Invertebrate Scavenging Guilds along the Continental Shelf and Slope of Eastern Australia—General Description

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Final Report to The Fisheries Research Development Corporation

J.K. Lowry and S.D.A. Smith

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Cover
Bathynomus sp. – a giant scavenging crustacean living on the outer continental slope off the Great Barrier Reef. Photo: Roger Steene

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Non-technical Summary

Little is known about scavenging invertebrates in Australian waters. The SEAS (Scavengers of Eastern Australian Seas) Project was developed to delineate the scavenging fauna along the continental shelf and slope of eastern Australia. Between June 1993 and July 1995 a team of researchers from the Australian Museum, set baited traps at six sites (off Cairns, Gladstone, Mooloolaba, Coffs Harbour, Wollongong and Hobart) in depths of 50 m, 100 m, 200 m, 300 m, 400 m and 1000 m off the east coast of Australia. From these traps we collected 283 invertebrate scavengers and approximately 800,000 individuals. Nearly 70% of these species were new to science. Crustaceans (amphipods, copepods, decapods, isopods, leptostracans and ostracods) dominate guilds at all depths. Two other invertebrate groups (gastropods and polychaetes) are also represented.

Analyses of the data showed that the scavengers formed guilds (a group of species having similar ecological resource requirements and foraging strategies) according to latitude and depth. These guilds were mainly dominated by three groups of crustaceans: cypridinid ostracods, cirolanid isopods and lysianassoid amphipods. Cypridinids were most abundant in the 50 to 200 m sites all along the coast. Cirolanids are generally abundant throughout the area and lysianassoids are most important in the south between Wollongong and Hobart and all along the coast at 1000 m depth. Off Gladstone and Mooloolaba tiny tharybid copepods dominate guild numbers. Cirolanids often dominate biomass because of their size. Between Cairns and Wollongong at 300 and 400 m depth, two species of the giant cirolanid, *Bathynomus*, are common and often dominate guild biomass. At 1000 m lysianassoids almost always play an important role in number and biomass. In the northern part of the study area one or two specimens of large portunid crabs often came into traps and influenced biomass. In deep water pandalid shrimps occasionally influenced biomass. In the southern part of the study area large hermit crabs (*Strigopagurus strigimanus*) consistently entered traps, influencing biomass.

Species richness of scavenging guilds appears to be higher on the continental shelf and slope of eastern Australia than in other places studied. It is highest (20 to 25 species) between 50 and 100 m depth, usually slightly lower at 200 m depth (15 to 20 species), lowest (5 to 15 species) at 300 to 400 m depth and usually slightly higher (10 to 15 species) at 1000 m depth. The increase in species richness in shallower depths is mainly due to the cypridinid ostracod and cirolanid isopod component of the guild structure. These animals (particularly the cypridinids) are most diverse between 50 and 200 m depth. Cypridinid diversity decreases dramatically below 200 m depth. In deeper water lysianassoid amphipods (mainly eurytheneids, scopelocheirids, tryphosines and uristids) are usually more diverse, but they never match the richness of cypridinids in shallower water.

Although comparisons are difficult, studies from other parts of the world, such as the Arctic, the Antarctic and the deep sea, indicate that lysianassoid amphipods almost always dominate scavenging guild systems. The Australian scavenging fauna has representative lysianassoid genera of most of the other systems and is similar in this way. But the inclusion of such a diverse fauna of cypridinid ostracods (nearly 90 species) and cirolanid isopods (51 species) add several layers of complexity to the Australian scavenging guild system not known from other parts of the world.

Introduction

As in the terrestrial environment there are diverse and abundant scavengers operating in most marine habitats. These scavengers are represented by many different kinds of animals acting at different levels, from sharks and large fish to small molluscs and minute copepods. But in the demersal marine environment the invertebrate scavenging guild (a group of species having similar ecological resource requirements and foraging strategies) is made up almost entirely of crustaceans wherever these guilds have been studied.

Crustacean scavengers feed primarily on dead organisms which they locate with powerfully developed chemosensory organs (Dahl, 1979; Busdosh *et al.*, 1982; Hargrave, 1985; Lowry, 1986). However, crustacean scavengers are also important pests of commercial trap and long line fisheries (Vader *et al.*, 1985). Not only are they abundant and mobile, arriving on fresh bait, which they then devour before the target species, but they can also attack trapped fish rendering them unmarketable (e.g. Sekiguchi, 1982).

There are a number of casual reports in the European literature. Norman (1869) reported hundreds of specimens of the lysianassoid amphipod *Anonyx nugax* on fish brought up dead on long lines from off the Shetland Islands. Norman (1900) reported great numbers of another lysianassoid *Tryphosella nanoides* also from dead fish in a different locality of the Shetland Islands. Robertson (1888) reported *Tryphosella nanoides* attacking cod fish, *Gadus morhua*, from the Firth of Clyde. Another lysianassoid amphipod, *Tryphosella sarsi*, was reported as abundant on dead fish in shallow water off the Isle of Man in the Irish Sea. Scott (1900) reported many specimens of the scopelocheirid amphipod *Scopelocheirus crenatus* feeding on the tope shark, *Galeorhinus galeus*, caught off Aberdeen, Scotland, North Sea. Raitt (1929) also reported *Tmetonyx cicada* attacking cod fish *Gadus morhua*, from Moray Firth, Scotland, North Sea and Faulkner (1925) reported *Tmetonyx cicada* from the ovaries of cod, *Gadus morhua*, bought at a Scottish fish market.

Templeman (1954, 1958) reported American lobster *Homarus americanus* losses in shallow water due to "sea-fleas" later identified as *Orchomenella pinguis*. Scarrat (1965) found that lobster catches confined in cages and left in shallow water overnight were destroyed by a lysianassoid amphipod, later identified as *Anonyx sarsi*. Bowman (1974) reported on a new eusirid amphipod pest (*Leptamphopus mardeni*) of the New England lobster fishery which occurred when fisherman began setting their traps in waters deeper than 100 m.

Sekiguchi *et al*. (1981) reported on serious damage to sharks and other fish caught in deep sea gill nets set off the coast of Kumano-nada, Japan caused by the giant cirolanid isopod scavenger *Bathynomus doederlini*. Sekiguchi (1982) found that, in shallower waters, the large cirolanid isopod (*Cirolana japonica*) and smaller lysianassoid amphipods (*Orchomenella* spp.) caused "hopeless damage" to bait and on occasion wholly consumed the soft parts of the target lobster, *Panulirus japonicus*.

In Australian waters there are large trap fisheries for the eastern rock lobster, *Jasus verreauxi*, between Brisbane, Queensland and Eden, in southern New South Wales; the southern rock lobster, *Jasus edwardsii*, mainly in Tasmania and South Australia and the western rock lobster, *Panulirus cygnus*, from Albany to Northwest Cape in Western Australia. Although reports are largely anecdotal, scavengers are constant bait pests in these fisheries. Hale (1925, 1929) talks about using "sea lice" to obtain vertebrate skeletons. He also reported a specimen of Port Jackson shark (*Heterodontus portusjacksoni*) from St Vincent Gulf, South Australia which was being eaten alive by hundreds of specimens of the cirolanid isopod, *Natatolana woodjonesi*, which had entered the body cavity. Problems with pests in the southern shark fishery apparently only occur if fishermen leave their lines on the bottom too long. In South Australia one positive use of these "pests" occurs during the preparation of a shark cartilage product. A uristid amphipod, *Stephonyx pirloti*, which occurs in large numbers in southern Australian waters, is used to clean the cartilage. Aside from anecdotal evidence within the trap fisheries, little is currently known about scavenging guilds in Australian waters.

Much research in the past has focused on one or a few species or on one component of a particular scavenging guild. There are few studies which consider an entire invertebrate guild (e.g. Desbruyères *et al.*, 1985; Keable, 1995).

This study considers the entire invertebrate guild system along the east coast of Australia and describes the composition and structure of guilds at six locations ranging from Cairns to Hobart, and along a depth gradient across the continental shelf at each location.

Invertebrate scavenging guilds - a short review

Britton & Morton (1994) reviewed the literature on marine scavengers and concluded that crustaceans dominate these systems. However, they also showed that numerous groups of marine invertebrates scavenge in one way or another and that in some areas, for instance on intertidal mud and sand flats, other invertebrates, such as buccinid gastropods often dominate scavenging guilds.

Lysianassoid amphipods

Of all the crustacean scavengers, lysianassoid amphipods (mainly alicellids, eurytheneids, scopelocheirids, tryphosines and uristids) have long been recognised as the dominant scavengers.

In the Arctic and subarctic, lysianassoid amphipods have been identified as important scavengers, especially those of the genus *Anonyx* (especially *A. nugax*) (Parry, 1824; Miers, 1877b; Stephensen, 1912; Chevreux, 1926; Kuznetsov, 1964; Just, 1970; Percy & Fife, 1981; Steele, 1986; Sainte-Marie *et al.*, 1989; Christiansen & Diel-Christiansen, 1993) and the genus *Onesimus* (Chevreux, 1899, 1935; Stephensen, 1923; Just, 1970; Percy, 1975, 1977; Busdosh *et al*, 1981, 1982).

In the Antarctic and subantarctic, less than 15 species of lysianassoid amphipods dominate scavenging guilds to the exclusion of other actively-mobile scavengers. *Abyssorchomene* (K.H. Barnard, 1932; Bellan-Santini, 1972; Thurston, 1974; Arnaud, 1977; Nagata, 1986; Slattery & Oliver, 1986), *Cheirimedon* (Chevreux, 1906; Everson, 1970; Thurston, 1974b Jazdezski, 1981; Arnaud *et al*., 1986), *Hippomedon* (Bellan-Santini, 1972; Bregazzi, 1973b; Arnaud, 1970; Bellan-Santini & Ledoyer, 1987), *Orchomenella* (Slattery & Oliver, 1986; Bellan-Santini & Ledoyer, 1987; Moore, 1994) and *Pseudorchomene* (Chilton, 1912; Bellan-Santini & Ledoyer, 1987; De Broyer, 1990) are the dominant genera. Three additional, large and conspicuous scavengers which occur in shallow water around the Antarctic coastline are the sea star *Odontaster validus*, the sea urchin *Sterechinus neumayeri* and the nemertean *Parborlasia corrugatus*.

In the northern north-west Atlantic, species of lysianassoids in the genera *Anonyx* and *Orchomenella* are common scavengers (Scarrat, 1965; Templeman, 1967; Sainte-Marie, 1984, 1986, 1986a, 1986b; Steele & Brunel, 1968) and on the south-eastern Atlantic outer continental shelf and slope Biernbaum & Wenner (1993) trapped species of *Schisturella* and *Tmetonyx*. Further south in the Caribbean Sea Lowry & Stoddart (1997) reported the common shallow water lysianassoid scavenger *Eclecticus eclecticus*.

In the northern north-east Atlantic, species of lysianassoids in the genera *Anonyx*, *Orchomenella*, *Scopelocheirus*, *Tmetonyx*, *Tryphosella* are dominant scavengers (Vader & Romppainen, 1985; Moore & Wong, 1995a, b; Ingolfsson & Agnarsson, 1999). In the eastern North Pacific lysianassoids in the genera *Anonyx*, *Orchomene*, *Orchomenella*, *Schisturella* and *Valettiopsis* (J.L. Barnard, 1967; Meador & Present, 1985) and western North Pacific more lysianassoid species in the genera *Anonyx*, *Aroui*, *Schisturella*, *Scopelocheirus* and *Waldeckia* and in deeper water the cirolanid *Bathynomus* (Hirayama & Kikuchi, 1980; Sekiguchi, 1982; Sekiguchi & Yamaguchi, 1983; Takekawa & Ishimaru, 2000) are dominant scavengers.

In the deep seas of the North Atlantic lysianassoids in the genera *Abyssorchomene*, *Alicella*, *Eurythenes*, *Orchomenella*, *Paracallisoma* and *Paralicella* dominate the scavenging fauna (Thurston, 1979, 1990; Lampitt et al., 1983; Hargrave, 1985; Desbruyères *et al*., 1985; Charmasson & Calmet, 1987; Charmasson & Calmet, 1990; Christiansen, 1996). Species in the same genera dominate the North Pacific deep sea fauna (Shulenberger & Hessler, 1974; Shulenberger & Barnard, 1976; Ingram & Hessler, 1983; Sekiguchi & Yamaguchi, 1983; Smith & Baldwin, 1984). In the South Pacific much less is known from the deep sea, but *Abyssorchomene*, *Cyclocaris*, *Eurythenes*, *Stephonyx* and *Waldeckia* have been reported (Intes, 1978; Lowry & Stoddart, 1994). Only one species, *Hirondellea gigas*, is known from the Pacific deep sea trenches (Hessler *et al*., 1978; France, 1993).

This short review indicates the diversity of taxa and the breadth of distribution that lysianassoids maintain as world wide scavengers.

Other Crustacean Scavengers

The concept of lysianassoid dominance has been well established, but workers have also reported other scavengers in their studies. Williams (1938) reported the cirolanid isopod *Natatolana borealis* as well as the lysianassoid amphipod *Scopelocheirus hopei* as principal scavengers of spiny dogfish. Stepien & Brusca (1985) reported cypridinid ostracods and cirolanid isopods as well as lysianassoids attacking trapped fish off the California coast. Nickell & Moore (1991) reported *Scopelocheirus hopei* and the cirolanid, *Natatolana borealis*, in their studies from the Clyde Sea, but the dominant scavengers were a pagurid crab, *Pagurus bernhardus*, a spider crab, *Hyas araneus*, a starfish *Asterias rubens* and a brittlestar, *Ophiocomina nigra*. Albertelli *et al*. (1992) reported scavenging mysids in the deep Mediterranean Sea. Taylor & Moore (1995), Wong & Moore (1996) and Moore & Howarth (1996) studied the biology, including scavenging behaviour, of *Natatolana borealis* living in Loch Fyne, Scotland. Johansen (1996, 2000) looked at bait attraction and other aspects of *N.*

borealis biology from populations living in western Norway. Berrow (1994) also reported the cirolanid *Natatolana borealis* as well as the lysianassoid *Orchomenella nana* from the north-eastern Atlantic.

Species of the giant cirolanid isopod, *Bathynomus* have long been known as dominant scavengers in the Gulf of Mexico and the Caribbean Sea (Kensley & Schotte, 1989; Poupin, 1994) and in the north-western Pacific (Sekiguchi *et al*., 1981, 1982). Old records from the Indian Ocean and new information (Lowry & Dempsey, in prep.) indicate that they are also diverse and widespread scavengers in the deep waters of the Indian Ocean.

Two important papers by Poupin *et al*. (1990, 1994) further illustrate the diversity of crustacean scavengers other than lysianassoid amphipods. Poupin (1990) set approximately 3000 traps in the deep waters of French Polynesia between 1986 and 1989 and captured 66 species of crustaceans of which only one was a lysianassoid amphipod. Poupin (1994) trapped 107 deep sea species in the French Caribbean of which 80 species were crustaceans. Of these, 75 species were decapod crustaceans and of the remaining five, only two (*Eurythenes gryllus* and *Stephonyx biscayensis*) were lysianassoid amphipods.

Keable (1995) studied scavenging guilds in the tropical shallow waters around Lizard Island on the Great Barrier Reef, Australia. His study told a different story. Keable found a high diversity (108 species) of scavengers in the Lizard Island guild system. Crustaceans dominated the scavenging guilds (97% of all individuals and 75% of all species), but lysianassoid amphipods contributed only 4% of the guild diversity and guild numbers. The dominant scavengers were cirolanid isopods (47% of individuals and 9% of all species - mainly species of *Cirolana*), and cypridinid ostracods (47% of individuals and 17% of all species - mainly species of *Cypridinodes* and *Paradoloria*). Other crustaceans were also diverse: caridean shrimps (15 species), portunid crabs (20 species) and mysidaceans (8 species). Buccinid gastropods were also very diverse with 24 species and approximately 22% of the total number of animals collected). Keable (1995) also found that the guild system was complex; a different suite of scavengers operated on hard coral reefs than operated on the soft sediments of the lagoon floors and there was no interchange between guilds. Keable (1997) further reported 22 species of cirolanid isopods from baited traps in Darwin Harbour, northern Australia. He also found buccinid molluscs, lysianassoid amphipods, nebaliid leptostracans and occasionally decapods, but only the cirolanids were diverse and abundant. Bruce (1993, 1995) reported a similar number of cirolanids scavengers from Madang Lagoon, Papua New Guinea, but here lysianassoids (Lowry & Stoddart, 1995) and cypridinids are more diverse.

The results of Keable's studies (1995, 1997) are different to previous studies of scavenging guilds. The main reason for this is probably that the study area was shallow and tropical, an environment not previously studied. The results highlight the lack of knowledge of scavenging systems in Australian waters and raises a number of specific issues concerning the composition and structure of guild systems in this Indo-Pacific area.

The SEAS (Scavengers of Eastern Australian Seas) Project

In 1993 we started a large-scale project to document and describe the scavenging guilds operating on the continental shelf and slope off eastern Australia. The main aim of the project was to to describe patterns in the structure and composition of scavenging guilds along the continental shelf and slope of eastern Australia.

Specifically the objectives were to evaluate patterns across depth (50 - 1000 m) and latitudinal gradients (Cairns to Hobart).

Methods

Sampling Design

Two random, cross-shelf transects were located at each of six different latitudes along the eastern Australian coast: off Cairns, Gladstone, Mooloolaba, Coffs Harbour, Wollongong and Hobart. On each transect, three replicate trap samples were taken at each of six depths (50, 100, 200, 300, 400 and 1000 metres). Each transect was sampled twice, at approximately yearly intervals between 1993 and 1995, giving a theoretical total of 72 samples from each location. The sampling design thus incorporated replication at all levels and provided the opportunity to test for differences in patterns of guild structure across four factors: latitude, transect within latitude, depth, and time. However, due to the loss of some samples over the duration of the study (see below) and the lose of one replicate per trap set because of financial constraints, the optimum design was not possible in the subsequent analyses.

Traps

All traps were attached to buoys at the surface by 8 to 10 mm diameter silver rope. The three traps in each set were placed at 20 m intervals on the line and the third trap in the set had a small Danforth anchor attached (Figure 1). Surface lines were prepared in predetermined lengths for each depth along the transects and colour-coded accordingly. Although this system worked down to about 1000 m, the 1000 m trap occasionally moved due to the drag resulting from strong currents.

In order to sample all scavengers along each transect we use nested traps, a large trap with a smaller trap, containing the bait, inside. The large traps are a commercial design (Figure 2a) from Fathoms Plus, San Diego, California, which open into two halves and can be stacked within each other for efficient storage. The traps were 90 cm long, 70 cm wide and 35 cm tall. The liner was a 0.75 cm square plastic mesh. Two oblong openings were each 9 cm x 17 cm. Four 12 kg diving weights were attached to the bottom of each trap. A smaller bait trap (Figure 2b), made of pvc tubing and similar to those used by Keable (1995), were attached inside each large trap by velcro straps. The small trap was 30 cm long and 11 cm in diameter. One end was 0.5 mm nylon mesh and the other end was a funnel with a 0.75 cm opening. The meshed end formed a cap which came off to empty the contents of the trap. Using this nested trap design we collected invertebrate scavengers with a size range of 0.3 - 250 mm.

Traps were set along each transect from early morning until early afternoon, left overnight, and relocated the next day (using GPS) in the same order in which they were deployed. When the traps came aboard they were opened and all animals in the large traps were collected and fixed in 5% formalin on deck. The small, inner trap was placed in a plastic bag and immediately frozen. These samples were then processed on shore.

