rhodophyta, Gracilariaceae) CAAB 55 106002

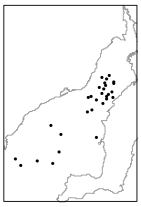
Common name = Gracilaria sp. 1
Length = Not recorded
Depth range = 18.9 - 44.7 m
Stations = 81, 84, 90, 99, 100, 105, 166, 178, 203, 306, 383, 517, 526, 531, 538
Average biomass = 24.42 g/ha Rank biomass = 80
Average abundance = 0.27/ha Rank abundance = 64

X007 *Gracilaria flageliformis* (Sonder) Womersley (Rhodophyta, Gracilariaceae) CAAB 55 106017

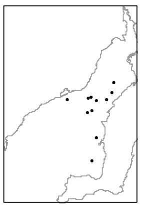
Common name = Gracilaria sp. 2
Length = Not recorded
Depth range = 18.9 - 44.7 m
Stations = 100, 163, 166, 197, 306, 384, 531
Average biomass = 6.20 g/ha Rank biomass = 132
Average abundance = 0.09/ha Rank abundance = 104

X008 *Sporolithon durum* (Foslie) Townsend & Woelkerling (Rhodophyta,Sporolithaceae) CAAB 55 120001

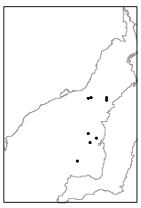
Common name = Popcorn
Length = Not recorded
Depth range = 16.6 - 44.3 m
Stations = 63, 64, 69, 73, 74, 77, 81, 84, 87, 90, 92, 99, 100, 104, 105, 115, 163, 384, 502, 503, 505, 508, 509, 517, 529, 534, 535, 536, 538
Average biomass = 157.86 g/ha Rank biomass = 25
Average abundance = 0.45/ha Rank abundance = 47

X009 *Spongoclonium conspicuum* Sonder (Rhodophyta, Ceramiaceae) CAAB 55 130238

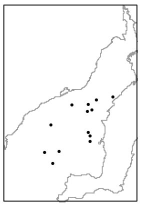
Common name = Spongoclonium
Length = Not recorded
Depth range = 17.8 - 25.5 m
Stations = 84, 87, 99, 104, 166, 384, 502, 505, 508, 509, 533
Average biomass = 10.84 g/ha Rank biomass = 110
Average abundance = 0.18/ha Rank abundance = 76

X011 *Osmundaria prolifera* J.V.Lamouroux (Rhodophyta, Rhodomelaceae) CAAB 55 133148

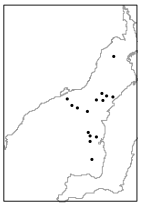
Common name = Osmundaria
Length = Not recorded
Depth range = 17.8 - 37.4 m
Stations = 84, 99, 105, 197, 203, 384, 505, 526
Average biomass = 5.55 g/ha Rank biomass = 136
Average abundance = 0.10/ha Rank abundance = 100

X012 *Dictyopteris muelleri* (Sonder) Reinbold (Phaeophyta, Dictyotaceae) CAAB 54 025003

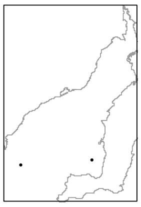
Common name = Dictyopteris sp. 1
Length = Not recorded
Depth range = 18.1 - 44.7 m
Stations = 100, 104, 128, 178, 197, 383, 508, 509, 517, 526, 529, 531, 536
Average biomass = 2.29 g/ha Rank biomass = 170
Average abundance = 0.27/ha Rank abundance = 63

X013 *Lobospira bicuspidata* Areschoug (Phaeophyta, Dictyotaceae) CAAB 54 025007

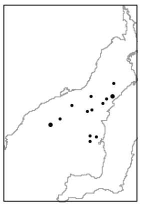
Common name = Lobospira
Length = Not recorded
Depth range = 18.9 - 28.7 m
Stations = 22, 92, 100, 104, 105, 111, 134, 166, 178, 197, 383, 384, 509, 526, 533
Average biomass = 5.18 g/ha Rank biomass = 141
Average abundance = 0.28/ha Rank abundance = 62

