Benthic Invertebrate Composition and Characterization of the South Orkney Islands

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Abstract The epi-benthic megafaunal invertebrate community density and composition of the South Orkney Islands was sampled during Leg II of the 2008/09 AMLR Survey and analyzed to the level of phyla. The benthic invertebrate megafaunal component of 75 bottom trawls completed around the South Orkney Islands, and an additional three off the Antarctic Peninsula, was analyzed by weight and by sorting into 61 operational taxonomic units (OTUs), including the 18 provisionally recognized by CCAMLR as indicators of the presence of a Vulnerable Marine Ecosystem (VME). The results from this year's survey include:

- Around the South Orkney Islands, total megafaunal invertebrate densities show a geographic pattern whereby the highest densities are clustered at the western and eastern tips of the island chain, while benthic community densities decrease toward the outer limits of the shelf.
- Densities of the VME indicator taxon (VME-IT) Porifera in general follow the same pattern as the total benthic community, while densities of Other VME-IT are greatest along the northern shelf.
- On the western shelf, Porifera dominate the community composition in the region closest to Coronation Island while on the outer limits of the shelf the benthos is dominated by Echinoderms.
- Large assemblages of tunicates (Chordata) are often found near narrow sections of shelf between islands that presumably experience higher currents and water flow than broader regions of the shelf.
- Well-established sponge communities dominate the benthos closest to Laurie Island on the eastern shelf, which give way to communities dominated by Pterobranchia and Echinodermata at the eastern most shelf limits and to the south and southeast of the South Orkney Islands.
- The southern shelf of the South Orkney Islands supports benthic communities mostly dominated by Echinodermata.
- Additional oceanographic factors in further analyses are required to explain the geographic patterns in density and composition described herein.
- Of the 18 provisionally recognized VME-IT, 15 were encountered during the course of this expedition.

Introduction

Benthic invertebrate catch composition and habitat characterization was conducted concurrent with the bottom trawl survey and demersal finfish research (Chapter 9). In order to better understand the Antarctic finfish ecosystem and the relationships of its components it is vital to conjointly investigate the characteristics of the benthic invertebrate communities with which these fish are associated. Moreover, the relevance and value of benthic community research has been elevated, and the need to identify, define and designate Vulnerable Marine Ecosystems (VME) has been recognized by the Commision for the Conservations of Antarctic Marine Living Resources, or CCAMLR (CM 22-06 and 22-07) and the United Nations General Assembly (RES. 61/105) with the aim of minimizing risk to VMEs, and ultimately the successful monitoring and sustainable management of the Antarctic ecosystem and its resources.

With this intent, the objectives for Leg II included composition analysis (identification and quantification) of the benthic invertebrate component of bottom trawl catches in order to characterize the seafloor habitats encountered with intent to gather data necessary for VME identification and designation and work toward the benthic bioregionalization of the area. In addition, extensive sampling of the benthic invertebrate species encountered was conducted by the current authors for their own continued research and also on behalf of other specialists in the U.S. and around the world with the aim of augmenting current, inadequate, knowledge of the region's biodiversity.

Methods

Bottom trawling was conducted primarily along the South Orkney Islands shelf. Seventy successful hauls were accomplished at shelf depths between

Table 10.1. Operational taxonomic units (OTUs) utilized in the characterization of the benthic invertebrate component of the bottom trawl catch. ✓ denotes those currently classified by CCAMLR as indicator taxa of vulnerable marine ecosystems (VME-IT). NB: The genera *Flabellum* and *Gorganocephalus* are not treated as separate VME-IT by Parker et al. (2008), but are instead included under the high taxonomic ranks of Scleractinia and Pharynophiurida, respectively. Likewise, bryozoans and ascideans (each separated herein into two groups: filamentous/foliose and hard/reef building; and solitary and compound, respectively) are each treated as one VME-IT by Parker et al. (2008). † denotes OTUs not encountered during the course of the current field season. *Harpovoluta weights, including symbiotic anemone, were attributed to Mollusca except in the few cases where anemones were detached and easily included within Actiniaria.