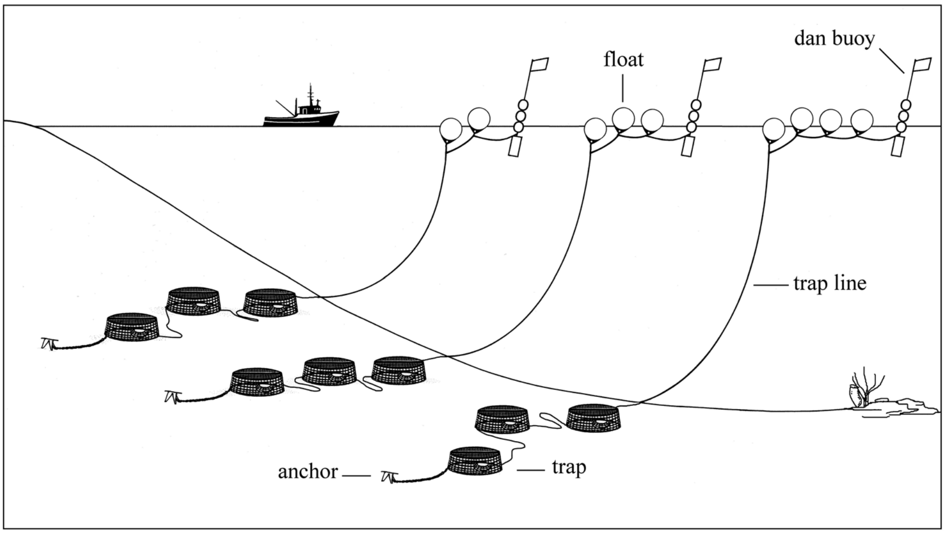

Figure 1. Sampling setup along the continental shelf and slope.

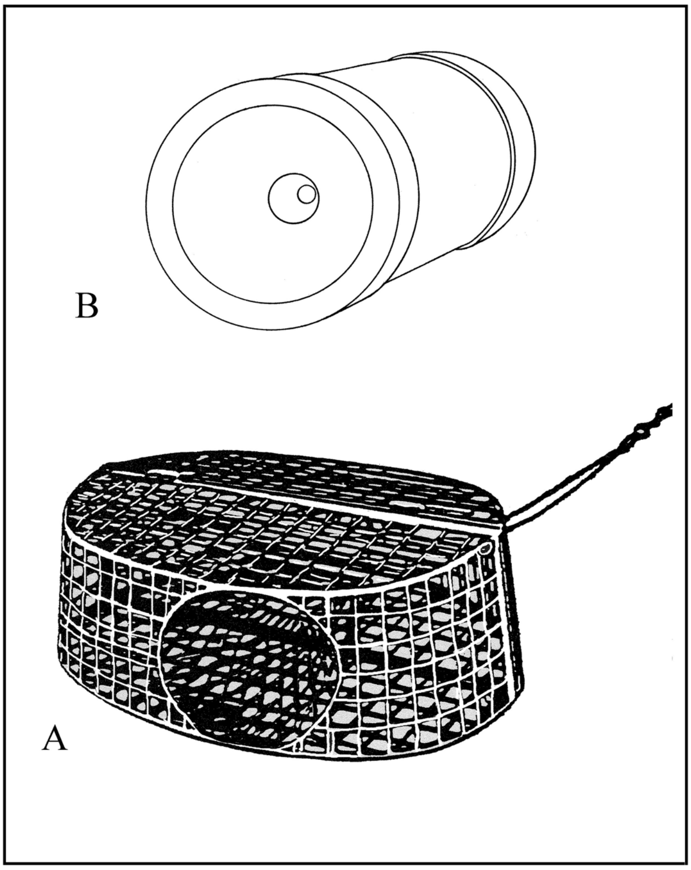

Figure 2. A: large commercial trap used to sample large scavengers. B: small inner bait trap used to sample small scavengers.

Although this system worked well but there were trap losses which are summarised in Table 1. The main factors which resulted in trap loss were poor weather at the time of sampling and coastal shipping removing the buoys of traps. It should also be noted that because of the width of the continental shelf off Gladstone it was not possible to sample the 1000 m site along the Gladstone transect.

Table 1. Summary of trap losses throughout the project. T1 = transect 1, T2 = transect 2.

Location and sample period	Traps lost	Reason for loss
Cairns 1994	1000 m	Poor weather conditions for both transects
	300 m	Line severed by propeller
Mooloolaba 1994	1000 m	Unable to relocate surface buoy
Coffs Harbour 1993	400 m T1	Probably run over by shipping
	400 m T2	Poor weather conditions prevented deployment
Coffs Harbour 1994	200 m T1	Equipment damage due to poor conditions
	300 m T1	Equipment damage due to poor conditions
	1000m T2	Unable to relocate surface buoy
Wollongong 1994	100 m T1	Probably run over by shipping

Temperatures and sediments

Temperatures were measured using a RBR submersible data logger model XL-100. The recorder was dropped on a handline after traps were deployed. Because of the time only one set of temperatures was taken at each site. Temperature data failed for the 50 to 300 m sites at Cairns. Sediment samples were collected once at each site using a pipe dredge attached by line to the last trap. They were analysed by Dr Gavin Birch, Department of Geology & Geophysics, Sydney University.

Laboratory methods

Samples often contained 10,000 plus animals of which there was usually a larger-sized component such as amphipods and isopods and a smaller-sized component, such as ostracods or copepods. The larger-sized component was removed from the sample and the smaller-sized component was then split into four fractions using a plankton splitter. The larger-sized component and one or two fractions of the smaller-sized component were identified and counted. The fraction was then multiplied to give an estimate of the total for the smaller-sized component and combined with the larger-sized component to produce a total sample.
Sixty-seven percent of the species in this study were new to science, mainly species of ostracods, amphipods and isopods. These species had to be carefully studied by specialists who prepared identification guides for technicians who were then able to sort, identify and count the samples. Many of these species are now being prepared for publication (see species list, Appendix 1). Other invertebrate groups, such as the decapod crustaceans, gastropod molluscs and polychaete worms, which were not so abundant and better known, were identified by other specialists (see Acknowledgements for list of specialists). Biomass was determined for each species lot using wet weights to the nearest 0.01 g on a Mettler electric balance. All identifications, counts and biomass measurements were completed and entered onto Excel spreadsheets by early 1998.

Statistical methods

For this report, and in order to provide a comprehensive description of the scavenging guilds over the gradients of depth and latitude, a number of summary statistics were generated. These were: the mean number of species per trap (S), the mean number of individuals per trap (N), the mean biomass per trap, and the mean biomass of individual animals per trap (i.e. total biomass divided by the total number of animals in the trap). Due to trap losses and thus uneven sampling across the main factors, each of these summary statistics were calculated using all traps recovered from each depth at each location over the duration of the study. In other words, the factors of transect within location and time were ignored. Although this approach precludes the evaluation of temporal and small-scale spatial variation, it nevertheless provides valid summary data on guild structure for each depth at each location.

In order to provide a broad overview of guild structure, data for individual species were also aggregated across major taxonomic groups. Raw abundance counts and biomass measures were converted to percentages of the total sample (which is a measure of dominance) so that the relative contribution of the major taxa could be evaluated by location and by depth.

Descriptions of sites and environmental conditions

For this study we used local fishing boats, where possible, from each area we sampled. The main advantages were the flexibility of the skippers and their local knowledge. The essential information for each transect is presented in Table 2.

Table 2. Summary of trap locations and depths.

Cairns Transects	**Latitude & Longitude**	**Depth**	**Sampling Dates**
Off Flynn Reef, Far North Queensland	16°41.61'S 146°17.94'E	50 m	June '93/May '94
Off Flynn Reef, Far North Queensland	16°41.32'S 146°18.26'E	100 m	June '93/May '94
Off Flynn Reef, Far North Queensland	16°40.82'S 146°18.81'E	200 m	June '93/May '94
Off Flynn Reef, Far North Queensland	16°40.14'S 146°20.03'E	300 m	June '93/May '94
Off Flynn Reef, Far North Queensland	16°39.92'S 146°20.71'E	400 m	June '93/May '94
Off Flynn Reef, Far North Queensland	16°37.81'S 146°23.08'E	1000 m	June '93/May '94
Gladstone Transects			
Off East Fitzroy Reef, North Queensland	23°34'92'S 152°11.76'E	50 m	June '93/ June '94
Off East Fitzroy Reef, North Queensland	23°32.53'S 152°16.45'E	100 m	June '93/ June '94
Off East Fitzroy Reef, North Queensland	23°32.16'S 152°17.98'E	200 m	June '93/ June '94
Off East Fitzroy Reef, North Queensland	23°30.46'S 152°21.32'E	300 m	June '93/ June '94
Off East Fitzroy Reef, North Queensland	23°26.17'S 152°28.46'E	400 m	June '93/ June '94
Mooloolaba Transects			
Due east of Mooloolaba, Queensland	26°39.13'S 153°18.88'E	50 m	August '94/July '95

Due east of Mooloolaba, Queensland	26°36.21'S 153°34.90'E	100 m	August '94/July '95
Due east of Mooloolaba, Queensland	26°35.42'S 153°41.50'E	200 m	August '94/July '95
Due east of Mooloolaba, Queensland	26°35.69'S 153°43.29'E	300 m	August '94/July '95
Due east of Mooloolaba, Queensland	26°35.46'S 153°44.00'E	400 m	August '94/July '95
Due east of Mooloolaba, Queensland	26°35.65'S 153°46.33'E	1000 m	August '94/July '95
Coffs Transects			
North-east of Coffs Harbour, NSW	30°17.49'S 153°13.90'E	50 m	August '93/Sept '94
North-east of Coffs Harbour, NSW	30°15.94'S 153°21.90'E	100 m	August '93/Sept '94
North-east of Coffs Harbour, NSW	30°14.84'S 153°27.55'E	200 m	August '93/Sept '94
North-east of Coffs Harbour, NSW	30°13.75'S 153°28.37'E	300 m	August '93/Sept '94
North-east of Coffs Harbour, NSW	30°12.97'S 153°29.23'E	400 m	August '93/Sept '94
North-east of Coffs Harbour, NSW	30°10.94'S 153°32.27'E	1000 m	August '93/Sept '94
Wollongong Transects			
Due east of Wollongong, NSW	34°26.44'S 150°57.55'E	50 m	May '93/March '94
Due east of Wollongong, NSW	34°28.15'S 151°02.37'E	100 m	May '93/March '94
Due east of Wollongong, NSW	34°32.02'S 151°13.00'E	200 m	May '93/March '94
Due east of Wollongong, NSW	34°32.25'S 151°15.16'E	300 m	May '93/March '94
Due east of Wollongong, NSW	34°32.53'S 151°17.07'E	400 m	May '93/March '94
Due east of Wollongong, NSW	34°33.41'S 151°21.35'E	1000 m	May '93/March '94
Hobart Transects			
Due east of Fortescue Bay, Tasmania	43°07.77'S 145°59.47'E	50 m	April '93/April '94
Due east of Fortescue Bay, Tasmania	43°06.70'S 148°03.45'E	100 m	April '93/April '94
Due east of Fortescue Bay, Tasmania	43°06.70'S 145°13.6'E	200 m	April '93/April '94
Due east of Fortescue Bay, Tasmania	43°09.37'S 145°13.6'E	300 m	April '93/April '94
Due east of Fortescue Bay, Tasmania	43°07.36'S 145°13.75'E	400 m	April '93/April '94
Due east of Fortescue Bay, Tasmania	43°08.96'S 145°15.36'E	1000 m	April '93/April '94

Temperatures

Summer temperature ranges on the shelf and slope along the east coast Australian do not vary greatly (Figure 3). Bottom temperatures at 50 m depth only vary 2.6°C between the Gladstone transect (22.1°C) and the Wollongong transect (19.5°C) and another 3.3°C between the Wollongong transect and the Hobart transect. Between the Gladstone transect (22.1°C) and the Hobart transect (16.2°C) the change is only 5.9°C.

Temperatures then decrease about 6°C between 50 m and 400 m depth so that along the Gladstone transect the 400 m temperature is 14.2°C and along the Hobart transect it is 10.2°C, a change of only 4°C.

Bottom temperatures at 1000 m depth vary even less. The extremes between the Hobart transect (5.1°C) and the Coffs transect (7.4°C) is only 2.3°C. Bottom temperatures at 1000 m off Hobart (5.1°C) and off Cairns (5.2°C) were almost identical during this study.

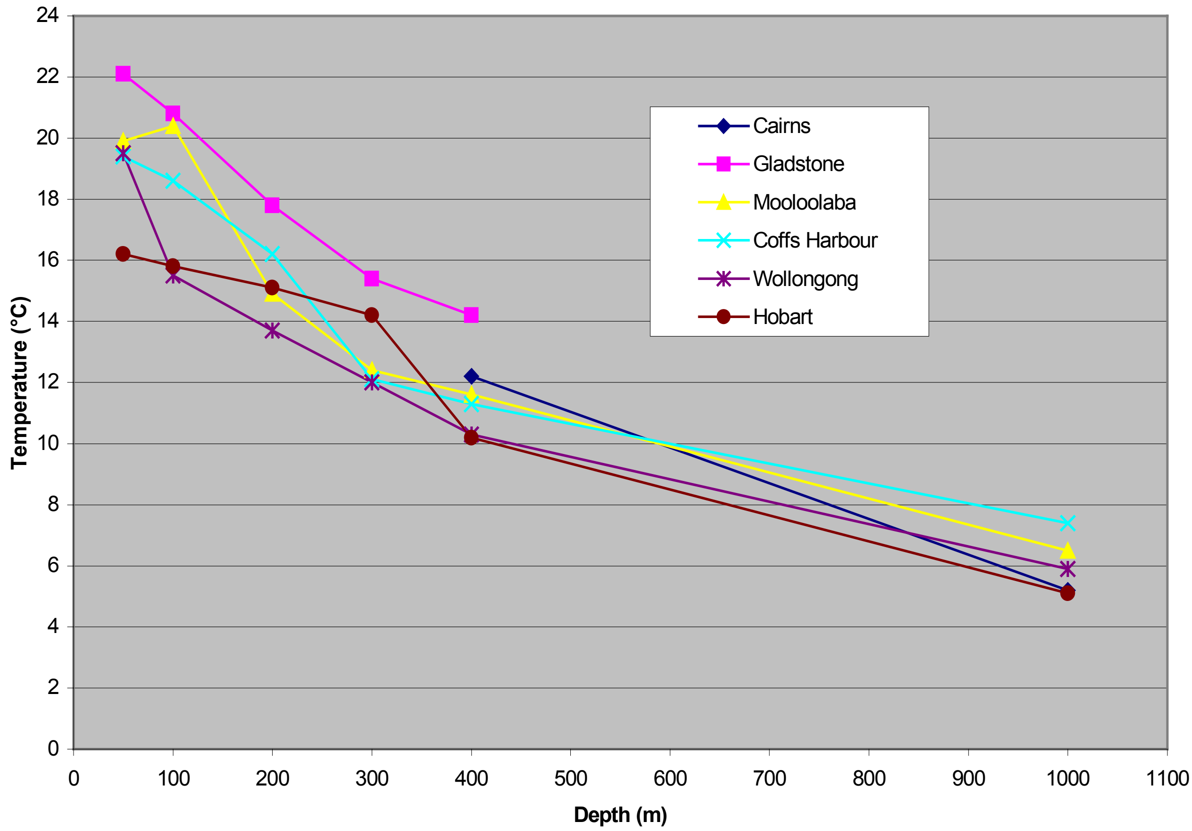

Figure 3. Mean temperatures in study area.

Sediments

Along the Cairns transect sediments were: 50 m - coarse, moderately well sorted calcareous gravelly sand, with large, rounded, relict calcareous and rock fragments; 100 m - medium, poorly sorted calcareous gravelly sand, with calcareous fragments and minor small angular quartz; 200 m - very fine, moderately well sorted calcareous sandy mud, with whole and fragmented foraminiferans; 300 m - fine, moderately sorted calcareous foraminiferal sandy mud, with trace very fine quartz; 400 m - fine, moderately sorted foraminiferal sandy mud, with trace quartz; 1000 m - fine, moderately sorted calcareous sandy mud, with whole and fragmented foraminiferans.

Along the Gladstone transect, sediments were: 50 m - coarse, moderately well sorted calcareous sandy gravel, with rounded yellow ?relict calcareous fragments; 100 m - medium, moderately well sorted quartzitic gravelly sand, with large rounded and fine angular quartz, rock fragments, large fragmented and whole shell; 200 m - medium, poorly sorted calcareous sand, with large rounded and small fragmented angular quartz and calcareous rock fragments; 300 m - fine, moderately sorted calcareous muddy sand, with whole and fragmented foraminiferans; 400 m - fine, moderately sorted calcareous muddy sand, with whole and fragmented foraminiferans and trace quartz.

Along the Mooloolaba transect, sediments were: 50 m - fine, moderately sorted quartzitic, slightly gravelly sand, with angular fine quartz and shell fragments; 100 m - medium, poorly sorted quartzitic gravelly sand, with moderate to fine poorly sorted foraminiferan and fragmented shell and ?calcareous ?relict rock fragments; 200 m - medium, moderately well sorted quartzitic gravelly sand, with moderate authigenic (glauconitic/phosphatic) rock fragments; 300 m - fine, moderately well sorted calcareous muddy sand, with foraminiferans, fragmented shell, faecal pellets and minor authigenic minerals; 400 m - fine, moderately sorted calcareous sandy mud, with mainly foraminiferans and fragments and minor faecal pellets.

Along the Coffs transect, sediments were: 50 m - coarse, well sorted quartzitic slightly gravelly sand, with well rounded quartz and rock fragments and large fragmented shell; 100 m - medium, poorly sorted calcareous sand, with large rounded and small angular quartz and rock fragments; 200 m - coarse, moderately well sorted calcareous sand, with well rounded ?relict calcareous fragments and authigenic rock fragments; 300 m - fine, moderately sorted calcareous muddy sand, with foraminiferans and trace glauconite/phosphorite and quartz; 400 m - fine, moderately sorted calcareous muddy sand, with minor fine quartz, opaque minerals and rock fragments; 1000 m - fine, moderately well sorted foraminiferal sandy mud, with trace very fine quartz.

Along the Wollongong transect, sediments were: 50 m - coarse, well sorted calcareous sand, with trace well rounded large, smooth quartz (?relict); 100 m - medium, moderately well sorted calcareous muddy sand, with moderate large quartz and rock fragments and trace mica; 200 m - fine moderately well sorted calcareous sand, with moderate fine, angular quartz and authigenic rock fragments; 300 m - medium, moderately well sorted calcareous sand, with foraminiferans and fragmented shell, glauconite, phosphorite and trace fine quartz; 400 m - medium, moderately well sorted calcareous sand, with mainly whole foraminiferans and glauconitic casts; 1000 m - fine, moderately sorted calcareous sand, with whole and fragmented foraminiferans and trace fine quartz.

Along the Hobart transect sediments were: 50 m - coarse, well sorted calcareous gravelly sand, with trace very coarse rounded quartz; 100 m - fine, moderately well sorted calcareous gravelly sand, with large well rounded and fine angular quartz; 200 m - coarse, moderately well sorted calcareous muddy gravelly sand, with yellow very coarse rounded ?relict calcareous fragments and trace quartz; 300 m - Coarse, moderately well sorted calcareous muddy gravelly sand, with yellow ?relict calcareous fragments and trace large, rounded quartz; 400 m - Coarse, moderately well sorted calcareous sandy gravelly, with rounded yellow ?relict calcareous fragments; 1000 m - fine, poorly sorted calcareous gravelly muddy sand, with sponge spicules.