X015 *Asperococcus bullosus* J.V.Lamouroux (Phaeophyta, Punctariaceae) CAAB 54 067002

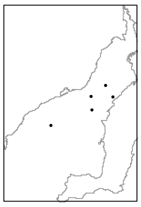
Common name = Brown Leaf Algae
Length = Not recorded
Depth range = 19.2 - 37.4 m
Stations = 533, 538
Average biomass = 1.74 g/ha Rank biomass = 178
Average abundance = 0.02/ha Rank abundance = 196

X017 *Zonaria turneriana* J.Agardh (Phaeophyta, Dictyotaceae) CAAB 54 025074

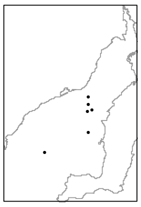
Common name = Zonaria sp. 2
Length = Not recorded
Depth range = 18.1 - 30.7 m
Stations = 84, 99, 100, 115, 152, 178, 383, 384, 503, 508, 509, 517, 526
Average biomass = 251.31 g/ha Rank biomass = 18
Average abundance = 0.25/ha Rank abundance = 65

X020 *Cladostephus spongiosus* (Hudson) C.Agardh (Phaeophyta, Sphacelariaceae) CAAB 54 021001

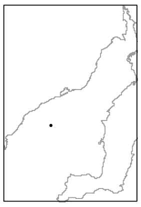
Common name = Cladostephus
Length = Not recorded
Depth range = 18.1 - 26.1 m
Stations = 74, 84, 100, 508, 517
Average biomass = 23.70 g/ha Rank biomass = 82
Average abundance = 0.14/ha Rank abundance = 86

X021 *Phacelocarpus peperocarpus* (Poiret) (Rhodophyta, Phacelocarpaceae) CAAB 55 058002

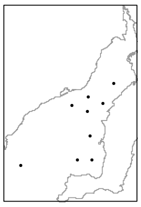
Common name = Phacelocarpus
Length = Not recorded
Depth range = 17.8 - 44.7 m
Stations = 128, 197, 505, 508, 509, 531
Average biomass = 1.29 g/ha Rank biomass = 191
Average abundance = 0.13/ha Rank abundance = 88

X022 *Dictyopteris* sp. 2 (Phaeophyta, Dictyotaceae) CAAB 54 025000



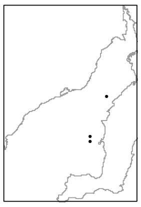
Common name = Dictyopteris sp. 2
Length = Not recorded
Depth range = 26.1 - 26.1 m
Stations = 517
Average biomass = 0.58 g/ha Rank biomass = 215
Average abundance = 0.06/ha Rank abundance = 121

X024 *Erythroclonium muelleri* Sonder (Rhodophyta, Areschougiaceae) CAAB 55 056001



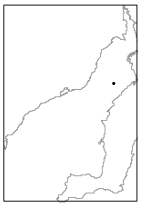
Common name = Erythroclonium
Length = Not recorded
Depth range = 17.8 - 37.4 m
Stations = 115, 178, 203, 383, 503, 505, 509, 533, 538
Average biomass = 1.26 g/ha Rank biomass = 193
Average abundance = 0.16/ha Rank abundance = 79

X025 *Dictyota ciliolata* Sonder ex Kützing (Phaeophyta, Dictyotaceae) CAAB 54 025030



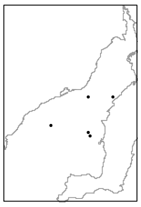
Common name = Dictyota
Length = Not recorded
Depth range = 22.8 - 24.7 m
Stations = 105, 383, 526
Average biomass = 0.16 g/ha Rank biomass = 256
Average abundance = 0.02/ha Rank abundance = 209

X026 *Chordaria cladosipho* Kützing Sphaerotrichia divaricata (Phaeophyta, Chordariaceae) CAAB 54 012001