Phylum	Taxon	Genus or Common Name	VME-IT	CCAMLR Code
Porifera (PFR)	Hexactinellida	Glass Sponge	✓	PFR
Porifera	Demospongiae	Siliceous/Demo Sponge	✓	PFR
Cnidaria (CNI)	Hydrozoa	Hydroid	✓	CNI
Cnidaria	Hydrozoa/Stylasterida	Hydrocoral	✓	CNI
Cnidaria	Anthozoa/Actiniaria	Anemone	✓	ATX
Cnidaria	Anthozoa/Alcyonacea	Soft Coral	✓	AJH
Cnidaria	Anthozoa/Scleractinia	Stony Coral (Miscellaneous)	✓	CSS
Cnidaria	Anthozoa/Scleractinia	*Flabellum*	✓	CSS
Cnidaria	Anthozoa/Pennatulacea	Sea Pen	✓	CNI
Cnidaria	Anthozoa/Antipatharia	Black Coral†	✓	AQZ
Cnidaria	Gorgonacea/Isididae	Bamboo Coral	✓	GGW
Cnidaria	Gorgonacea/Coralliidae	Red/Precious Coral†	✓	GGW
Cnidaria	Gorgonacea/Primnoidae	Bottle Brush, Sea Fan/Whip	✓	GGW
Cnidaria	Gorgonacea/Paragorgiidae	Bubblegum Coral	✓	GGW
Cnidaria	Gorgonacea/Chrysogorgiidae	Golden Coral	✓	GGW
Brachiopoda		Lamp Shell		BRC
Bryozoa		Filamentous/Foliose	✓	-
Bryozoa		Hard/Reef Building	✓	-
Platyhelminthes		Flat Worm†		-
Nemertina		Ribbon Worm		-
Cephalorhyncha	Priapulida	Penis Worm		-
Mollusca (MOL)	Aplacophora	Aplacophoran		-
Mollusca	Polyplacophora	Chiton		-
Mollusca	Gastropoda	Sea Snails (Miscellaneous)		GAS
Mollusca (Cnidaria)	Gastropoda-Actiniaria	*Harpovoluta* (with obligate symbiotic anemone) *		GAS
Mollusca	Gastropod/Lamellaria	Lamellarian		GAS
Mollusca	Gastropoda/Opisthobranchia	Sea Slugs (Miscellaneous)		GAS
Mollusca	Gastropoda/Opisthobranchia	*Bathyberthella*		GAS
Mollusca	Scaphopoda	Tusk Shell		-
Mollusca	Bivalvia	Clam Shell		CLX
Mollusca	Cephalopoda/Octopodiformes	Octopus		OCT
Mollusca	Cephalopoda/Decapodiformes	Squid		SQQ
Sipuncula		Peanut Worm		-
Annelida	Echiura	Spoon Worm		-
Annelida	Polychaeta	Bristle Worm (Miscellaneous)		WOR
Annelida	Polychaeta/Aphroditidae	Sea Mouse		WOR
Arthropoda	Pycnogonida	Sea Spider		PWJ
Arthropoda	Cirripedia	Barnacle		-
Arthropoda	Amphipoda	Sand Hopper		AQM
Arthropoda	Isopoda	Sea Slater (Miscellaneous)		ISH
Arthropoda	Isopoda/Serolidae	Serolid		ISH
Arthropoda	Isopoda/Chaetiliidae	*Glyptonotus*		ISH
Arthropoda	Decapoda	Shrimp, Prawn		DCP
Echinodermata (ECH)	Crinoidea (Stalked)	Sea Lily †	✓	CWD
Echinodermata	Crinoidea/Comatulida	Feather Star (Miscellaneous)		CWD
Echinodermata	Crinoidea/Comatulida	*Promachocrinus*		CWD
Echinodermata	Asteroidea	Sea Star (Miscellaneous)		STF
Echinodermata	Asteroidea/Forcipuladitda	*Labidiaster*		STF
Echinodermata	Ophiuroidea	Brittle Star (Miscellaneous)		OWP
Echinodermata	Ophiuroidea/Ophiuridae	*Ophionotus*		OWP
Echinodermata	Ophiuroidea/Pharynophiurida	Snake Star, Basket Star (Miscellaneous)	✓	OWP
Echinodermata	Ophiuroidea/Pharynophiurida	*Gorganocephalus*†	✓	OWP
Echinodermata	Holothuroidea	Sea Cucumber (Miscellaneous)		CUX
Echinodermata	Holothuroidea/Aspidochirotida	*Bathyplotes*		CUX
Echinodermata	Holothuroidea/Psolidae	Psolid Cucumber		CUX
Echinodermata	Echinoidea/Cidaroida	Pencil Spine Sea Urchin		URX
Echinodermata	Echinoidea/Echinidae	*Sterechinus*		URX
Echinodermata	Echinoidea/Spatangoida	Irregular Sea Urchin		URX
Hemichordata	Pterobranchia	Pterobranchs		-
Chordata	Tunicata/Ascidiacea	Solitary Tunicate/Sea Squirt	✓	SSX
Chordata	Tunicata/Ascidiacea	Compound Ascidian	✓	SSX