Results

Cairns transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 4. The trends shown in Figure 4 are outlined below.

Species richness (S)

Along the Cairns transect there is a mean of 19.3 species of scavengers at 50 m depth (fig.) increasing to a mean of 21.3 species at 100 m. Species richness declines between 200 m (13.9 species), 300 m (8.6 species) and 400 m (5.8 species), and then increases at 1000 m (9.6 species).

Abundance (N)

Mean numbers of individuals follow a similar pattern to species richness. Thus, highest mean numbers occur at 50 m depth (23175 individuals per trap), are lower at 100 m (5611 individuals per trap) and 200 m (3719 individuals per trap) and reach their lowest levels at 300 m (196 individuals per trap) and 400 m (166 individuals per trap), and increase at 1000 m (567 individuals per trap).

Biomass

At 50 m (61 g per trap) and 100 m (50 g per trap) depth the mean biomass similar. This increases to 342 g per trap at 200 m, 2348 g per trap at 300 m and 2426 g per trap at 400 m depth. At 1000 m depth biomass is 172 g per trap.

Individual biomass follows a similar pattern. At 50 m depth it is less than 0.002 g per individual and at 100 m it increases to about 0.01 g per individual. At 200 m there is a 10 fold increase in individual weight to 0.11 g per individual. At 300 to 400 m depth biomass increases dramatically to 12.03 g per individual and at 1000 m it is 1.17 g per individual.

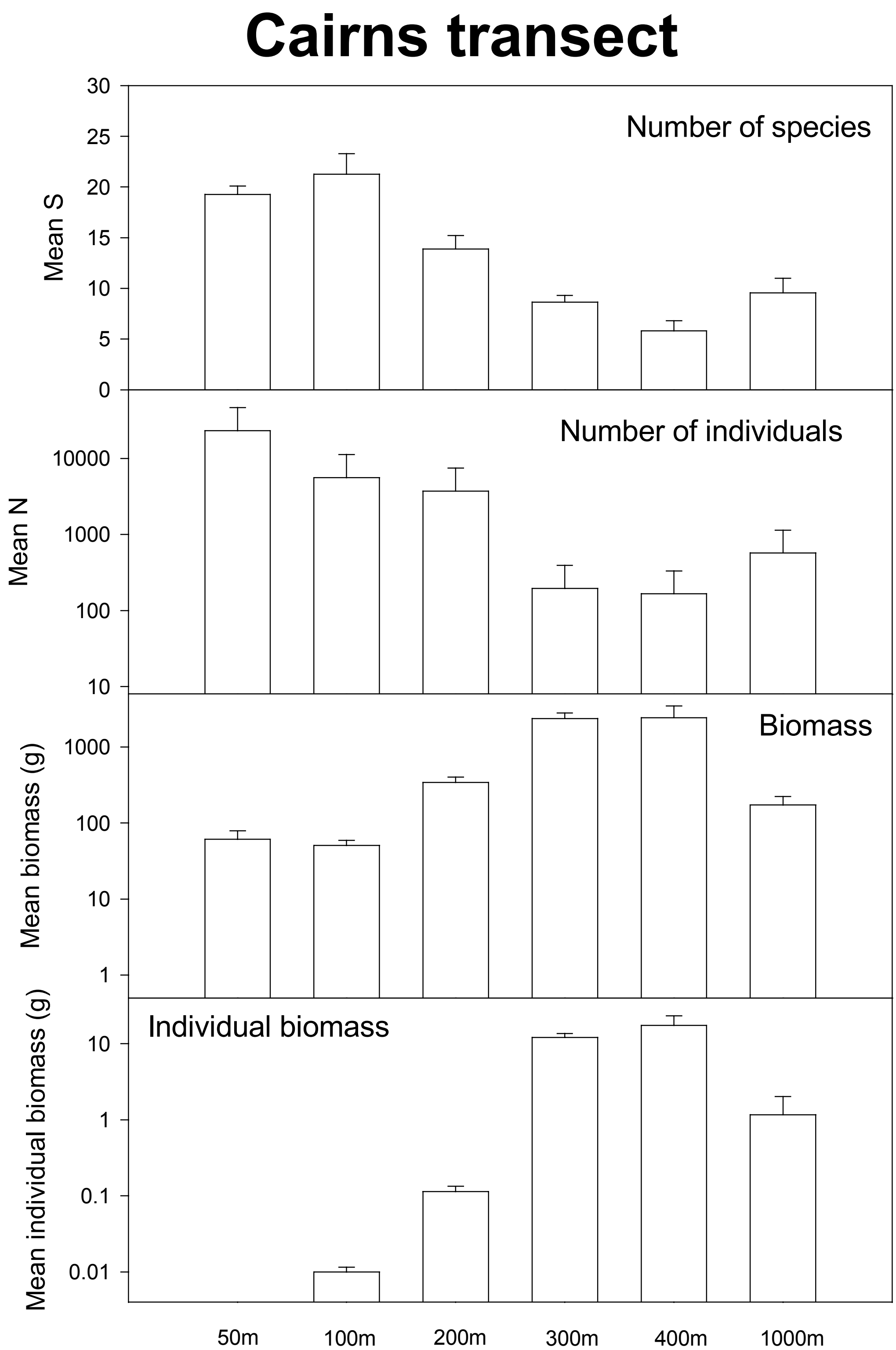

Figure 4. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Cairns transect.

Guild structure - higher taxonomic resolution

A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 5 and 6. The trends within these plots are outlined below.

Cirolanid isopods dominate the scavenging guilds along the Cairns transect. At most depths they make up between 57% and 68% of the individuals in the guilds. However between 300 and 400 m depth they make up 80% to 95% of the individuals. These isopods also dominate the biomass contributing 72 to 81% of the total biomass of the scavenging guilds at most depths. Between 300 m and 400 m they completely dominate, making up 99.5 to 100% of the biomass.

Between 50 and 200 m depth cypridinid ostracods make up 26% to 35% of the individuals in the guilds. Below 300 m numbers of individuals are reduced to less than 5% of the total abundance. Similarly, these ostracods contribute substantially to the biomass between 50 and 100 m depth (16.5 to 18.5%).

The only other important group of scavengers along the Cairns transect is the amphipods which make up only about 3% of individuals at 50 m depth, and then steadily increase to approximately 14% at 300 m. Amphipod abundance increases substantially at 100 m where they contribute 40% of the total. In terms of biomass, the main additional contributors to the total for the guild are the decapods at 200 m depth (approximately 25%) and the amphipods at 1000 m depth (approximately 17%).

Guild structure at each depth

50 m

Abundance

Cirolanid isopods (*Cirolana tumulosa* and *C. arafura*) dominate the individuals (60.9%) of the 50 m scavenging guild. The cypridinid ostracods (*Paradoloria* sp. GLF, *Cypridinodes* sp. GS, *Paradoloria* sp. GHF, *Skogsbergia* sp. CR, *Cypridinodes* sp. CRE, *Lowrya* sp. CS and *Cypridinodes* sp. L) make up 34.6% of individuals. Two lysianassoid amphipods (*Rhinolabia* sp. 102 and *Tryphosella* sp. 482) make up the remainder of the numbers in the 50 m guild.

Biomass

Cirolanids (*Cirolana tumulosa* and *Cirolana arafura*) dominate (78.2%) guild biomass. Cypridinids (*Cypridinodes* sp. GS, *Paradoloria* sp. GLF, *Paradoloria* sp. GHF, *Cypridinodes* sp. CRE and *Cypridinodes* sp. L) contribute an additional 15.4%. A diogenid hermit crab, *Dardanus* sp. 2 and a lysianassoid amphipod, *Tryphosella* sp. 482 make up the rest of the biomass.

100 m

Abundance

The 100 m guild is dominated by cirolanids (*Plakolana acuta*, *Cirolana curtensis*, *C. arafura*, *Cirolana* sp. 3 and *C. tumulosa*) which make up 67.7% of guild numbers. Cypridinids (*Cypridinodes* sp. CRE, *Paradoloria* sp. CR, *Cypridinodes* sp. MCL, *Cypridinodes* sp. CRE, *Cypridinodes* sp. L and *Paradoloria* sp. GHF) make up

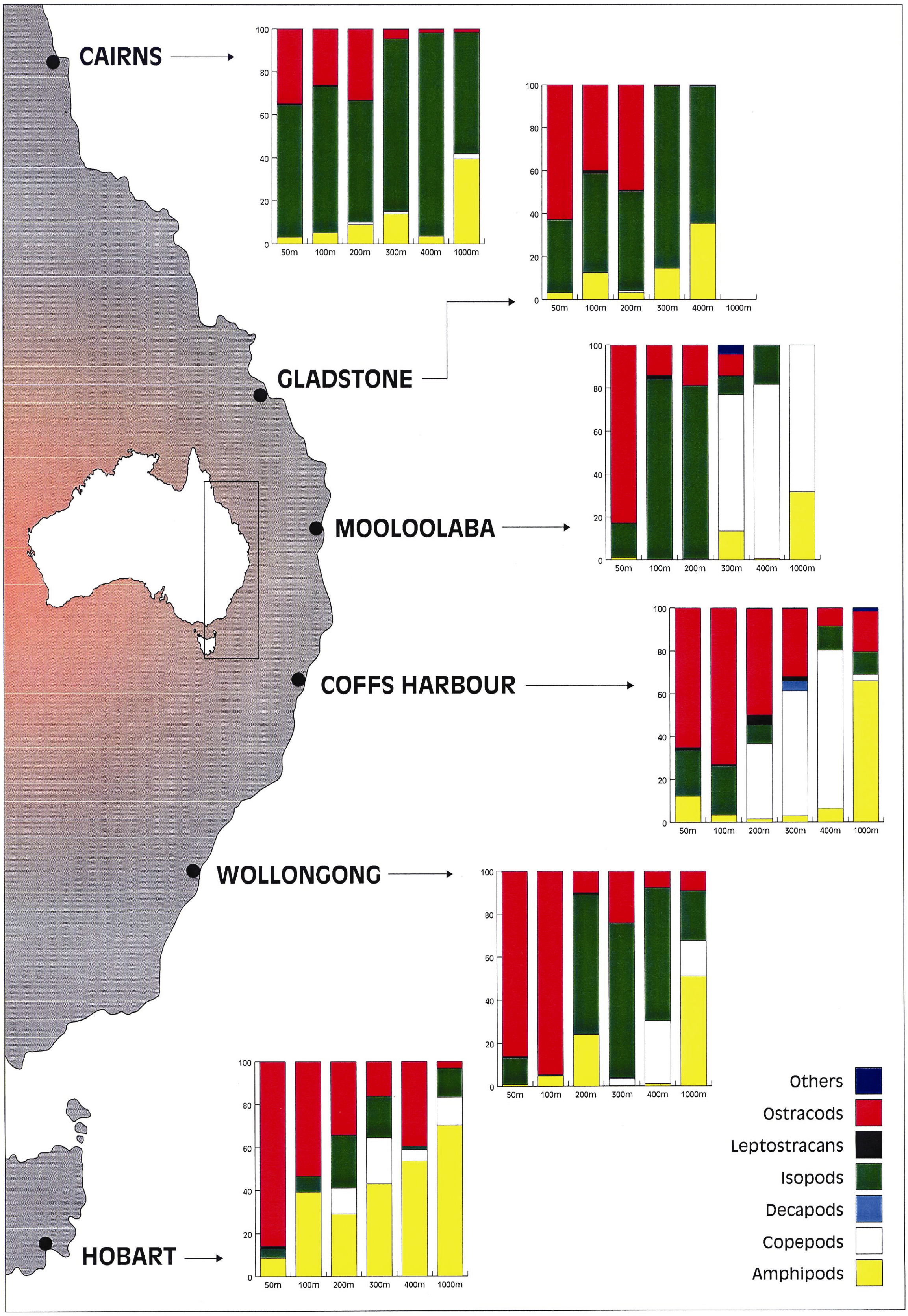

Figure 5. Summary of the percentage contribution of the major taxa to the total abundance along each transect on the continental shelf and slope off eastern Australia.

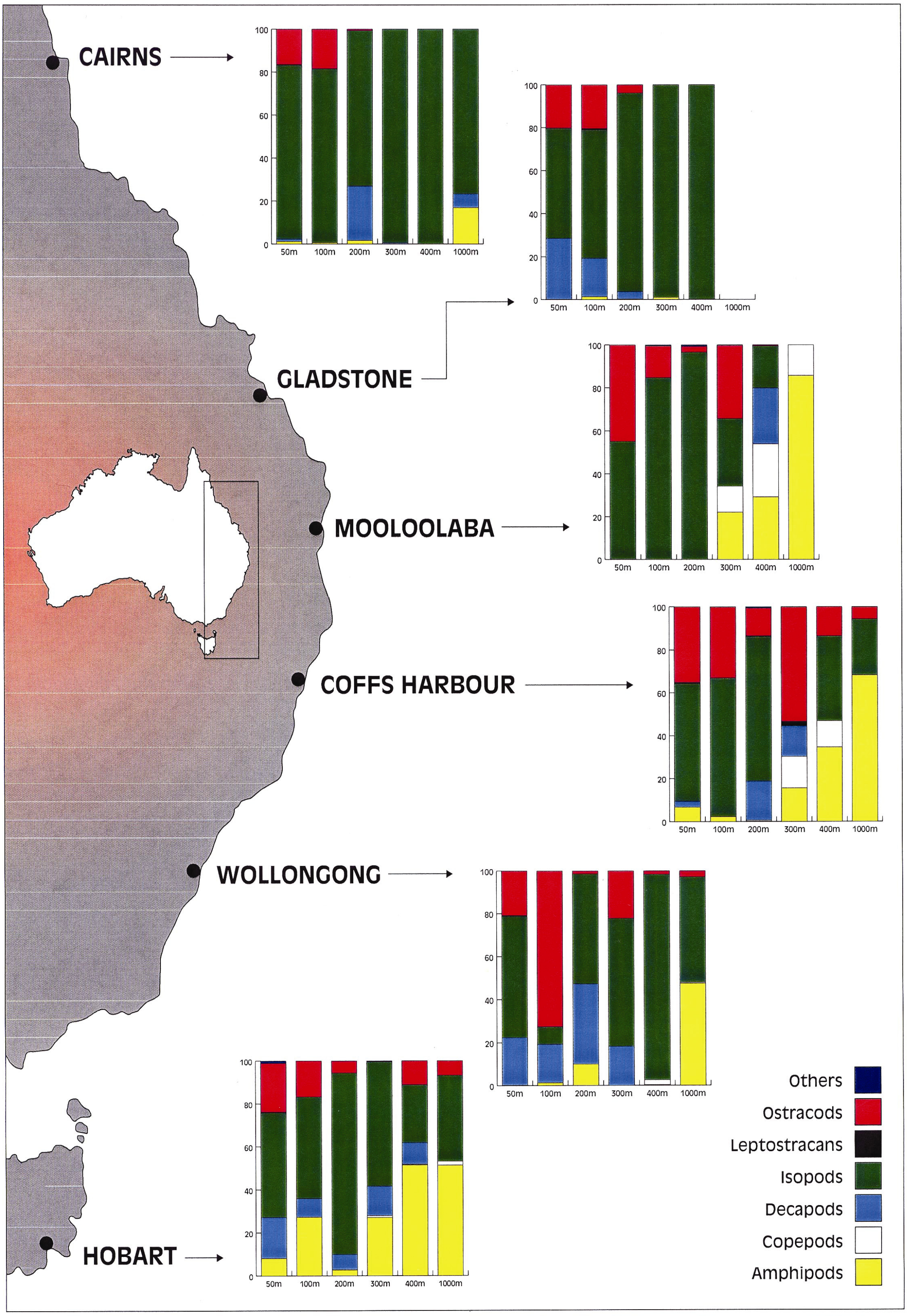

Figure 6. Summary of the percentage contribution of the major taxa to the total biomass along each transect on the continental shelf and slope off eastern Australia.

25.7% of guild numbers. The remainder of the guild contains two lysianassoids, *Rhinolabia* sp. 102 and *Tryphosella* sp. 482.

Biomass

The 100 m scavenging guild is strongly dominated by cirolanids (*Plakolana acuta*, *Cirolana arafura*, *C. curtensis*, *Cirolana* sp. 3, and *C. tumulosa*), which make up 79.3% of guild biomass. Cypridinids (*Cypridinodes* sp. MCL, *Cypridinodes* sp. CRE and *Paradoloria* sp. GHF) make up the majority (16%) of the rest of the biomass. The remainder of the guild is made up of a number of species which each contribute less than 1% to the total biomass.

200 m

Abundance

Cirolanids (*Natatolana bulba* and *Natatolana* sp. 10) dominate (56%) the 200 m guild. Cypridinids (*Vargula puppis*, *Metavargula* sp. NM2 and *Lowrya* sp. CRT), make up an additional 33.1% of the guild numbers. Two lysianassoids *Ichnopus tenuicornis* and *Parschisturella* sp. 47/159 make up the remainder (8.9%) of guild individuals.

Biomass

At 200 m guild biomass changes dramatically. Large deep water cirolanids (*Bathynomus immanis*, *Natatolana bulba*, *Booralana bathynella* and *Natatolana* sp. 10) dominate (72.3%) guild biomass. A highly mobile portunid crab, *Charybdis miles* (25%) appears and one lysianassoid scavenger, *Ichnopus tenuicornis*, contributes slightly (1.4%) to the biomass at this depth. The remainder of the guild is made up of a number of species which each contribute less than 1% to the total biomass.

300 m

Abundance

The 300 m guild is dominated by three deep water cirolanids (*Bathynomus immanis* and *Booralana bathynella* and *Natatolana pellucida*), which make up 78.7% of the guild. A lysianassoid, *Rhinolabia* sp. 102 (13%), and a cypridinid, *Metavargula* sp. NM2 (3.5%), make up the majority of the remainder of the guild. A number of species contribute less than 1% each to the total abundance.

Biomass

Bathynomus immanis which made up about 30% of the guild by numbers contributes 92.7% of the biomass. By contrast *Booralana bathynella* which also made up about 30% of the guild by numbers contributes only 5% of the biomass. Another large deep water scavenger, *Bathynomus* sp. 2, contributes another 1%. The remainder of the guild is made up of a number of species which each contribute less than 1% to the total biomass.

400 m

Abundance

Deep water cirolanids (*Booralana bathynella*, *Bathynomus immanis* and *Natatolana* sp. 36) again strongly dominate (93.8%) scavenging guild numbers. One lysianassoid *Rhinolabia* sp. 102 makes up the majority (3.2%) of the remainder of guild individuals. A number of additional species each contribute less than 1% to the total abundance.

Biomass

Three cirolanid isopods, *Bathynomus immanis*, *Booralana bathynella* and *Bathynomus* sp. 3, completely dominate (approximately 99%) guild biomass at 400 m depth.

1000 m

Abundance

The 1000 m guild is dominated (71.7%) by two species of deep water cirolanids, *Natatolana laewilla* and *Natatolana* sp. 46. Three species of deep water amphipods, *Parandania* sp.; *Orchomenella gerulicorbis* and *Paralicella* sp. 181 contribute 21.4%, and copepods contribute approximately 1.7% to the total abundance. The remainder of the guild is made up of a number of species which each contribute less than 1% to the total abundance.