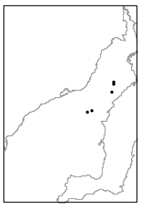
Common name = Chordaria
Length = Not recorded
Depth range = 19.5 - 19.5 m
Stations = 503
Average biomass = 0.26 g/ha Rank biomass = 245
Average abundance = 0.01/ha Rank abundance = 225

X028 *Solieria robusta* (Greville) Kylin (Rhodophyta, Areschougiaceae) CAAB 55 056002



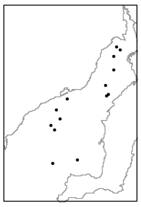
Common name = Solieria
Length = Not recorded
Depth range = 17.8 - 26.1 m
Stations = 100, 197, 383, 505, 517
Average biomass = 4.07 g/ha Rank biomass = 148
Average abundance = 0.15/ha Rank abundance = 81

X029 *Botryocladia sonderi* P.C.Silva (Rhodophyta, Rhodymeniaceae) CAAB 55 110001



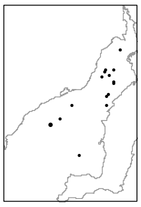
Common name = Botryocladia
Length = Not recorded
Depth range = 18.1 - 22.0 m
Stations = 87, 502, 503, 508, 509
Average biomass = 0.96 g/ha Rank biomass = 199
Average abundance = 0.08/ha Rank abundance = 112

X030 *Gracilaria* sp. 3 (Rhodophyta, Gracilariaceae) CAAB 55 106000



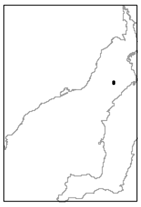
Common name = Gracilaria sp. 3
Length = Not recorded
Depth range = 18.9 - 43.4 m
Stations = 8, 22, 51, 74, 90, 105, 152, 157, 166, 184, 203, 306, 517, 536
Average biomass = 27.21 g/ha Rank biomass = 78
Average abundance = 0.23/ha Rank abundance = 68

X031 *Gelidium asperum* (C.Agardh) Greville (Rhodophyta, Gelidiaceae) CAAB 55 030001



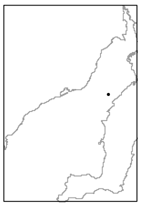
Common name = Gelidium sp. 1
Length = Not recorded
Depth range = 16.6 - 33.8 m
Stations = 8, 46, 51, 54, 63, 64, 90, 105, 119, 152, 178, 199, 502, 503, 517
Average biomass = 86.19 g/ha Rank biomass = 32
Average abundance = 0.31/ha Rank abundance = 59

X033 *Zonaria crenata* J.Agardh (Phaeophyta, Dictyotaceae) CAAB 54 025072



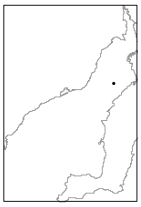
Common name = Zonaria sp. 3
Length = Not recorded
Depth range = 18.9 - 19.5 m
Stations = 502, 503
Average biomass = 0.26 g/ha Rank biomass = 244
Average abundance = 0.04/ha Rank abundance = 160

X034 *Gelididum* sp. 2 (Rhodophyta, Gelidiaceae) CAAB 55 030000



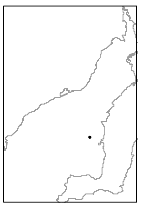
Common name = Gelidium sp. 2
Length = Not recorded
Depth range = 23.1 - 23.1 m
Stations = 90
Average biomass = 0.09 g/ha Rank biomass = 272
Average abundance = 0.02/ha Rank abundance = 201

X035 *Cystophora* sp. 1 (Phaeophyta, Cystoseiraceae) CAAB 54 103000



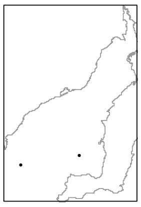
Common name = Cystophora sp. 1
Length = Not recorded
Depth range = 19.5 - 19.5 m
Stations = 503
Average biomass = 0.13 g/ha Rank biomass = 264
Average abundance = 0.01/ha Rank abundance = 225

X036 *Hormosira banksii* (Turner) Decaisne (Phaeophyta, Hormosiraceae) CAAB 54 100001