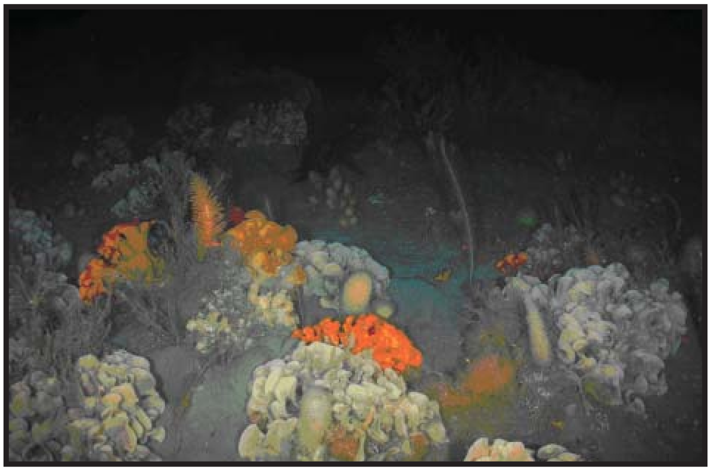

Figure 10.1. A number of different hard bryozoan species can form reef-like structures as complex as coral reefs in tropical waters. This particular example is located at station 63 (mean depth: 142 m) south of Inaccessible Islands, South Orkney Islands.

63-497 m (mean trawl depth). Five more hauls were completed at slope depths around the South Orkney Islands (mean trawl depth range: 629-798 m) and an additional three slope hauls were taken off the Antarctic Peninsula (mean trawl depth range: 623-759 m). Specifics on trawling activities and techniques are described in Chapter 9 of this report, which includes details of each haul (Table 9.1) and a map illustrating station locations (Chapter 9, Figure 9.1).

Once the trawl catch was secured on deck it was shoveled into fish baskets and moved to the sorting tables. For catches that required sub-sampling, the fish were separated on the back deck and for those that did not the fish were usually separated from the benthos on the sorting tables. At a few locations the biomass of the hauls was so great that only a portion of the invertebrate component could feasibly be put into baskets for weighing. In these cases up to 20 baskets of invertebrates were moved to the sorting area for weighing, while any additional baskets were counted and discarded. In this way, an average weight per basket could be calculated for extrapolation. In cases where it was not feasible to sort all baskets of benthic invertebrates that made it to the sorting area, a subsample was randomly chosen (minimum 6 baskets) and the remainder weighed.

Density of megafaunal invertebrates by sampling station was standardized by prorating nominal pooled catch of the station's swept area to one square nautical mile (nmi^2). The area of seabed sampled at each station was determined by GPS latitude/longitude coordinates, taken at the start and the end of bottom trawling (seabed contact), and the average trawl mouth width during this time. Calculations of total benthic invertebrate density excluded only inorganic matter, pelagics and algae. VME-Indicator Taxa (VME-IT; Table 10.1) biomass data were separated into two categories - Porifera and Other VME-IT – to avoid the density of the latter from being swamped by the significantly heavier sponges.

The benthic invertebrate catch was compositionally analyzed by sorting into 61 feasible taxonomic groupings, or operational taxonomic units (OTUs) (Table 10.1). This number of OTUs represents a significant increase in complexity and resolution since the 2006 survey (44 OTUs) in order to incorporate those taxa recently put forward by CCAMLR as taxonomic indicators of VMEs (Parker et al., 2008). As per current opinion, echiurans are not treated as a distinct phylum, but rather are included within Annelida (Rousset et al., 2007). The phylum Bryozoa was divided into two functional groupings: those that do and those that do not form reef-like structures utilized by other organisms. That hard bryozoans can be reef-forming is well illustrated in Figure 10.1. Thus, the bryozoans were split into: a) filamentous or foliose forms and; b) hard or reef-building forms. Likewise, the class Tunicata was split into: a) solitary forms and; b) colonial forms. The VME-IT Ascidiacea is a class-level taxon (CCAMLR Code, SSX) of the subphylum Tunicata rather than Urochordata, which is no longer recognized as a distinct phylum from Chordata (World Register of Marine Species (WoRMS); www.marinespecies.org). The *On-deck classification guide for potentially vulnerable invertebrate taxa in the Ross Sea long-line fishery* (Parker et al., 2008) includes the order Euryalinida (phylum: Echinodermata) which, according to the WoRMS (www.marinespecies.org), is no longer a valid taxon; the appropriate order is Pharynophiurida. Whether this designated VME-IT should be further refined to the family level - that which encompasses the three species depicted on the *On-deck Classification guide* (Parker et al., 2008), i.e. Gorgonocephalidae, - remains to be determined.