Biomass

The 1000 m guild biomass is dominated (85.8%) by deep water cirolanids (*Bathynomus* sp. 2, *Natatolana* sp. 46 and *Natatolana laewilla*). Several well known, deep sea lysianassoid and stegocephalid genera, *Paralicella* sp. 181, *Parandania* sp., *Eurythenes gryllus* and *Eurythenes* sp. contribute 9.3% of the guild biomass, and a parapagurid hermit crab, *Sympagurus papossus* contributes a further 3.6%. The remainder of the guild is made up of a number of species which each contribute less than 1% to the total biomass.

Summary

Species diversity is highest at 50 m depth (25 species) and lowest at 300 to 400 m depth (9 species). Medium diversity (12 species) occurs at 1000 m depth. Scavengers are most abundant (about 9300 individuals per trap) at 50 m depth, decreasing to 7000 - 6000 individuals per trap at 100 to 200 m depth and about 180 to 270 individuals per trap at 300 to 400 m depth. At 1000 m depth abundance increases slightly to about 740 individuals per trap. Individual biomass is very low at 50 (less than 0.01 g) and rises to 0.1 g at 200 m.. Between 300 m and 400 m individual biomass increases to more than 10 g before decreasing to approximately 1 g at 1000 m.

At all depths along the Cairns transect cirolanid isopods dominate guild numbers. At 50 m cirolanids (mainly *Cirolana tumulosa*) make up nearly 2/3 of the individuals. Cypridinids (mainly *Paradoloria* sp. GLF and *Cypridinodes* sp. GS) make up the remainder. In the 100 m guild cirolanids (particularly *Plakolana acuta*, *Cirolana curtensis* and *C. arafura*) make up more than 2/3 of the individuals. Cypridinids (mainly *Cypridinodes* sp. CRE, *Paradoloria* sp. CR and *Cypridinodes* sp. MCL) make up the remainder. At 200 m *Cirolana* is replaced by *Natatolana* (mainly *N. bulba*) which makes up nearly 2/3 of the guild individuals. Cypridinids (mainly *Vargula puppis*) make up 1/3 of the individuals. The remainder of the abundance is made up of lysianassoids (manly *Ichnopus tenuicornis*). At 300 m and 400 m depths deep water cirolanids (mainly *Bathynomus immanis* and *Booralana bathynella*) strongly dominate scavenging guild numbers. At 1000 m, although *Bathynomus* is present, *Natatolana* (mainly *N. laewilla* and *N.* sp. 46) is the dominant taxon. Several amphipods (mainly *Parandania* sp. and *Orchomenella gerulicorbis*) make a smaller contribution to guild numbers.

As was the case with individuals, cirolanid isopods dominate the guild biomass at all depths along the Cairns transect. At 50 m depth cirolanids (mainly *Cirolana tumulosa*) strongly dominate guild biomass. Five cypridinids (*Cypridinodes* sp. GS, *Paradoloria* sp. GLF and *Paradoloria* sp. GHF) make a small, but significant contribution to guild biomass. At 100 m cirolanids (mainly *Plakolana acuta*, *Cirolana arafura*, *C. curtensis*, and *Cirolana* sp. 3) also strongly dominate guild biomass. Again cypridinids (mainly *Cypridinodes* sp. MCL) make a small, but significant contribution to guild biomass. Cirolanids continue to dominate guild biomass at 200 m depth, but the generic composition (*Bathynomus immanis*, *Natatolana bulba* and *Booralana bathynella*) is completely different. A portunid crab, *Charybdis miles* also contributes significantly to biomass at this depth. The 300 m and 400 m guilds are completely dominated by large deep water cirolanids (mainly *Bathynomus immanis*). At 1000 m, although a number of deep sea amphipod genera are represented, the guild biomass is again dominated by *Bathynomus* and *Natatolana*.

Gladstone Transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 7. The trends shown in Figure 7 are outlined below.

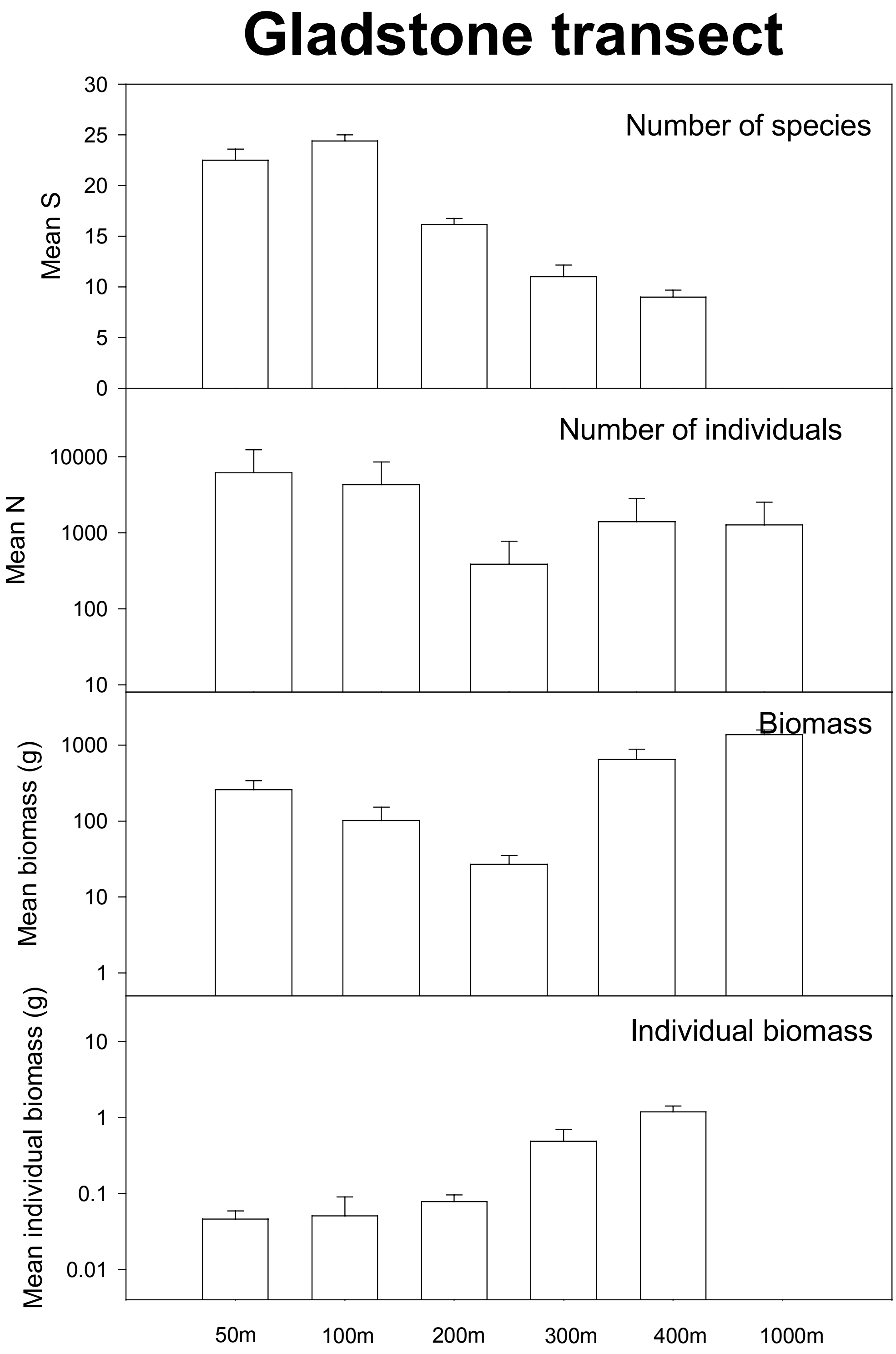

Figure 7. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Gladstone transect.

Species Richness (S)

Along the Gladstone transect the mean number of scavenging species is 22.5 species at 50 m depth, increasing to 24.4 species at 100 m depth. Mean number of species declines between 200 m (16.1 species), 300 m (11.0 species) and 400 m (9.0 species).

Abundance (N)

Mean numbers of individuals is 6165 per trap at 50 m depth and slightly to 4286 per trap at 100 m depth. Mean numbers of individuals decrease significantly at 200 m (386 per trap) and increase at 300 (1403 per trap) and 400 m (1263 per trap) depths.

Biomass

Biomass steadily decreases from a high of about 259 g per trap at 50 m to 100 g per trap at 101 m and 27 g per trap at 200 m. This increases to 649 g per trap at 300 m and 1372 g per trap at 400 m depth.

Individual biomass is lowest (0.05 to 0.08 g per individual) between 50 m and 200 m depth. At 300 (0.5 g per individual) to 400 m (1.2 g per individual) depth biomass increases significantly.

Guild Structure - higher taxonomic resolution

A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 5 and 6. The trends within these plots are outlined below.

At 50 m depth cypridinid ostracods dominate (62.2%) guild numbers. Between 100 and 200 m depth they continue to contribute significantly (38 to 47%) to guilds numbers, but below 300 m depth cypridinid populations completely crash. Between 50 and 100 m depth cypridinid ostracods make up (20%) of the biomass. At 200 m depth they contribute only 3.9%to the biomass.

Cirolanid isopods contribute significantly to the 50 m guild (about 33% of the individuals) and between 100 m and 400 m depth they dominate guild numbers (45 to 83%). Between 50 and 100 m depth cirolanid isopods make up 50 to 60% of guild biomass and between 200 m and 400 m depth they completely dominate, making up 92 to 100% of the biomass.

Lysianassoid amphipods make up less than 15% of the guild numbers between 50 and 300 m depth. At 400 m they increase to about 35% of the guild population.

Between 50 and 100 m depth decapods make up 28% to 18% of the biomass. At 200 m depth they contribute only 3.5% of the biomass.

50 m

Abundance

Cypridinid ostracods (*Cypridinodes* sp. GS, ngen IV sp. GNE and *Paradoloria* sp. GHF, ngen III sp. L, *Cypridinodes* sp. MCL and ngen VT sp. RR) strongly dominate (62% of individuals) the 50 m scavenging guild. Cirolanid isopods (*Cirolana tumulosa*, *C. capricornica*, *Natatolana vieta Cirolana* sp. 2, *N. thalme* and *N. pellucida*) also make a significant contribution (33%) to guild numbers. One lysianassoid, *Ichnopus cribensis*, makes a minor contribution (2%) to guild numbers. The remainder is made up of species which each contribute less than 1% to the guild.

Biomass

The cirolanids (*Natatolana vieta*, *Cirolana capricornica*, *C. tumulosa* and *N. thalme*) plus several others contribute 51.1% of guild biomass. The portunid crab *Charybdis natator* (28.4%) and four cypridinids (ngen IV sp. GNE, *Paradoloria* sp. GHF, *Cypridinodes* sp. GS, *Cypridinodes* sp. MCL) also make a significant contribution (20.3%) to guild biomass.

100 m

Abundance

At 100 m depth two cirolanids, *Natatolana bulba* and *Plakolana obtusa*, make up 49.7% of guild numbers. Seven cypridinids (*Skogsbergia* sp. GRP, *Paradoloria* sp. GHF, *Cypridinodes* sp. GS, *Vargula* sp. NEC, *Vargula tubulata*, *Cypridinodes* sp. WRD and ngen VT sp. GNE) contribute another 38.2% of the guild numbers. Three lysianassoids (*Tryphosella* sp. 483, *Rhinolabia elliotti* and *Rhinolabia* sp. 102) contribute 9.6% and nebaliid leptostracans make up the remainder of the numbers.

Biomass

Cirolanids, mainly *Natatolana bulba*, *Plakolana obtusa*, *Cirolana* sp. 3, *C. capricornica* and *Natatolana matong*, dominate (59.6%) guild biomass at 100 m depth. A portunid crab, *Charybdis granulatus*, contributes another 17.9% and cypridinid ostracods, mainly *Paradoloria* sp. GHF, *Skogsbergia* sp. GRP, ngen VT sp. GNE, *Cypridinodes* sp. GS, *Cypridinodes* sp. MCL and *Vargula tubulata*, contribute another 20.4%. Lysianassoids make up the remaining 1.3%, share the remainder of the guild biomass.

200 m

Abundance

At 200 m depth cirolanids and cypridinids continue to numerically dominate the guild. Five cirolanids (*Natatolana* sp. 10, *Natatolana pellucida*, *Booralana bathynella*, *Natatolana bulba* and *Aatolana springthorpei*) contribute 45.5% of individuals and five cypridinids (*Vargula sp.* NEC, *Vargula puppis*, *V. tubulata*, *Cypridinodes* sp. CH, *Metavargula* sp. NM2) contribute another 47.3% of individuals in the guild. One stegocephalid amphipod, *Andaniotes* sp. and a copepod add slightly to the numbers. The remainder is made up of a number of species which each contribute less than 1% to the guild.

Biomass

Seven species of cirolanids (*Natatolana* sp. 10, *Booralana bathynella*, *Aatolana springthorpei*, *Bathynomus immanis*, *N. pellucida* and *N. bulba*) almost completely dominate (92.3%) guild biomass. Only the plesionikid shrimp, *Plesionika spinipes* and two cypridinid ostracods (*Vargula puppis* and *V. tubulata*) contribute slightly to the biomass.

300 m

Abundance

At 300 m the scavenging guild is reduced to a few species. Three cirolanids, mainly *Natatolana pellucida* plus *Bathynomus immanis* and *Booralana bathynella* (83.4%) and two lysianassoids, *Tryphosella* sp. ?91, *Parschisturella* sp. 47/159 (14.6%), completely dominate guild numbers.

Biomass

In a different order, three cirolanids, mainly *Bathynomus immanis* plus *Booralana bathynella* and *Natatolana pellucida* completely dominate (98.2%) guild biomass.

400 m

Abundance

Nearly the same taxon structure dominates 400 m guild numbers. Three cirolanids, mainly *Natatolana pellucida* plus *Bathynomus immanis* and *Natatolana bulba* dominate (63.2%) guild numbers. Two lysianassoids, *Tryphosella* sp. ?91, *Parschisturella* sp. 47/159, contribute the remaining 35%.

Biomass

One cirolanid, *Bathynomus immanis*, completely dominates (97.7%) guild biomass.

Summary

Species diversity is highest between 50 and 100 m depth (24 to 26 species) and drops steadily from 200 m (19 species) to 300 (13 species) to 400 m depth (10 species). Scavengers are most abundant (9000 individuals per trap) at 50 m and 100 m depth, decreasing dramatically to about 500 individuals per trap at 200 m depth and increasing to about 1000 individuals per trap at 300 to 400 m depth.

Numbers of individuals in the 50 m guild of the Gladstone transect are dominated by cypridinids (particularly *Cypridinodes* sp. GS, ngen IV sp. GNE and *Paradoloria* sp. GHF) and to a lesser extent cirolanids (mainly *Cirolana tumulosa*, *C. capricornica* and *Natatolana vieta*). In the 100 m guild cirolanids (*Natatolana bulba* and *Plakolana obtusa*) and cypridinids (*Skogsbergia* sp. GRP) share numerical dominance and lysianassoid amphipods make a minor contribution. In the 200 m guild the situation is similar. Cirolanids (*Natatolana* sp. 10 and *Natatolana pellucida*) and cypridinids (*Vargula sp.* NEC, *V. puppis* and *V. tubulata*) share numerical dominance and stegocephalid amphipods make a minor contribution. At 300 m depth cypridinids are no longer important. Cirolanids (mainly *Natatolana pellucida*) strongly dominate the guild and lysianassoids (mainly *Tryphosella* sp. ?91) make a small contribution to guild numbers. The guild at 400 m is similar to the 300 m guild. Cirolanids (mainly *Natatolana pellucida*) dominate guild numbers, but lysianassoids (*Tryphosella* sp. ?91, *Parschisturella* sp. 47/159) make a stronger contribution to guild numbers.

At 50 m depth biomass is dominated by cirolanids (mainly *Natatolana vieta* and *Cirolana capricornica*) and to a lesser extent by the portunid crab *Charybdis natator* and cypridinid ostracods (mainly ngen IV sp. GNE and *Paradoloria* sp. GHF). At 100 m depth cirolanids (mainly *Natatolana bulba* and *Plakolana obtusa*) dominate guild biomass, and to a lesser extent the portunid crab *Charybdis granulatus* and cypridinid ostracods (mainly *Paradoloria* sp. GHF). At 200 m depth cirolanids (mainly *Natatolana* sp. 10 and *Booralana bathynella*) almost completely dominate guild biomass. Only the plesionikid shrimp, *Plesionika spinipes*, and two cypridinid ostracods (*Vargula puppis* and *V. tubulata*) contribute slightly to the biomass. At 300 m and 400 m depths cirolanid isopods (mainly *Bathynomus immanis* and *Booralana bathynella*) completely dominate guild biomass.

Mooloolaba Transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 8. The trends shown in Figure 8 are outlined below.

Species richness (S)

Along the Mooloolaba transect the mean number of scavenging species is 20.5 species at 50 m depth, then declines to 14.00 species at 100 m depth and 17.0 species at 200 m and declines even further to 5.7 species at 300 m, 3.5 at 400 m and 3.0 species at 1000 m.

Abundance (N)

At 50 m depth the mean number of individuals is more than 34719 per trap. It declines steadily from 2750 individuals per trap at 100 m depth to 451 individuals per trap at 300 m depth. There is an increase to 2508 individuals per trap at 400 m depth and then another decrease to about 149 individuals per trap at 1000 m.

Biomass

Along the Mooloolaba transect mean biomass is highest (211 g per trap) at 50 m depth. It is significantly lower at 100 m (58 g per trap) to 200 m (38 g per trap) depth. It is lowest at 300 m (about 2 g per trap) and then increases to about 125 g per trap at 400 m depth. The biomass at 1000 m depth is very low, 0.12 g per trap.

Individual biomass follows an opposite pattern. At 50 m depth it is 0.007 g per individual and increases steadily to about 0.04 g per individual at 200 m and 300 m depth. At 400 m there is a huge increase in individual weight to about 4.5 g per individual and a huge decrease (0.003) at 1000 m depth.

Guild Structure - higher taxonomic resolution

A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 5 and 6. The trends within these plots are outlined below.