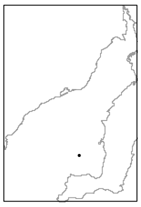
Common name = Hormosira
Length = Not recorded
Depth range = 24.2 - 24.2 m
Stations = 383
Average biomass = 0.03 g/ha Rank biomass = 284
Average abundance = 0.01/ha Rank abundance = 261

X040 *Wrangelia nobilis* J.D. Hooker & Harvey (Rhodophyta, Ceramiaceae) CAAB 55 130006



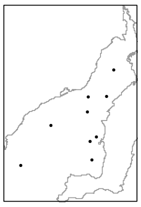
Common name = Wrangelia
Length = Not recorded
Depth range = 33.8 - 37.4 m
Stations = 199, 538
Average biomass = 7.55 g/ha Rank biomass = 125
Average abundance = 0.02/ha Rank abundance = 208

X041 *Gracilaria blodgettii* Harvey (Rhodophyta, Gracilariaceae) CAAB 55 106013



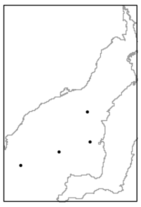
Common name = Gracilaria sp. 4
Length = Not recorded
Depth range = 33.8 - 33.8 m
Stations = 199
Average biomass = 0.13 g/ha Rank biomass = 263
Average abundance = 0.01/ha Rank abundance = 259

X044 *Perithalia caudata* (Labillardière) Womersley (Phaeophyta, Sporochnaceae) CAAB 54 045002



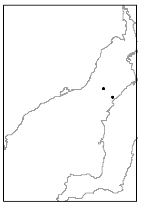
Common name = Perithalia
Length = Not recorded
Depth range = 17.8 - 37.4 m
Stations = 51, 105, 384, 505, 509, 517, 526, 533, 538
Average biomass = 24.93 g/ha Rank biomass = 79
Average abundance = 0.16/ha Rank abundance = 80

X045 *Sargassum* sp. 1 (Phaeophyta, Sargassaceae) CAAB 54 105000



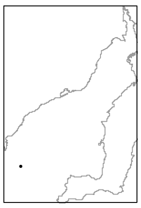
Common name = Sargassum sp. 1
Length = Not recorded
Depth range = 22.0 - 37.4 m
Stations = 509, 526, 529, 538
Average biomass = 0.24 g/ha Rank biomass = 247
Average abundance = 0.04/ha Rank abundance = 165

X046 *Cystophora* sp. 3 (Phaeophyta, Cystoseiraceae) CAAB 54 103000



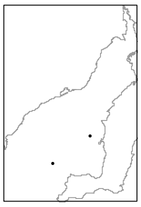
Common name = Cystophora sp. 3
Length = Not recorded
Depth range = 22.5 - 23.2 m
Stations = 81, 100
Average biomass = 0.27 g/ha Rank biomass = 243
Average abundance = 0.05/ha Rank abundance = 132

X048 *Laurencia filiformis* (C.Agardh) Montagne (Rhodophyta, Rhodomelaceae) CAAB 55 133008



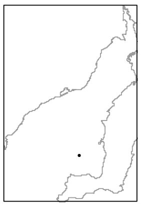
Common name = Laurencia
Length = Not recorded
Depth range = 37.4 - 37.4 m
Stations = 538
Average biomass = 0.11 g/ha Rank biomass = 267
Average abundance = 0.01/ha Rank abundance = 230

X051 *Ecklonia radiata* (C.Agardh) J.Agardh (Phaeophyta, Alariaceae) CAAB 54 080001



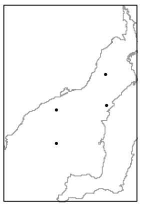
Common name = Ecklonia
Length = Not recorded
Depth range = 24.2 - 43.4 m
Stations = 383, 536
Average biomass = 0.36 g/ha Rank biomass = 228
Average abundance = 0.01/ha Rank abundance = 215

X052 *Heterosiphonia muelleri* (Sonder) De Toni (Rhodophyta, Dasyaceae) CAAB 55 132038