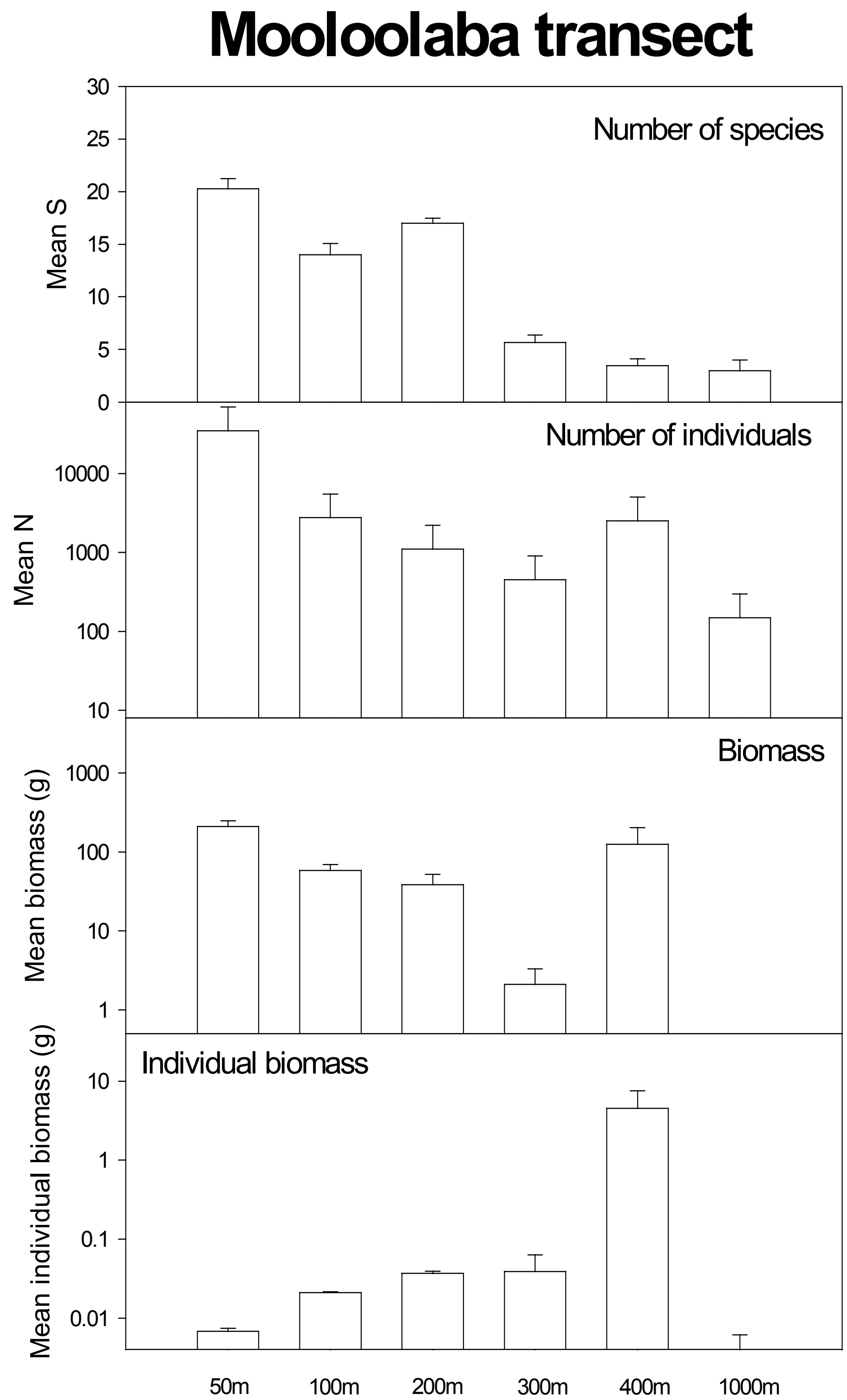

Figure 8. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Mooloolaba transect.

Cypridinid ostracods dominate the 50 m Mooloolaba guild (about 83% of the individuals), but contribute significantly less to the guilds between 100 and 300 m (19% to 9.8%). At 400 m and 1000 m their contribution is negligible. At 50 m depth cypridinids contribute 45% of the biomass. At 100 m and 200 m their contribution is negligible, but at 300 m they make a significant (34%) contribution.

Cirolanid isopods make up about 16% of the individuals in the 50 m Mooloolaba guild. They dominate the guilds at 100 and 200 m (84 to 80 %) depth. They contribute significantly less to the 300 m (8%), 400 m (18%) guilds and are not present in the 1000 m guild. At 50 m depth cirolanids contribute 55% of the biomass. They dominate biomass between 100 m (85%) and 200 m (97%) depths and make a significant contribution (31%) at 300 m and 400 m (20%) depth.

Lysianassoid amphipods are not important scavengers along the Mooloolaba transect, except in the 300 m guild where they contribute about 13.5% of the individuals and in the 1000 m guild where they contribute about 32% of the individuals. Lysianassoids make a significant contribution to biomass at 300 (22%) m, 400 m depth (29%) and at 1000 m where they dominate (86%).

Copepods are significant scavengers in deeper waters of the Mooloolaba transect. They make up 63 to 68% of the individuals between 300 m and 1000 m depth and even with their small size they contribute 34% of the biomass at 300 m depth and 25% at 400 m and 14% at 1000 m depth.

At 400 m depth pandalid prawns make a significant contribution (26%) to guild biomass.

50 m

Abundance

At 50 m depth the dominant scavengers are cypridinids, mainly *Cypridinodes* sp. L, plus ngen III sp. L, *Cypridinodes* sp. CRE, *Cypridinodes* sp. MCL and *Vargula* sp. NEC and the cylindroleberid sp. NC1, which together make up about 79.8%, of the individuals. The cirolanids *Natatolana bulba* and *Natatolana arcicauda*, make a smaller, but significant (15.3%) contribution to the numbers.

Biomass

Two cirolanids, *Natatolana bulba* and *Natatolana arcicauda* (50.6%) and two cypridinids, *Cypridinodes* sp. L and *Cypridinodes* sp. MCL (40%), strongly dominate (90.6%) the guild biomass. Other cirolanids and cypridinids fill out the biomass.

100 m

Abundance

Cirolanids dominate the 100 m scavenging guild, mainly *Natatolana bulba*, but also *Natatolana pellucida* and a few minor species make up nearly 84% of the guild numbers. The remainder is four cypridinids (*Cypridinodes* sp. MCL (6.3%), *Cypridinodes* sp. CH (3.7%), *Cypridinodes* sp. WR (2.2%), *Vargula trifax*), nearly 14% and nebaliid leptostracans which make a minor contribution to the guild.

Biomass

Two cirolanids, mainly *Natatolana bulba*, but also *Natatolana pellucida* make up nearly 85% of the biomass. Two cypridinids, *Cypridinodes* sp. MCL (12.5%), *Cypridinodes* sp. CH contribute the majority of the remaining 15%.

200 m

Abundance

The 200 m scavenging guild is very similar to the 100 m guild. Cirolanids (mainly *Natatolana bulba* plus *N. pellucida*, *N. wowine* and *N. arcicauda*) make up 80.4% of guild numbers. Six cypridinids (*Vargula trifax*, *Lowrya* sp. MDE, *Cypridinodes* sp. DC, *Cypridinodes* sp. MLS , *Skogsbergia tenax*, *Cypridinodes* sp. WR) contribute nearly 17% to the remainder of the guild.

Biomass

The same two cirolanids as at 100 m depth, mainly *Natatolana bulba*, but also *Natatolana pellucida*, make up 72% of guild biomass. Two additional cirolanids, *Natatolana wowine* and *Natatolana arcicauda*, and a cypridinid *Vargula trifax* make up the majority of the remaining biomass.

300 m

Abundance

At 300 m depth the scavenging guild changes dramatically. Copepods (63.4%) dominate numbers of individuals. The amphipods *Valettiopsis* sp. 184 and *Nagada uwedoae* contribute an additional 13.5% to guild numbers. The cirolanid *Natatolana bulba* (8.4%), which dominates some guilds in shallower depths along this transect, is still prevalent. Although cypridinids are not common, three species (cylindroleberid sp. NLL, *Metavargula* sp. MLS and *Cypridinodes* sp. L) occur in small numbers, about 7% of guild numbers. A polychaete worm, *Goniada* sp. (1.9%) and a nassarid gastropod, *Nassarius dijki* (1.9%), also occur in small numbers in this guild.

Biomass

Also in biomass this guild changes significantly from those in shallower water. The cirolanid *Natatolana bulba* (28.5%) continues to make a significant contribution to guild biomass, but the giant deep water cypridinid, *Azygocypridina lowryi* (25.6%) and the deep water amphipod, *Valettiopsis* sp. 184 (21.2%) contribute nearly equal contributions. Copepods which dominated guild numbers contribute only (12.1%) to guild biomass. A cirolanid, *Natatolana arcicauda*, and several cypridinids (*Cypridinodes* sp. L, *Cypridinodes* sp. MCL, *Metavargula* sp. MLS and ngen III sp. L) make minor contributions to guild biomass.

400 m

Abundance

At 400 m depth along the Mooloolaba transect, species diversity is very low. Copepods (81%) and the deep sea cirolanid, *Bathynomus immanis* (18.2%), dominate guild numbers.

Biomass

At 400 m depth the amphipod *Valettiopsis sp.* 184 (28.4%), a deep water pandalid shrimp, *Heterocarpus sibogae* (25.5%), copepods (24.7%) and a giant deep water cirolanid *Bathynomus immanis* (18.2%) dominate guild biomass. A cirolanid, *Cirolana kendi* and a lysianassoid, *Parschisturella* sp. 47/159 make minor contributions to guild biomass.

1000 m

Abundance

A similar trend occurs in the 1000 m guild with copepods (68.1%) and a deep sea lysianassoid, *Tryphosella* sp. 91 (30%), dominating guild numbers.

Biomass

Four lysianassoids (*Tryphosella* sp. 91 (49.3%), *Stephonyx* sp. 177 (21.8%), *Koroga megalops* (7.3%), *Paracallisoma* sp. 178 (7.3%)) and copepods (14.3%) totally dominate the guild biomass.

Summary

The scavenging guilds of the Mooloolaba transect are more complex than the more northern Cairns and Gladstone transects. At 50 m depth six species of cypridinids (mainly *Cypridinodes* sp. L) strongly dominate guild numbers. The only other group to make a significant contribution to individual numbers at this depth is the cirolanids (mainly *Natatolana bulba*). At 100 m depth cirolanids (mainly *Natatolana bulba* and to a lesser extent *Natatolana pellucida*) strongly dominate guild numbers. Cypridinids (mainly *Cypridinodes* sp. MCL) make a small contribution to guild numbers. Cirolanids (particularly *Natatolana bulba* and to a lesser extent *Natatolana pellucida*) continue to strongly dominate guild numbers at 200 m depth. Cypridinids again make a small contribution to numbers. In deeper water (between 300 m and 1000 m depth) copepods strongly dominate guild numbers. At 300 m the amphipod (*Valettiopsis* sp. 184) and the cirolanid *Natatolana bulba* each make a significant contribution to guild numbers. Unusually, a goniadid polychaete and a nassariid gastropod occur in small but significant numbers in the 300 m guild. At 400 m depth, aside from the copepods, only the cirolanid *Bathynomus immanis* makes a significant contribution to guild numbers. At 1000 m depth, in addition to copepods, a lysianassoid, *Tryphosella* sp. 91, makes a significant contribution to guild numbers.

At 50 m depth cirolanids (mainly *Natatolana bulba* and *N. arcicauda*) and cypridinids (mainly *Cypridinodes* sp. L and *Cypridinodes* sp. MCL) completely dominate guild biomass. At 100 m depth cirolanids (*Natatolana bulba* and *Natatolana pellucida*) strongly dominate guild biomass, but cypridinids (mainly *Cypridinodes* sp. MCL) still make a small, but significant contribution. At 200 m depth cirolanids (mainly *Natatolana bulba*) completely dominate guild biomass. In the 300 m guild biomass is distributed more evenly between cirolanids (*Natatolana bulba*), cypridinids (*Azygocypridina lowryi*) and amphipods (*Valettiopsis* sp. 184). Copepods make a smaller, but significant contribution to biomass at this depth. In the 400 m guild ostracods are no longer important. Amphipods (*Valettiopsis* sp. 184), carid shrimps (*Heterocarpus sibogae*), copepods and cirolanids (*Bathynomus immanis*) dominate guild biomass. At 1000 m depth only amphipods (mainly *Tryphosella* sp. 91 and *Stephonyx* sp. 177) and to a much less extent copepods dominate guild biomass.

Coffs Transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 9. The trends shown in Figure 9 are outlined below.

Species richness (S)

Along the Coffs transect the mean number os species is 24.9 at 50 m and 24.5 at 100 m depths. Numbers steadily decrease between 200 m (13.9 species), 300 m (6.7 species) and 400 m (4.4 species), and then increase at 1000 m (14.4 species).

Abundance (S)

Mean numbers of individuals follow a similar pattern. Highest numbers of individuals occur at 50 m (18339 per trap) and 100 m depths (20222 per trap), and are significantly lower at 200 m (706 per trap), 300 m (369 per trap) and 400 m (174 per trap), and then increase at 1000 m (647 per trap).

Biomass

Along the Coffs transect mean biomass is highest (98 g per trap) at 50 m and (122 g per trap) at 100 m depths. It decreases by significantly (17.4 g per trap) at 200 m depth. At 300 m biomass is 1.5 g per trap and at 400 m depth it is 0.5 g per trap and then increases to 13.0 g at 1000 m depth.

Mean individual biomass follows an almost opposite pattern. At 50 m depth it is 0.006 g per individual and increases steadily to 0.05 g per individual at 200 m depth. At 300 m there is a large increase in individual weight to 0.44 grm per individual. At 400 m depth it is 0.009 g and increases to 0.02 at 1000 m depth.

Guild Structure - higher taxonomic resolution

A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 6 and 7. The trends within these plots are outlined below.

Cirolanid isopods make a significant contribution to the Coffs scavenging guilds between 50 m (21%) and 100 m (23%) depths. Between 400 m and 1000 m depths they make up 11% each of the individuals. Cirolanids dominate guild biomass between 50 m depth and 200 m depth (55 to 67% of the biomass).

Cypridinid ostracods dominate the Coffs scavenging guilds between 50 m (65% of individuals), 100 m (73% of individuals) and 200 m (50% of individuals) depths. They continue to make a significant contribution at 300 m (31.5% of individuals), 400 m (8.5% of individuals) and 1000 m (19% of individuals) depths. Unusually, cypridinids maintain significantly high biomass along the entire Coffs transect and dominate guild biomass at 300 m depth.

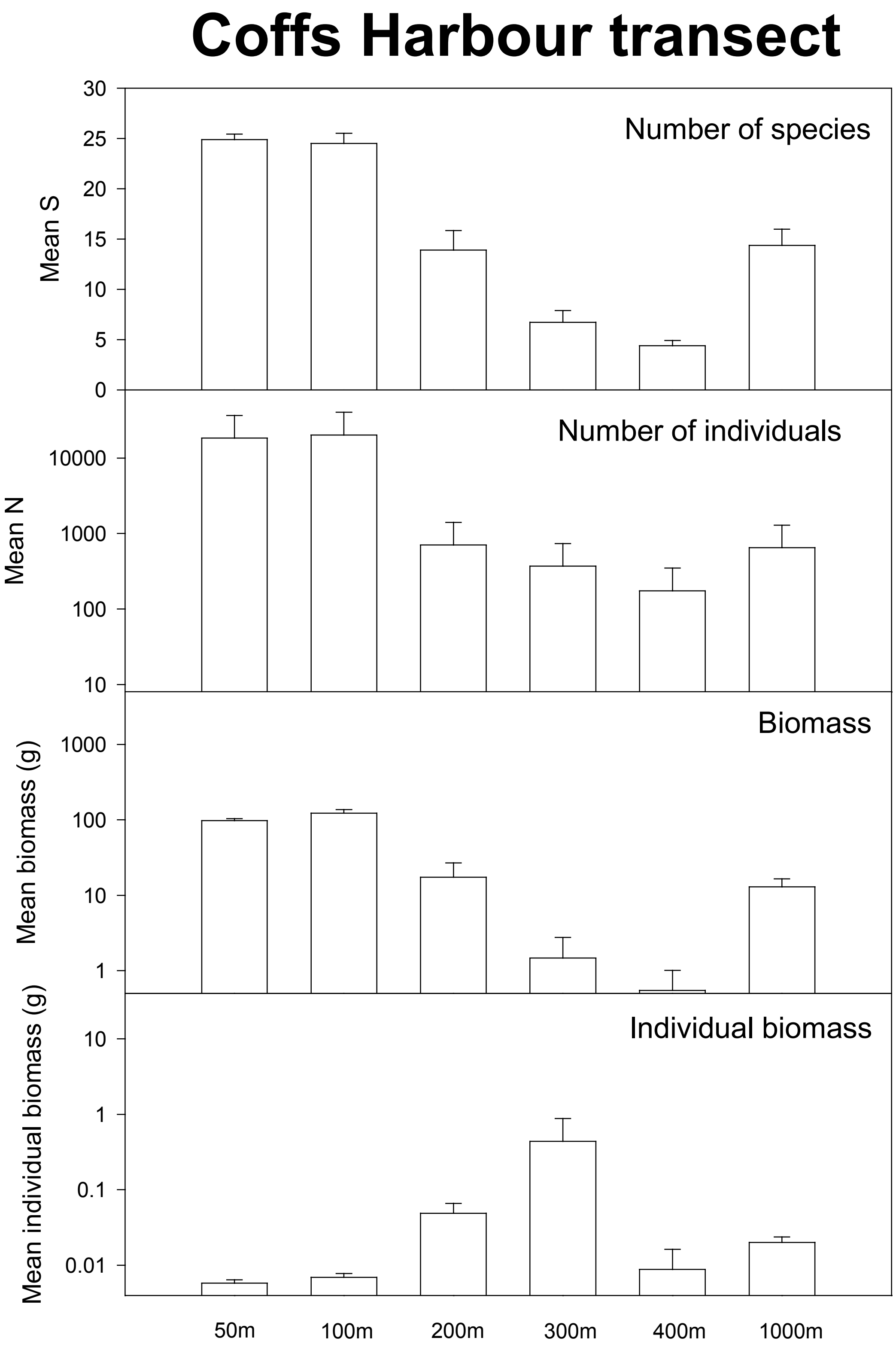

Figure 9. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Coffs transect.

Amphipods make up only about 12% of individuals at 50 m depth, but dominate (66%) the 1000 m guild. Lysianassoids make a significant contribution to guild biomass between 300 m (15.6%) and 400 m (34.7%) depths and dominate guild biomass (68%) at 1000 m.

Copepods make a significant contribution to guild numbers at 200 m (35% of individuals) and dominate the 300 m guild (58% of individuals) and 400 m guild (74% of individuals) depths. Copepods make a significant contribution to biomass at 300 (14.7%) and 400 m (12.2%) depths, but the never dominate.

Deep water shrimp make a significant contribution to guild biomass at 200 m (18.1%) and 300 m (14.2%) depths, but never dominate guild biomass.

50 m

Abundance

Although cypridinid ostracods clearly dominate the guild numbers at 50 m depth, no one species dominates. Twelve species in five genera (*Cypridinodes* sp. CH, *Vargula tubulata*, *Cypridinodes* sp. L, *Lowrya taiti*, *Cypridinodes* sp. GS, *Skogsbergia tenax*, *Vargula karamu*, ngen III sp. L, *Skogsbergia* sp. WS, *Cypridinodes* sp. CRE, *Vargula sp.* NEC and *Vargula trifax*) make up about 65% of guild numbers. Cirolanids isopods (*Natatolana arrama*, *N. kahiba* and *N. bulba*) also contribute significantly to guild numbers. The only other significant contributor to guild numbers is the lysianassoid *Waldeckia* sp. 68b (12.1%). Nebaliids (1.3%) make a minor contribution.

Biomass

For biomass the guild is dominated by cirolanids in the genus *Natatolana* (*N. arrama*, *N. kahiba*, *N. bulba*, *N. wowine* and *N. pellucida*) which make up almost 53% of guild biomass. Eight species of cypridinids contribute significantly to guild biomass (*Cypridinodes* sp. CH, *Vargula tubulata*, *Cypridinodes* sp. L, *Cypridinodes* sp. GS, *Lowrya taiti*, ngen III sp. L, *V. trifax* and *V. karamu*, making up almost 34%. Two other taxa, a lysianassoid, *Waldeckia* sp. 68b, contributes nearly 7% and a portunid crab, *Charybdis bimaculata*, contributes an additional 2.8%.

100 m

Abundance

A similar situation occurs in the 100 m guild where cypridinids, although not as diverse, dominate guild numbers even more strongly. Five species in three genera (mainly *Skogsbergia tenax*, but also *Cypridinodes* sp. CH, *Vargula tubulata*, *Vargula sp.* NEC, *Vargula puppis*) contribute 71% of guild numbers. Cirolanid isopods (*Natatolana bulba*, *N. galathea*, *N. pellucida* and *N. kahiba*) again contribute significantly (23%) to guild numbers. The only other significant contributor to guild numbers is the lysianassoid, *Ichnopus cribensis* (2.9%).

Biomass

Cirolanids again dominate biomass. Seven species (manly *Natatolana bulba*, but *N. wowine*, *N. galathea*, *N. kahiba*, *N. pellucida* and *Plakolana obtusa*) contribute about 64% of guild biomass. Five species of cypridinids

(*Cypridinodes* sp. CH , *Vargula tubulata*, *Skogsbergia tenax*, *Vargula sp.* NEC and *V. puppis*) contribute 32% of the guild biomass. The lysianassoid *Ichnopus cribensis* contributes an additional 2%.

200 m

Abundance

At 200 m depth the pattern changes. Cypridinids still dominate the guild numbers. Five species in four genera (*Skogsbergia tenax*, *Vargula tubulata*, *V. dentata*, *Cypridinodes* sp. CH and *Lowrya* sp. NLM) contribute 47% of the guild numbers. Copepods make up 34.5% of guild numbers. Two cirolanids (*Natatolana thurar* and *N. wowine*) (about 8%) and nebaliid leptostracans (4.5%) make minor contributions to guild numbers.

Biomass

Cirolanids continue to dominate guild biomass with three species (mainly *Natatolana thurar*, but also *N. wowine* and *Aatolana springthorpei*) contributing 67% of the guild biomass. Two decapods, a deep water plesionikid shrimp, *Plesionika edwardsi* and a diogenid hermit crab, *Strigopagurus strigimanus* contribute about 18% to guild biomass. Cypridinids continue to contribute (11.3%) to guild biomass (*Vargula tubulata*, *Azygocypridina lowryi*, *Skogsbergia tenax*, *Vargula puppis*), but are becoming less important in deeper water.

300 m

Abundance

In a surprising situation, there are no scavenging isopods at the 300 m Coffs site. Copepods dominant (58.2%) guild numbers. Unusual for this depth, cypridinids (*Vargula puppis*, *Skogsbergia tenax*, *Cypridinodes* sp. MLS and *V. tubulata*) contribute nearly 30% of guild numbers. Other crustaceans such as a deep water carid shrimp, *Heterocarpus sibogae* (4.8%), a lysianassoid, *Nagada uwedoae* (2.5%), and nebaliid leptostracans (2%) make minor contributions to guild numbers.

Biomass

Even more unusual cypridinids dominate guild biomass (*Vargula tubulata*, *V. puppis*, *Skogsbergia tenax*, Cylindroleberid sp. NL, *Cypridinodes* sp. WR, *Metavargula sp.* MN1, *Lowrya* sp. NLM and *Pterocypridina sp. LW*) at this site, contributing 52%. Amphipods in the families Stegocephalidae (*Stegocephaloides* sp. 1) and Uristidae (*Nagada uwedoae*) contribute nearly 16% of guild biomass. Deep water copepods, which dominated guild numbers, contribute only 15% to guild biomass and a deep water carid shrimp, *Heterocarpus sibogae*, contributes another 14%. Nebaliids make a minor contribution of 2% to this guild.

400 m

Abundance

At 400 m copepods strongly dominate (74%) guild numbers. Cirolanids (*Natatolana bulba* and *Natatolana sp.* 39) contribute an additional 10.8% and cypridinids (*Vargula puppis*, *Metavargula sp.* CCT) contribute 8.4% to guild numbers. Lysianassoids (*Parschisturella* sp. 47/159 and *Waldeckia* sp. 68b) make a minor (6%) contribution.

Biomass

Cirolanids, which dominated guild biomasses from 50 to 200 m, co-dominate with amphipods at 400 m depth. Four species of *Natatolana (N. bulba*, *N. arrama*, *N. pellucida* and *Natatolana* sp. 39) contribute 40% of guild biomass. Three species of deep water amphipods (*Parschisturella* sp. 47/159, *Valettiopsis* sp. 184 and *Waldeckia* sp. 68b) contribute 35% to guild biomass. Cypridinids (*Metavargula sp.* CCT, *Vargula puppis* and *Skogsbergia tenax*), which usually do not influence deep water guilds, contribute almost 14% to the 400 m biomass. Copepods, which strongly dominated guild numbers, contribute 12.2% to guild biomass.

1000 m

Abundance

At 1000 m depth a diverse group of lysianassoid amphipods (*Paracallisoma sp.* 178, *Schisturella* sp. 33, *Parschisturella* sp. 47/159, *Eurythenes* sp, *Koroga megalops*, *Tryphosella* sp. 146 and *Stephonyx* sp. 177) dominate the scavenging guild, making up 66% of guild numbers. Unusual for this depth, cypridinids (*Vargula dentata*, *Cypridinodes* sp. CH and *Cypridinodes* sp. WD) contribute 17% of guild numbers. Two deep water cirolanids (*Natatolana laewilla* and *N. bowmani*) contribute nearly 11% of guild numbers and the copepods, although dramatically reduced in numbers, contribute nearly 3% to guild numbers. The only other significant contributor to the 1000 m guild is the syllid polychaete *Sphaerosyllis ?lateropapillata* (1.2%).

Biomass

Guild biomass is dominated by deep water lysianassoid and stegocephalid amphipods (*Eurythenes* sp., *Paracallisoma sp.* 178, *Schisturella* sp. 33, *Parschisturella* sp. 47/159, *Andaniexis sp.* and *Koroga megalops*), which contribute nearly 67%. Two species of deep water cirolanids (*Natatolana bowmani* and *N. laewilla*) contribute an additional 26%. Three species of cypridinids (*Cypridinodes* sp. CH, *Vargula dentata* and *Cypridinodes* sp. WD) and one species of cylindroleberid (Cylindroleberid sp. FE) contribute an additional 4.5% to guild biomass.

Summary

A high diversity of cypridinid ostracods dominate guild numbers from 50 m to 200 m depths and unusually, continue to contribute significantly to guild numbers down to 1000 m depth. Between 200 m and 400 m copepods dominate guild numbers along the Coffs transect. Between 50 and 200 m depth cirolanid isopods occur in significant numbers, but never dominate guild numbers at any depth along the coffs transect. Lysianassoids also occur in significant numbers between 50 and 200 m depth. They dominate guild numbers at 1000 m depth with a high diversity of genera and species.

Between 50 and 200 m depths cirolanid isopods (species of *Natatolana*) and cypridinid ostracods (usually species of *Cypridinodes*) dominate guild biomass. At 300 m an unusual situation occurs where cirolanids are absent from the scavenging guild and cypridinids (*Vargula* and *Skogsbergia*) dominate the guild biomass. Three other groups, amphipods (stegocephalids and lysianassoids), copepods and a deep water carid shrimp complete the guild biomass at this depth. In the 400 m guild cirolanids and lysianassoids share biomass dominance. Cypridinids and copepods each contribute significantly to biomass at this depth. At 1000 m depth a high diversity of amphipods dominate guild biomass. Two deep water cirolanids (*Natatolana bowmani* and *N.*

laewilla) make a significant contribution to guild biomass. Cypridinids, greatly diminished in numbers, make a minor contribution at this depth.

Wollongong Transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 10. The trends shown in Figure 10 are outlined below.

Species richness

Along the Wollongong transect the mean numbers of species is 20.4, 22.4 and 21 between 50 m, 100 m and 200 m depths. Numbers decrease to about 9.4 species at 300 m, 4.9 species at 400 m and then increases slightly to 7.8 species at 1000 m.

Abundance (N)

Mean individuals per trap 13864 at 50 m depth. This increases to 33248 individuals per trap at 100 m depth. Scavenging abundance is significantly lower at 200 m (2906 individuals per trap), 300 m (about 855 individuals per trap) and 400 m (163 individuals per trap), and then increases at 1000 m (343 individuals per trap).

Biomass

Along the Wollongong transect mean biomass is relatively high at all depths (76.8 g per trap at 50 m and 68.2 g per trap 100 m depths. It increases to 346 g per trap at 200 m depth. At 300 m and 400 m depths biomass is 123.4 and 95.4 g per trap and decreases to 40.7 g per trap at 1000 m depth.

At 50 m depth guild mean individual biomass is 0.009 g per individual. It decreases to 0.003 g per individual at 100 m depth. At 200 m (0.27 g per individual) and 300 m depth (0.51 g per individual) biomass increases significantly. At 400 m depth biomass is highest (5.3 g per individual) and decreases at 1000 m to 0.12 g per individual.

Guild Structure - higher taxonomic resolution

A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 6 and 7. The trends within these plots are outlined below.

At 50 m depth along the Wollongong transect cirolanid isopods are the only group, besides cypridinids, to make a significant contribution (about 12%) to scavenging guild numbers. They dominate guilds between 200 m and 400 m depth (62% to 72% of individuals) and they make a significant contribution at 1000 m depth. Cirolanids dominate guild biomass along most of the Wollongong transect (51% to 96%) except 100 m, where they are inexplicably rare (8%), and 1000 m where they shares dominance with lysianassoid amphipods. Cypridinids dominate biomass at 100 m depth (72%) and make significant contribution at 50 m (21%) and 300 m (22%) depth.

Cypridinid ostracods strongly dominate the Wollongong scavenging guilds between 50 m (86% of individuals) and 100 m (95% of individuals) depth. Below 200 m depth their numbers are diminished and they contribute between 8 to 24% of guild biomass.

Amphipods make up a significant contribution to the scavenging guilds along the Wollongong transect at 200 m depth (24% of individuals) and at 1000 m depth (51% of individuals) where they dominate guild numbers. Lysianassoids make a significant contribution to guild biomass at 200 m depth (10%) and co-dominate with cirolanids at 1000 m depth.

Copepods make a significant contribution to guild numbers at 400 m (about 30% of individuals) and at 1000 m depth (about 17% of individuals), but along the Wollongong transect they never dominate guild numbers.

Decapods (mainly the diogenid hermit crab *Strigopagurus strigimanus*) make a significant contribution to guild biomass between 50 and 300 m depths (18% to 37%), but never dominate.

50 m

Abundance

Cypridinids almost completely dominate guild numbers at 50 m depth, particularly *Vargula karamu*, but also *Lowrya kornickeri*, Vargula *sp.* NEC and *Cypridinodes* sp. CH. Together they contribute about 82% of individuals. Cirolanids are the only other group contributing to guild numbers. Four species of *Natatolana* (*N. arrama*, *N. pellucida*, *N. galathea* and *N. nammuldi* contribute about 14% of the individuals.

Biomass

Five species of the cirolanid genus *Natatolana* (*N. arrama*, *N. gorung*, *N. pellucida*, *N. nammuldi* and *N. kahiba*) contribute 56.5% of guild biomass. Two other species, a diogenid hermit crab, *Strigopagurus strigimanus* (22.2%), and a cypridinid, *Vargula karamu* (18.5%), also contribute significantly to the 50 m guild biomass.

100 m

Abundance

A similar pattern occurs at 100 m depth. Cypridinids, particularly *Skogsbergia tenax*, but also *Vargula puppis*, *Vargula karamu*, *Lowrya* sp. NLM, *Vargula* sp. TB and *Cypridinodes* sp. CH dominate guild numbers, contributing nearly 93% of guild individuals. Two amphipods, a stegocephalid, *Andaniotes* spp and a lysianassoid, *Rhinolabia* sp. 102, contribute an additional 5% of individuals.

Biomass

Cypridinids (mainly *Skogsbergia tenax*, but also *Vargula puppis*, *V. karamu*, *Cypridinodes* sp. CH, *Vargula sp.* TB, *Lowrya* sp. NLM, *V. tubulata*) contribute 71.1% of guild biomass. Two other species, a diogenid, *Strigopagurus strigimanus* (18%) and the cirolanid *Natatolana wowine* (7.6%) also contribute significantly to the 100 m guild biomass.

200 m

Abundance

At 200 m depth the pattern changes. Cirolanids in the genus *Natatolana* (mainly *N. bulba*, but also *N. matong*, *N. wowine* and *N. pellucida*) contribute nearly 65% of guild numbers. Two species of lysianassoids (*Stephonyx pirloti* and *Aroui hamatopodus*) contribute 23% of individuals. Three cypridinids in the genus *Vargula* (*V. puppis*, *V. karamu* and *V. puppis*) plus the giant cypridinid, *Azygocypridina lowryi*, contribute a further 7% of guild individuals.

Biomass

Three species of the cirolanid genus *Natatolana* (mainly *N. bulba*, *N. matong* and *N. wowine*) contribute 51% of guild biomass. Two other species, a diogenid hermit crab, *Strigopagurus strigimanus* (37.1%) and a lysianassoid, *Stephonyx pirloti* (9.6%), also contribute significantly to guild biomass.

300 m

Abundance

Cirolanids continue to dominate guild numbers at 300 m depth. Mainly *Natatolana bulba*, but also *N. pellucida* and *N. matong* contribute about 76% of individuals. Amphipods are absent from this site, but the deep water cypridinid *Azygocypridina lowryi* (about 18%) makes a significant contribution to guild numbers. Copepods (3.2%) and a cypridinid, *Vargula karamu* (2.9%), each make a small contribution to guild numbers.

Biomass

Three species of the cirolanid genus *Natatolana* (mainly *N. bulba*, but also *N. matong*, *N. pellucida*) contribute nearly 60% of guild biomass. Two other species, a giant cypridinid, *Azygocypridina lowryi* (about 22%) and a diogenid hermit crab, *Strigopagurus strigimanus* (about 18%), also contribute significantly to the 200 m guild biomass.

400 m

Abundance

Cirolanids again dominate guild numbers. A large species, *Bathynomus kapala*, and five smaller species of *Natatolana* (mainly *N. valida* and *N. bulba*, but also *N. arrama*, *N. wowine* and *N. pellucida*) contribute 67.1% of guild numbers. Copepods are abundant and contribute 29.4% to guild numbers. Three species of cypridinids (*Siphonostra* sp. W, *Skogsbergia sp.* W and *Vargula karamu*) contribute an additional 6.2 % to guild numbers.

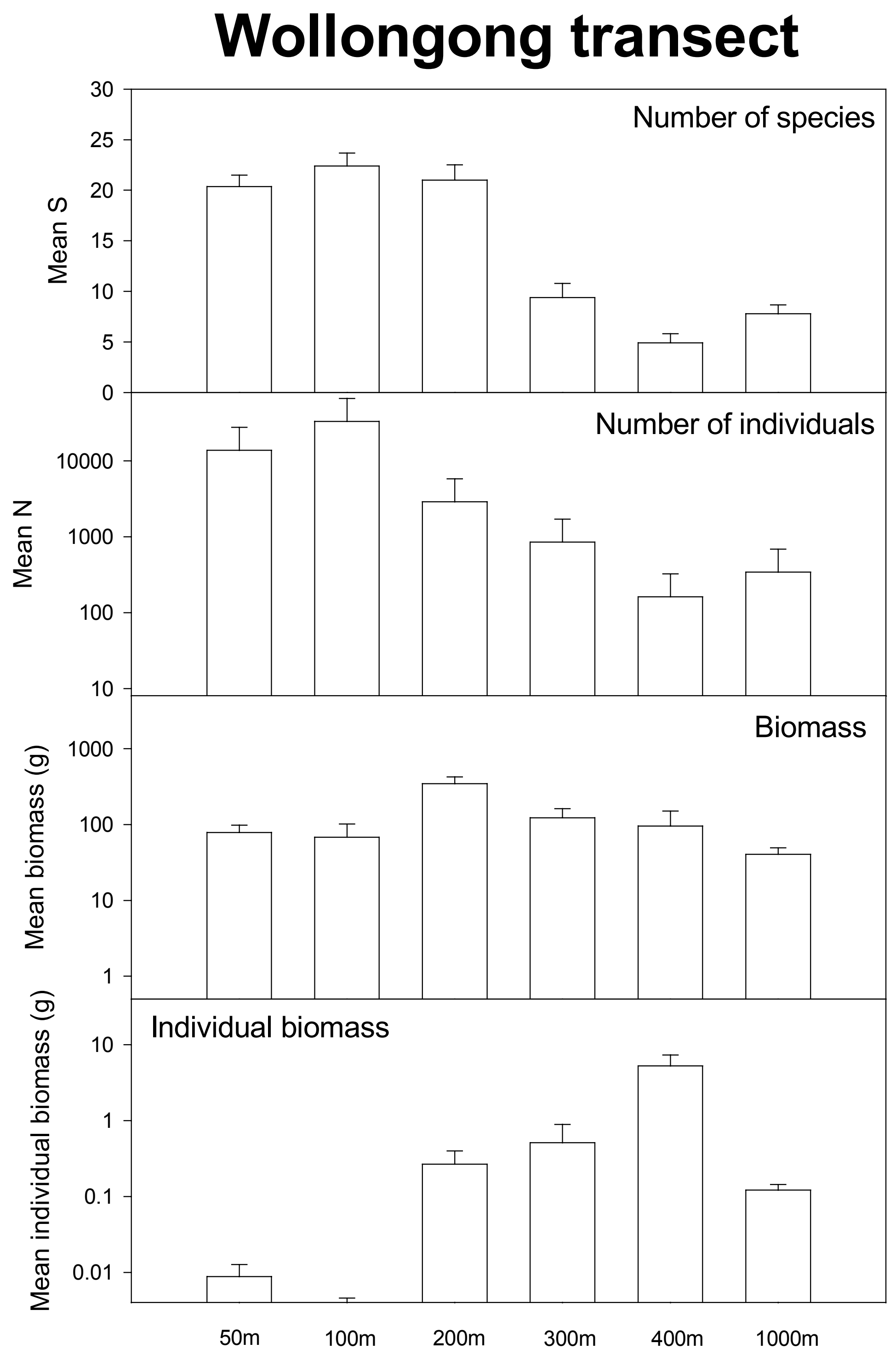

Figure 10. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Wollongong transect.

Biomass

Six species of cirolanids (*Bathynomus kapala*, *Natatolana bulba*, *N. valida*, *N. arrama*, *N. wowine* and *N. pellucida*) completely dominate (95%) guild biomass. The only other group which contributes to guild biomass at this depth is the copepods (about 2%).

1000 m

Abundance

At this depth lysianassoid amphipods dominate guild numbers. Four genera and species (mainly *Stephonyx* sp. 63, but also *Schisturella* sp. 33, *Hirondellea* sp. 29a and *Parschisturella* sp. 26) contribute 51.3% of guild numbers. The deep water cirolanids, *Natatolana bowmani* and *Natatolana laewilla* contribute about 26% and the deep water copepods contribute an additional 13%. Two cypridinids (ngen IV sp. RR, *Vargula dentata*) make a minor contribution of about 5%.

Biomass

A lysianassoid, *Stephonyx* sp. 63 (47.4%)) and a cirolanid, *Natatolana bowmani* (44.4%)), dominate guild biomass. Several other species (*Vargula dentata* (2%), *Bathynomus kapala* (1.8%), *Natatolana laewilla* (1.3%) and *Stephonyx pirloti* (1%)) make minor contributions.