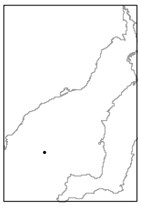
Common name = Heterosiphonia sp. 2
Length = Not recorded
Depth range = 33.8 - 33.8 m
Stations = 199
Average biomass = 0.06 g/ha Rank biomass = 277
Average abundance = 0.01/ha Rank abundance = 259

X053 *Gracilaria* sp. 5 (Rhodophyta, Gracilariaceae) CAAB 55 106000



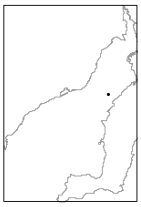
Common name = Gracilaria sp. 5
Length = Not recorded
Depth range = 21.1 - 42.2 m
Stations = 60, 119, 184, 389
Average biomass = 0.31 g/ha Rank biomass = 234
Average abundance = 0.06/ha Rank abundance = 116

X054 *Dictyopteris* sp. 3 (Phaeophyta, Dictyotaceae) CAAB 54 025000



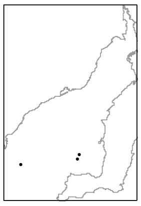
Common name = Dictyopteris sp. 3
Length = Not recorded
Depth range = 44.7 - 44.7 m
Stations = 531
Average biomass = 0.14 g/ha Rank biomass = 260
Average abundance = 0.005/ha Rank abundance = 275

X055 *Dasya extensa* Sonder ex Kützing (Rhodophyta, Dasyaceae) CAAB 55 132001



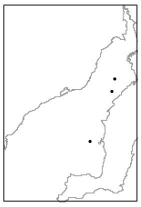
Common name = Dasya
Length = Not recorded
Depth range = 23.1 - 23.1 m
Stations = 90
Average biomass = 10.13 g/ha Rank biomass = 114
Average abundance = 0.02/ha Rank abundance = 201

X057 *Hypnea ramentacea* (C.Agardh) J. Agardh (Rhodophyta, Hypneaceae) CAAB 55 061001



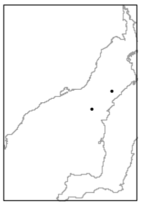
Common name = Hypnea
Length = Not recorded
Depth range = 33.8 - 37.4 m
Stations = 199, 203, 538
Average biomass = 0.28 g/ha Rank biomass = 242
Average abundance = 0.02/ha Rank abundance = 181

X058 *Scaberia agardhii* (Greville) (Phaeophyta, Cystoseiraceae) CAAB 54 103011



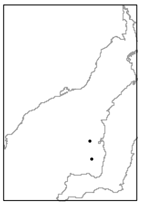
Common name = Scaberia
Length = Not recorded
Depth range = 18.7 - 22.8 m
Stations = 87, 501, 526
Average biomass = 6.09 g/ha Rank biomass = 134
Average abundance = 0.04/ha Rank abundance = 166

X059 *Sargassum* sp. 2 (Phaeophyta, Sargassaceae) CAAB 54 105000



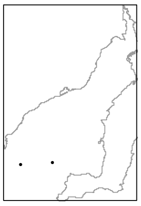
Common name = Sargassum sp. 2
Length = Not recorded
Depth range = 18.1 - 19.9 m
Stations = 87, 508
Average biomass = 1.33 g/ha Rank biomass = 189
Average abundance = 0.03/ha Rank abundance = 178

X060 *Caulerpa brownii* (C.Agardh) Endlicher (Chlorophyta, Caulerpaceae) CAAB 56 197004



Common name = Caulerpa sp. 2
Length = Not recorded
Depth range = 19.2 - 22.8 m
Stations = 526, 533
Average biomass = 7.85 g/ha Rank biomass = 124
Average abundance = 0.01/ha Rank abundance = 222

X061 *Bellotia eriophorum* (Harvey) (Phaeophyta, Sporochnaceae) CAAB 54 045004



Common name = Bellotia
Length = Not recorded
Depth range = 37.4 - 43.4 m
Stations = 536, 538
Average biomass = 2.43 g/ha Rank biomass = 169
Average abundance = 0.02/ha Rank abundance = 195