Summary

Along the Wollongong transect cypridinid ostracods strongly dominate guild numbers at 50 m (mainly *Vargula karamu*) and 100 m (mainly *Skogsbergia tenax*) depths. At 200 m depth the pattern changes so that cirolanid species in the genus *Natatolana* (mainly *N. bulba*) and lysianassoid species, *Stephonyx pirloti* and *Aroui hamatopodus*, dominate guild numbers. Cirolanid species of *Natatolana* (mainly *N. bulba*) continue to dominate guild numbers at 300 m depth. A deep water cypridinid, *Azygocypridina lowryi*, is also prominent. In the 400 m guild a large cirolanid, *Bathynomus kapala*, and species of *Natatolana* (mainly *N. bulba*, *N. valida* and *N. arrama*) dominate guild numbers. In this guild copepods occur in significant numbers. In the 1000 m guild a high generic diversity of lysianassoid amphipods (mainly *Stephonyx* sp. 63) and the two deep water cirolanids (*Natatolana bowmani* and *Natatolana laewilla*) dominate guild numbers.

In the 50 m guild cirolanids (particularly *Natatlana arrama* and *N. gorung*) dominate guild biomass. A conspicuous diogenid hermit crab, *Strigopagurus strigimanus*, and a cypridinid, *Vargula karamu*, also significantly contribute to the 50 m guild biomass. At 100 m depth a diverse array of cypridinids (mainly *Skogsbergia tenax*) strongly dominate guild biomass. A diogenid, *Strigopagurus strigimanus*, and a cirolanid, *Natatolana wowine*, also significantly contribute to guild biomass. At 200 m depth cirolanids (particularly *Natatlana bulba* and *N. matong*) dominate guild biomass. A diogenid, *Strigopagurus strigimanus*, makes a strong contribution to biomass at this depth. The only other significant contributor to biomass is *Stephonyx pirloti*. Cirolanids (mainly *Natatlana bulba*) continue to dominate guild biomass at 300 m depth. Two other significant contributors are the giant cypridinid *Azygocypridina lowryi* and the diogenid *Strigopagurus strigimanus*. At 400 m a diverse array of large cirolanids (particularly *Bathynomus kapala*, *Natatolana bulba*, *N. valida* and *N. arrama* completely dominate guild biomass. At 1000 m, guild biomass is shared between a lysianassoid, *Stephonyx* sp. 63, and a cirolanid, *Natatolana bowmani*.

Hobart Transect

A summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap is shown in Figure 11. The trends shown in Figure 11 are outlined below.

Species richness (S)
Along the Hobart transect the mean numbers of scavenging species is 25.6 and 26.8 at 50 m and 100 m depths. Species richness decreases significantly to about 15.5 species at 200 m depth and continues to decrease slightly to about 13 species at 300 m and 12.7 at 400 m depths and 9.4 species at 1000 m depth.

Abundance (S)
Mean numbers of individuals are highest at 50 m (28655 per trap) and 100 m (23081 per trap) depths. They decrease to 429 and 819 individuals per trap at 200 to 300 m depths and increase to 3116 individuals per trap at 400 m depth. Numbers at 1000 m depth are 745 individuals per trap.

Biomass
Along the Hobart transect the mean biomass is 114.6 g per trap at 50 m depth. It increases to about 297.3 g per trap at 100 m depth. Biomass then steadily decreases from 200 m (58.7 g per trap) to 300 m (35.1 g per trap) to 400 m (14.9 g per trap) to 1000 m (9.9 g per trap) depth.

At 50 m depth mean individual biomass is 0.005 g per individual. It increases to about 0.015 g per individual at 100 m depth. It increases significantly at 200 m (0.10 g per trap) and 300 m depth (0.07 g per trap), decreases to about 0.009 g per trap at 400 m and then increases to about 0.04 g per trap at 1000 m depth.

Guild Structure - higher taxonomic resolution
A summary of the percentage contribution of the major taxa to both the total abundance, and total biomass per trap is summarised in Figures 5 and 6. The trends within these plots are outlined below.

Cirolanid isopods significantly contribute to numbers of individuals in the 200 m (24.4%), 300 m (19.2%) and 1000 m (13.5%) scavenging guilds. They make minor contributions to the 50 m, 100 m, and 400 m guilds. Cirolanid isopods dominate guild biomass along most of the Hobart transect from 50 m to 300 m depth (48.5% to 84%), contribute significantly to guild biomass at 400 m (27%) and co-dominate with lysianassoid amphipods (40%) at 1000 m depth.

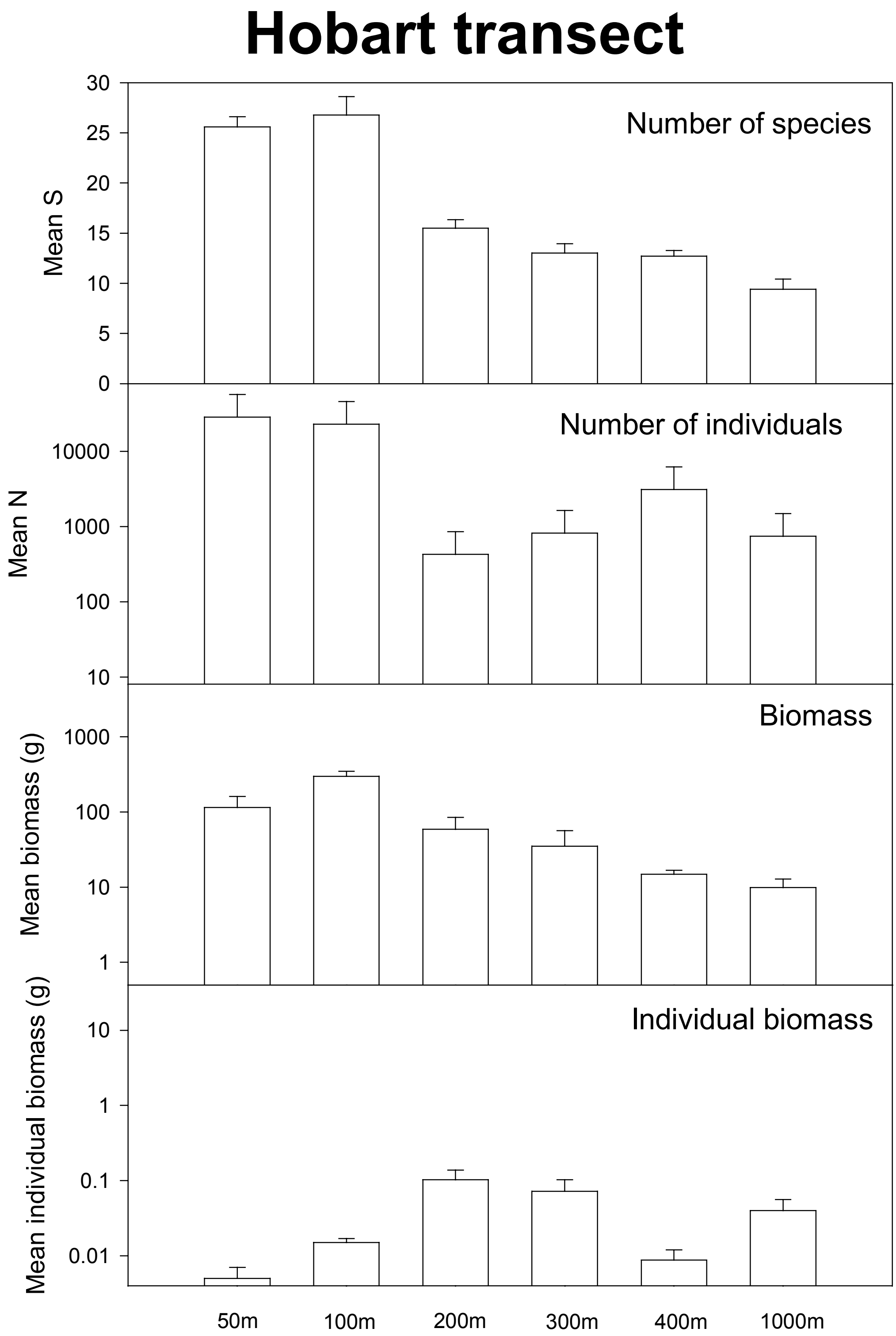

Figure 11. Summary of the data for mean number of species per trap, mean number of individuals per trap, total biomass per trap, and mean biomass of individuals per trap along the Hobart transect.

At 50 m depth cypridinid ostracods strongly dominate the scavenging guild (86% of individuals). They continue to dominate guild numbers at 100 m and 200 m depths (34% to 53%) and significantly contribute to guild numbers at 300 and 400 m depth (16% to 39%). At 1000 m depth cypridinids still make a minor contribution to guild numbers.

Lysianassoid amphipods significantly contribute to the 100 m (39%) and 200 m (29%) scavenging guilds and they dominate 300 m (43%) and 400 m (54%) guild numbers and strongly dominate the 1000 m (70%) guild numbers. Lysianassoids contribute significantly to guild biomass at 100 m (27%) and 300 m (27%) depths. They dominate guild biomass at 400 m (51.5%) and co-dominate with cirolanids at 1000 m (51%) depth.

Decapods (mainly the diogenid hermit crab *Strigopagurus strigimanus*) make significant contributions to guild biomass between 50 (19%) and 300 m (14%) depths, and make small contributions (7 to 10%) at 100 m, 200 m and 400 m depths.

50 m

Abundance

Cypridinids, mainly *Lowrya* sp. WDC, but also *Vargula karamu*, dominate guild numbers, contributing nearly 84% of guild individuals. Three lysianassoids (*Waldeckia* sp. 68b, *Waldeckia* sp. 68d and *Stephonyx pirloti*) contribute another 8% of individuals and a cirolanid, *Natatolana kahiba*, contributes nearly 4%. A cypridinid, *Skogsbergia tenax* (about 1%) and nebaliid leptostracans (about 1%) each make minor contributions to guild numbers.

Biomass

Three cirolanids (mainly *Natatolana kahiba*, but also *N. wowine* and *N. bulba*) contribute 48% of guild biomass. Two cypridinids, mainly *Lowrya* sp. WDC, but also *Vargula karamu*, contribute about 21%. A diogenid hermit crab, *Strigopagurus strigimanus*, contributes an additional 19% and three lysianassoids (*Waldeckia* sp. 68b, *Stephonyx pirloti* and *Waldeckia* sp. 68d) contribute 7.8%. The nassarid gastropod (*Nassarius nigellus*) makes a minor (1%) contribution to guild biomass.

100 m

Abundance

In the 100 m guild a cypridinid, *Vargula karamu* (45.7%) and two lysianassoids, *Stephonyx pirloti* (24%) and *Waldeckia* sp. 68d (10.5%) contribute 80.2% of guild individuals. Two cirolanids, *Natatolana bulba* and *N. wowine* contribute and additional 6.4% of guild individuals. Two lysianassoids, *Tryphosoides adentatus* and *Waldeckia* sp. 68b (2.3%) and three cypridinids, *Vargula sp.* TB, *V. tubulata* and *V. trifax* make minor (5.6%) contributes.

Biomass

Cirolanids again contribute the majority of the biomass. Three species, mainly *Natatolana wowine*, but also *N. bulba* and *N. matong* contribute 46.3%. Two lysianassoids, mainly *Stephonyx pirloti*, but also *Waldeckia* sp. 68d, contribute an additional 26% of the biomass. Four cypridinids (mainly *Vargula karamu*, but also *Vargula* *sp.* TB, *V. tubulata* and *V. trifax* contribute 15.8% and a cancrid crab, *Cancer novaezealandiae*, contributes an additional 8%.

200 m

Abundance

Four crustacean groups contribute significantly to 200 m guild numbers. Six cypridinids (mainly *Vargula* sp. T4, but also *V. karamu*, *Vargula* sp. T7, *Doloria* sp. T, *Lowrya* sp. T and *Vargula* sp. T**7**) contribute 31.8% of guild individuals. Five amphipods, four lysianassoids (mainly *Nagada uwedoae* and *Stephonyx pirloti*, but also *Waldeckia* sp. 68d and *Tryphosella* sp. 168/182) and a stegocephalid, *Andaniotes* sp. contribute 28.6% of guild individuals. Three cirolanids (mainly *Natatolana nammuldi*, but also *Booralana bathynella* and *N. matong*) contribute 24% of guild individuals and copepods contribute about 12% of guild individuals.

Biomass

Cirolanids strongly dominate guild biomass. *Booralana bathynella*, *Natatolana matong* and *N. nammuldi* contribute 84% of guild biomass. Three other species, a diogenid hermit crab, *Strigopagurus strigimanus* (7%), a cypridinid, *Azygocypridina lowryi* (4%), and a lysianassoid, *Stephonyx pirloti* (2%), make up the majority of the remainder of the biomass.

300 m

Abundance

Lysianassoids replace cypridinids as dominant scavengers at 300 m depth. Two lysianassoids (mainly *Tryphosella* sp. 168/182, but also *Nagada uwedoae*) contribute 41.3% of guild individuals. Copepods contribute 21.4% of guild individuals. Three cirolanids (mainly *Natatolana nammuldi*, but also *N. matong* and *Booralana bathynella* contribute 19.1 % of guild individuals. Four cypridinids (*Vargula* sp. T4, *Doloria* sp. T, *Vargula* sp. T7 and *V. karamu* contribute an additional 15% of guild individuals.

Biomass

The same cirolanids (*Natatolana nammuldi*, *N. matong* and *Booralana bathynella*) continue to dominate guild biomass (58%) at 300 m depth. The deep water lysianassoid, *Tryphosella* sp. 168/182 contributes 26.2% of the biomass. Two decapods, a goneplacid crab (*Carcinoplax meridionalis* and a galathaeid squat lobster, *Munida haswelli*) contribute an additional 13.7% of the biomass. Copepods (about 1%) make a minor contribution to biomass at this depth.

400 m

Abundance

The same lysianassoids (mainly *Tryphosella* sp. 168/182, but also *Nagada uwedoae*) contribute 52.7% of guild individuals. Two cypridinids (mainly *Vargula* sp. T8, but also *Lowrya* sp. T) contribute an additional 39.2% of individuals to the guild. Copepods (5.2%) and a cirolanid, *Natatolana nammuldi* (about 1.5%), make minor contributions.

Biomass

At 400 m a lysianassoid, *Tryphosella* sp. 168/182, becomes the dominant (50.1%) contributor to guild biomass. Two cirolanids, mainly *Natatolana nammuldi*, but also *Booralana bathynella*, contribute 26.3% to guild biomass. A cypridinid, *Vargula* sp. T8, contributes an additional 10.4% and two decapods, a carid shrimp *Merhippolyte chacei* and a goneplacid crab, *Carcinoplax meridionalis*, contribute 9.8% of guild biomass.

1000 m

Abundance

Lysianassoids dominate abundance in the 1000 m guild. Six genera and species (*Parschisturella* sp. 26, *Tryphosella* sp. 168/182, *Schisturella* sp. 33, *Tryphosella* 146, *Eurythenes sp.* and *Aristiopsis* sp. 28) contribute 66% of guild individuals. Copepods contribute 12.9% of the individuals. Three cirolanids (mainly *Natatolana bowmani*, but also *N. laewilla*, *Cirolana* sp. 4) contribute an additional 10.7%. Two cypridinids, *Doloria* sp. TS and *Cypridinodes* sp. WR, make a minor addition of 6.8% individuals.

Biomass

Lysianassoids and cirolanids dominate guild biomass. A generically diverse group of four lysianassoids (*Parschisturella* sp. 26, *Tryphosella* sp. 168/182, *Schisturella* sp. 33 and *Tryphosella* sp. 146) contribute about 50% of the biomass. Five cirolanids (mainly *Natatolana bowmani*, but also *N. laewilla*, *Cirolana* sp. 4, *Natatolana sp.* 37 and *N. bulba*) contribute 40% of guild biomass. A cypridinid, *Doloria* sp. TS (nearly 6%) and copepods (about 2%) make up the remainder of the biomass.

Summary

Along the Hobart transect cypridinid ostracods strongly dominate guild numbers at 50 m (mainly *Lowrya sp.* WDC) and 100 m (mainly *Vargula karamu*) depths. In the 100 m guild lysianassoids, particularly *Stephonyx pirloti*, also makes a major contribution. At 200 m depth the pattern changes. Cypridinids (particularly *Vargula* sp. T4), lysianassoids (particularly *Nagada uwedoae* and *Stephonyx pirloti*) and cirolanids (particularly *Natatolana nammuldi*, *N. matong* and *Booralana bathynella* share guild numbers. In the 300 m guild lysianassoids (particularly *Tryphosella* sp. 168/182) dominate guild numbers. Cirolanids (particularly *Natatolana nammuldi*) and cypridinids (particularly *Vargula* sp. T4) each make smaller, but similar contributions. At 400 m depth lysianassoids (mainly *Tryphosella* sp. 168/182), continue to dominate guild numbers. Cypridinids (particularly *Vargula* sp. T8) make up the remainder of the individuals. In the 1000 m guild a diverse array of lysianassoids (particularly *Parschisturella* sp. 26, *Tryphosella* 168/182 and *Schisturella* sp. 33) dominate guild numbers. Copepods, cirolanids (particularly *Natatolana bowmani*) and cypridinids (particularly *Doloria* sp. TS) each make a smaller contribution to guild numbers.

In the 50 m guild cirolanids (particularly *Natatolana kahiba*) dominate guild biomass. A diogenid hermit crab, *Strigopagurus strigimanus*, is a conspicuous contributor to guild biomass at this depth. Cypridinds (particularly *Lowrya* sp. WDC) make up the majority of the remainder of the biomass. In the 100 m guild cirolanids (particularly *Natatolana wowine*) continue to dominate biomass. Lysianassoids (particularly *Stephonyx pirloti*) make a significant contribution and cypridinids (particularly *Vargula karamu*) make a smaller, but significant contribution at this depth. At 200 m depth cirolanids strongly dominate guild biomass, particularly *Booralana* *bathynella*, *Natatolana matong* and *N. nammuldi*. *Strigopagurus strigimanus* is still a conspicuous, though less important contributor to biomass. At 300 m depth the same cirolanids (*Natatolana nammuldi*, *N. matong* and *Booralana bathynella*) in different proportions dominate biomass. *Tryphosella* sp. 168/182 makes a significant contribution to biomass as does the goneplacid crab *Carcinoplax meridionalis*. In the 400 m guild there is a major shift in biomass dominance. One lysianassoid, *Tryphosella* sp. 168/182 , dominates guild biomass. *Natatolana nammuldi* and *Booralana bathynella* continue to make an important contribution as does the deep water cypridinid *Vargula* sp. T8.

Discussion

In eastern Australia species richness of scavenging guilds is higher than in other places studied. Species richness follows a similar pattern along the eastern Australian continental shelf and slope. It is highest (20 to 25 species) between 50 and 100 m depth, usually slightly lower at 200 m depth (15 to 20 species), lowest (5 to 15 species) at 300 to 400 m depth and usually slightly higher (10 to 15 species) at 1000 m depth. The increase in species richness in shallower depths is mainly due to the cypridinid ostracod component of the guild structure. These animals are most diverse between 50 and 200 m depth and decrease dramatically below 200 m depth. In deeper water lysianassoids are usually more diverse, but they never match the richness of cypridinids in shallower water.

Scavenging guilds have not been studied for the majority of the world's oceans. Studies that have been done have had different aims, different sampling methods and as a result different biases. The following discussion attempts, from what we know at the moment, to place the eastern Australian guild system into the world picture.

In Antarctic and subantarctic waters most studies report less than six species of scavengers. Bellan-Santini & Ledoyer (1987) reported three species from Marion Island. In the New Zealand subantarctic only four species are known (Lowry & Stoddart, 1983; Fenwick, 1978). There are five species known from the South Shetlands (K.H. Barnard, 1932; Jazdzewski, 1981; Arnaud *et al*., 1986). In McMurdo Sound, Slattery & Oliver (1986) sampled extensively and reported only six species. Together, there are less than 15 species of scavengers driving the whole Antarctic/subantarctic scavenging system.

The eastern North Atlantic deep sea has been well studied. There are currently about 16 scavengers known from the entire area (eg. Chevreux, 1935; Desbruyères *et al*., 1985; Thurston, 1979; 1990) and all of these are lysianassoid amphipods. *Abyssorchomene* has three species; *Hirondellea*, *Paralicella* and *Valettietta* each have two species; and *Alicella*, *Eurythenes*, *Orchomenopsis*, *Paracallisoma*, *Stephonyx*, *Tmetonyx*, and *Valettiopsis* are all represented by one species.

The known scavengers from North Polar Seas are eight genera and twenty species of lysianassoid amphipods. The most diverse and widespread genus is *Onesimus* with five species; *Anonyx* has four species; *Orchomenella* has four species; *Tryphosella* has two; and *Menigrates*, *Tmetonyx* and *Socarnes* each have one. *Anonyx nugax* and *Onesimus edwardsi* are the most frequently reported scavengers. *Onesimus littoralis* and *Orchomenella minuta* are only slightly less frequently reported. *Onesimus brevicaudatus* and *O. nanseni* appear to be important scavengers in the high Arctic.

The only known system with possibly comparable species richness is in the French Antilles. Poupin (1994) reported 107 species of scavengers from 100 to 1000 m depth in the French Antilles, of which 75% were crustaceans and most were decapods. The aims and methods of his study were different to this study and it is difficult to compare species from different sites and depths. But it is interesting that the composition and structure of these scavenging guilds is completely different from similar depths in eastern Australia. However, Poupin did not use small traps inside of his larger traps and so the smaller scavengers, if present, were not captured.

The guilds on the shelf and slope, but not the bathyal plain, of eastern Australia all appear to be part of the same superguild. They belong to the most complex guild system yet described and appear to be completely different to any other system currently known. This system like all others described, except for the Caribbean system described by Poupin (1994), contained a diverse lysianassoid component. Known shallow water genera such as *Aroui*, *Ichnopus*, *Schisturella* and *Tryphosella* plus others such as *Nagada*, *Rhinolabia* and *Waldeckia* are widespread and common among the guilds on the continental shelf and slope. In the deep sea, genera such as *Abyssorchomene, Eurythenes*, *Hirondellea*, *Paralicella Stephonyx* and *Valettiopsis*, which characterise the well known North Atlantic and North Pacific guilds, are all present. What makes the eastern Australian guild system different is the large diversity of cypridinid ostracods and cirolanid isopods. Seventeen genera of cypridinids and nearly 90 species, not recorded as scavengers anywhere else, particularly dominate shallow water guilds along the entire coast. Six genera and 51 species of cirolanid isopods are widespread and common at all depths in this system. Keable & Bruce (1997) have shown that one genus, *Natatolana* (particularly *N. borealis*), occurs in the North Atlantic and Mediterranean, but its species diversity does not compare. The cypridinid and cirolanid components of the eastern Australian guild system add a remarkable layer of complexity not reported anywhere else in the world.

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Shane Ahyong identified the decapod crustaceans; Stephen Keable initially identified the cirolanid isopods and developed identification guides; Ian Loch identified the molluscs; Anna Murray identified the polychaetes; Dave McKinnon identified the copepods; Andrew Parker initially identified the cypridinid and cylindroleberid ostracods and developed identification guides; Helen Stoddart initially identified the lysianassoid and stegocephalid amphipods and developed identification guides; and Genefor Walker-Smith initially identified the nebaliid leptostracans and developed identification guides. The majority of the species (67%) in this project were undescribed. Without the help of the above experts in working out these species and then preparing identification guides, the project could never have succeeded.

Kate Dempsey, Rachael Peart and Greg Towner sorted and identified all species, Mila Sajinovic assited with sorting and Keyne Monro, collection management for the project, made all biomass measurements. The huge task of sorting and identifying more than 280 species and about 800,000 specimens and then weighing each lot is an remarkable achievement which has added a depth to this study not usually seen.

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Appendix: Species list

Amphipoda

Alicellids (Lysianassoidea)
Paralicella nsp 181

Amaryllididae (Lysianassoidea)
Amaryllis sp

Eurytheneids (Lysianassoidea)
Eurythenes gryllus (Lichtenstein, 1822)
Eurythenes n.sp. Stoddart & Lowry (in press)

Endevouridae (Lysianassoidea)
Endevoura sp 66 Lowry & Stoddart (in prep.)

Eusiridae
Membrilopus sp Lowry & Springthorpe (in prep.)

Hirondelleid (Lysianassoidea)
Hirondellea sp 29a Lowry & Stoddart (in prep.)

Lysianassidae (Lysianassoidea)
Tryphosinae
Hippomedon rodericki Moore, 1989
Hippomedon sp 171 Lowry & Stoddart (in prep.)
Rhinolabia elliotti Lowry & Stoddart, 1995
Rhinolabia jebbi Lowry & Stoddart, 1995
Rhinolabia sp 102 Lowry & Stoddart (in prep.)
Schisturella sp 33 Lowry & Stoddart (in prep.)
Tryphosella camela (Stebbing, 1910)
Tryphosella cf *camela* Lowry & Stoddart (in prep.)
Tryphosella sp 91 Lowry & Stoddart (in prep.)
Tryphosella sp ?91 Lowry & Stoddart (in prep.)
Tryphosella sp 128 Lowry & Stoddart (in prep.)
Tryphosella sp 135 Lowry & Stoddart (in prep.)
Tryphosella sp 146 Lowry & Stoddart (in prep.)
Tryphosella sp 168/182 Lowry & Stoddart (in prep.)
Tryphosella sp 183 Lowry & Stoddart (in prep.)
Tryphosella sp 188 Lowry & Stoddart (in prep.)
Tryphosella sp 368 Lowry & Stoddart (in prep.)
Tryphosella sp 482 Lowry & Stoddart (in prep.)
Tryphosella sp 483 Lowry & Stoddart (in prep.)
Tryphosella sp 485 Lowry & Stoddart (in prep.)
Tryphosella sp 486 Lowry & Stoddart (in prep.)
Tryphosoides adentatus (Moore, 1989)
Tryphosoides sp 190 Lowry & Stoddart (in prep.)
Waldeckia sp 68b Lowry & Stoddart (in prep.)
Waldeckia sp 68d Lowry & Stoddart (in prep.)

Uristidae (Lysianassoidea)
Abyssorchomene gerulicorbis (Shulenberger & Barnard, 1976)
Aristiopsis sp 28 Lowry & Stoddart (in prep.)
Gippsia jonesae Lowry & Stoddart, 1995
Ichnopus cribensis Lowry & Stoddart, 1992
Ichnopus tenuicornis (Haswell, 1879)
Ichnopus sp 20
Koroga megalops Holmes, 1909
Nagada uwedoae Lowry & Stoddart, 1995
Paracentromedon sp 61 Lowry & Stoddart (in prep.)
Parschisturella sp 26 Lowry & Stoddart (in prep.)
Parschisturella sp 47/159 Lowry & Stoddart (in prep.)
Pseudotryphosa sp 45 Lowry & Stoddart (in prep.)
Stephonyx pirloti (Sheard, 1938)
Stephonyx sp 63 Lowry & Stoddart (in prep.)
Stephonyx sp 177 Lowry & Stoddart (in prep.)
ngen nsp 479 Lowry & Stoddart (in prep.)

Opisidae (Lysianassoidea)
Podoprionella sp 186

Scopelocheiridae (Lysianassoidea)
Aroui hamatopodus Lowry & Stoddart, 1989
Paracallisoma sp 178 Lowry & Stoddart (in prep.)
Paracallisoma sp 179 Lowry & Stoddart (in prep.)

Stegocephalidae Dana, 1852
Andaniexis andaniexis Berge & Vader, 2003
Andaniotes wollongong Berge, 2001
Andaniotes abyssorum (Stebbing, 1888)
Andaniotes lowryi Berge, 2001
Gloradaniotes traudlae Berge & Vader, 2003
Parandania boecki (Stebbing, 1888)
Stegocephaloides ingstadi Berge & Vader, 2003
Stegocephaloides tucki Berge & Vader, 2003

Valettiopsids
Valettiopsis sp 146
Valettiopsis sp 184

Copepoda

Tharybidae
Tharybis sp 1
Tharybis sp 2

These are the main species in the collection, but others have not yet been identified.

Decapoda

Cancridae
Metacarcinus novaezealandiae (Jacquinot, 1853)

Diogenidae
Dardanus sp 1
Dardanus sp 2
Strigopagurus strigimanus (White, 1897)

Galatheidae
Munida haswelli Henderson, 1885

Geryonidae

Chaceon bicolor Manning & Holthuis, 1989

Goneplacidae
Carcinoplax meridionalis Rathbun, 1923

Hippolytidae
Merhippolyte chacei Kensley, Griffin & Tranter, 1987

Leucosiidae
Merocryptus lambriformis A. Milne Edwards, 1873

Majidae
Hyastenus sp
Leptomithrax sp

Paguridae
Pagurus nana Henderson, 1888
Pagurid sp

Pandalidae
Heterocarpus sibogae de Man, 1917
Plesionika edwardsi (Brandt, 1851)
Plesionika ocellus (Bate, 1888)
Plesionika spinipes Bate, 1888

Parapaguridae
Sympagurus papposus Lemaitre, 1996

Portunidae
Charybdis bimaculata (Miers, 1886)
Charybdis granulata (de Haan, 1833)
Charybdis miles (de Haan, 1833)
Charybdis natator (herbst, 1879)
Thalamita danae Stimpson, 1858

Xanthidae
Actaea sp
Pseudoliomera helleri A. Milne Edwards, 1865

Isopoda

Cirolanidae
Aatolana rapax Bruce, 1993
Aatolana springthorpei Keable, 1998
Bathynomus immanis Bruce, 1986
Bathynomus kapala Griffin, 1975
Bathynomus pelor Bruce, 1986
Bathynomus sp 1 Lowry & Dempsey (in prep.)
Bathynomus sp 2 Lowry & Dempsey (in prep.)
Bathynomus sp 3 Lowry & Dempsey (in prep.)
Booralana bathynella (Bruce, 1981)
Booralana sp 1 Bruce & Olesen (in prep.)
Cirolana arafura Bruce, 1986
Cirolana australiense Hale, 1925
Cirolana capricornica Bruce, 1986
Cirolana curtensis Bruce, 1986
Cirolana halei Bruce, 1981
Cirolana kendi Bruce, 1986
Cirolana similis Bruce, 1981
Cirolana tumulosa (Holdich, Harrison & Bruce, 1981)
Cirolana sp 3 Keable (in press)
Cirolana sp 4 Keable (in press)
Cirolana sp 9
Natatolana amplocula Bruce, 1986
Natatolana arcicauda (Holdich, Harrison & Bruce, 1981)
Natatolana arrama Bruce, 1986
Natatolana bowmani Bruce, 1986
Natatolana bulba Bruce, 1986
Natatolana galathea Bruce, 1986
Natatolana gorung Bruce, 1986
Natatolana kahiba Bruce, 1986
Natatolana laewilla Bruce, 1986
Natatolana matong Bruce, 1986
Natatolana nammuldi Bruce, 1986
Natatolana pellucida (Tattersall, 1921)
Natatolana tenuistylis (Miers, 1884)
Natatolana thalme Bruce, 1986
Natatolana thurar Bruce, 1986
Natatolana valida (Hale, 1940)
Natatolana variguberna (Holdich, Harrison & Bruce, 1981)
Natatolana vieta (Hale, 1925)
Natatolana wowine Bruce, 1986
Natatolana nsp 1 Keable (in prep.)
Natatolana nsp 9 Keable (in prep.)
Natatolana nsp 10
Natatolana nsp 36
Natatolana nsp 37
Natatolana nsp 39
Natatolana nsp 42
Natatolana nsp 46
Plakolana binyana Bruce, 1991
Plakolana acuta Keable, 1999
Plakolana obtusa Keable, 1999

Leptostraca

Nebaliidae
Nebalia nsp A Walker-Smith (in prep.)
Nebalia nsp B Walker-Smith (in prep.)
Nebalia nsp C Walker-Smith (in prep.)
Nebalia nsp D Walker-Smith (in prep.)
Nebalia nsp E Walker-Smith (in prep.)
Nebalia nsp F Walker-Smith (in prep.)

Ostracoda

Cylindroleberidae
Cylindroleberid sp FE
Cylindroleberid sp G
Cylindroleberid sp GL
Cylindroleberid sp MB
Cylindroleberid sp MS
Cylindroleberid sp NL
Cylindroleberid sp NLL
Cylindroleberid sp NS

Cylindroleberid sp NS1
Cylindroleberid sp NVL
Cylindroleberid sp TO
Cylindroleberid sp x
Cylindroleberid sp 1
Cylindroleberid sp 2

Cypridinidae
Heterodesmus sp G Parker & Lowry (in prep.)
Azygocypridina sp G
Azygocypridina lowryi Kornicker, 1985
Bathyvargula sp T Parker & Lowry (in prep.)
Cycloleberis sp CHP Parker & Lowry (in prep.)
Cypridinodes asymmetricai (Müller, 1906)
Cypridinodes favus Brady, 1902
Cypridinodes galatheae Poulsen, 1962
Cypridinodes wyvillethomsoni (Brady, 1880)
Cypridinodes sp CH Parker & Lowry (in prep.)
Cypridinodes sp CRE Parker & Lowry (in prep.)
Cypridinodes sp DC Parker & Lowry (in prep.)
Cypridinodes sp GS Parker & Lowry (in prep.)
Cypridinodes sp L Parker & Lowry (in prep.)
Cypridinodes sp MA1 Parker & Lowry (in prep.)
Cypridinodes sp MCL Parker & Lowry (in prep.)
Cypridinodes sp MLS Parker & Lowry (in prep.)
Cypridinodes sp MNL Parker & Lowry (in prep.)
Cypridinodes sp N Parker & Lowry (in prep.)
Cypridinodes sp TX Parker & Lowry (in prep.)
Cypridinodes sp WD Parker & Lowry (in prep.)
Cypridinodes sp WR Parker & Lowry (in prep.)
Cypridinodes sp WRD Parker & Lowry (in prep.)
Doloria sp A Parker & Lowry (in prep.)
Doloria sp T Parker & Lowry (in prep.)
Doloria sp TS Parker & Lowry (in prep.)
Lowrya kornickeri Parker, 1998
Lowrya taiti Parker, 1998
Lowrya sp NLM Parker & Lowry (in prep.)
Lowrya sp CRT Parker & Lowry (in prep.)
Lowrya sp CS Parker & Lowry (in prep.)
Lowrya sp MDE Parker & Lowry (in prep.)
Lowrya sp T Parker & Lowry (in prep.)
Lowrya sp WDC Parker & Lowry (in prep.)
Metavargula sp CCT Parker & Lowry (in prep.)
Metavargula sp DS Parker & Lowry (in prep.)
Metavargula sp MLS Parker & Lowry (in prep.)
Metavargula sp NM1 Parker & Lowry (in prep.)
Metavargula sp NM2 Parker & Lowry (in prep.)
Metavargula spadix Kornicker, 1996
Newgenus III sp L Parker & Lowry (in prep.)
Newgenus III sp S Parker & Lowry (in prep.)
Newgenus III sp ? Parker & Lowry (in prep.)
Newgenus IV sp GLR Parker & Lowry (in prep.)
Newgenus IV sp MFC Parker & Lowry (in prep.)
Newgenus IV sp RR Parker & Lowry (in prep.)
Newgenus VT sp GNE Parker & Lowry (in prep.)
Newgenus VT sp WD Parker & Lowry (in prep.)
Paradoloria sp CR Parker & Lowry (in prep.)
Paradoloria sp FC Parker & Lowry (in prep.)
Paradoloria sp GHF Parker & Lowry (in prep.)
Paradoloria sp GLF Parker & Lowry (in prep.)
Paravargula sp W Parker & Lowry (in prep.)
Pterocypridina appendix Kornicker, 1996
Pterocypridina tressleri Kornicker, 1996
Pterocypridina sp CPP Parker & Lowry (in prep.)
Pterocypridina sp LW Parker & Lowry (in prep.)
Pterocypridina sp NP2 Parker & Lowry (in prep.)
Pterocypridina sp NP3 Parker & Lowry (in prep.)
Pterocypridina sp PNW Parker & Lowry (in prep.)
Pterocypridina sp VB Parker & Lowry (in prep.)
Siphonostra sp CB Parker & Lowry (in prep.)
Siphonostra sp LM Parker & Lowry (in prep.)
Siphonostra sp W Parker & Lowry (in prep.)
Skogsbergia tenax Kornicker, 1996
? *Skogsbergia* sp CHP Parker & Lowry (in prep.)
Skogsbergia sp CR Parker & Lowry (in prep.)
Skogsbergia sp GRP Parker & Lowry (in prep.)
Skogsbergia sp WS Parker & Lowry (in prep.)
Vargula dentata Kornicker, 1975
Vargula fugax Kornicker, 1994
Vargula tubulata Poulsen, 1962
Vargula karamu Parker, 1998
Vargula psydrax Kornicker, 1994
Vargula puppis Poulsen, 1962
Vargula stranx Kornicker, 1994
Vargula trifax Kornicker, 1994
Vargula sp CD Parker & Lowry (in prep.)
Vargula sp CH Parker & Lowry (in prep.)
Vargula sp CS Parker & Lowry (in prep.)
Vargula sp DR Parker & Lowry (in prep.)
Vargula sp MRE Parker & Lowry (in prep.)
Vargula sp NEC Parker & Lowry (in prep.)
Vargula sp T4 Parker & Lowry (in prep.)
Vargula sp T6 Parker & Lowry (in prep.)
Vargula sp T7 Parker & Lowry (in prep.)
Vargula sp T8 Parker & Lowry (in prep.)
Vargula sp TB = NVS Parker & Lowry (in prep.)
Vargula sp ? Parker & Lowry (in prep.)

Polychaeta

Amphinomidae
Chloeia sp

Aphroditidae
Laetmonice cf. *producta* Grube, 1879

Chrysopetalidae
Chrysopetalum sp

Eunicidae
Eunice vittata (delle Chiaje, 1828)

Goniadidae
Goniada sp

Hesionidae
?*Ophiodromus* sp

Lumbrineridae
Lumbrineris sp

Nephtyidae
Micronephthys sp

Nephthys ?paradoxa Malm, 1874

Nereididae
Neanthes cricognatha (Ehlers, 1904)

Phyllodocidae
Phyllodoce madeirensis Langerhans, 1879

Polynoidae
?*Adyte* sp
Harmothoe sp
Lepidonotus carinulatus Grube, 1870

Sphaerodoridae
Sphaerodoropsis sp

Syllidae
Exogone sp
Pionosyllis sp
Sphaerosyllis ?lateropapillata Hartmann-Schroeder, 1986
Sphaerosyllis magnoculata Hartmann-Schroeder, 1986

Mollusca

Buccinidae
Nassaria problematica (Iredale, 1936)
Nassaria cf. *pusilla* Röding, 1798
Nassarius celebensis (Schepman, 1907)
Nassarius dijki (Martin, 1895)
Nassarius ephamillus (Watson, 1882)
Nassarius nigellus (Reeve, 1854)
Nassarius sp

Columbellidae
Aesopus plurisulcatus (Reeve, 1859)
Pyreneola abyssicola (Brazier, 1877)

Marginellidae
Alaginella sp
Persicula sp

Rissoidae
Rissoid sp

Ranellidae
Sassia apennicia remensa Iredale, 1936
Sassia ponderi Beu, 1987

Turridae
Turrid sp