Weights of each OTU were recorded and individuals counted where appropriate. Any dead or non-sortable organic matter was also weighed and, for the latter, characterized (e.g. 60% demosponge, 30% irregular echinoid fragments, 10% organic matter). Algae were also weighed and recorded, but the data is not presented here. Incidentally caught pelagic invertebrates such as jellyfish and salps (excluding decapods and squid) and inorganic matter were weighed only in the cases where subsampling was necessary. When excessive biomass prevented complete analysis of a haul, weighed baskets of benthos were numbered and a subset (maximum feasible) randomly chosen for characterization.

For the purpose of meso-scale comparisons of benthic invertebrate composition between stations, weights were pooled within each phylum to calculate the proportion each contributed to the total. These calculations excluded the dead non-characterizable portion of the non-sortable organic matter as described above, as well as inorganic matter, pelagics and algae. In past field seasons, stations within the same stratum and in close vicinity were pooled and averaged for visual simplicity. However, with the current focus on VMEs, and how CCAMLR is to define and designate them, it was deemed essential to treat each station separately so that an idea of the size of various benthic ecosystem types could be gained.

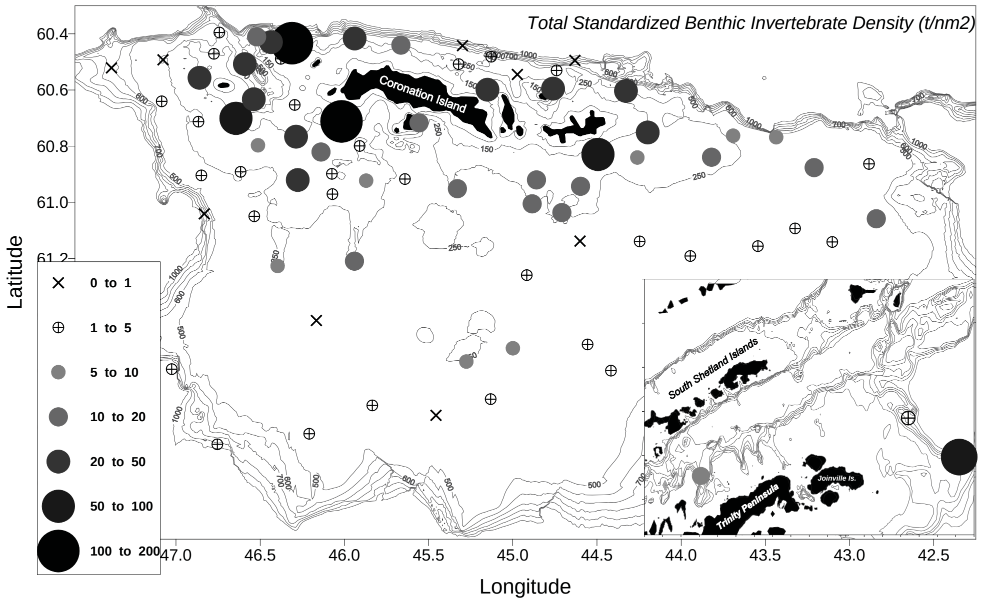

Figure 10.2. Total standardized benthic invertebrate density (t/nmi^2) at each station sampled during the 2009 bottom trawl finfish survey of the South Orkney Islands and the Antarctic Peninsula (inset).

Results

The distributional density of benthic fauna in the South Orkney Islands is illustrated in Figure 10.2. The invertebrate community with the greatest density encountered at the South Orkney Islands, just over 183 t/nmi^2, was at station 82 off the southwest tip of Coronation Island, at a mean depth of 96 m. In contrast, no benthic invertebrates were collected at Station 87, at a mean depth of 657 m, at the far western edge of the shelf. Even though a relationship between density and depth generally exists (Lockhart and Jones, 2006), the fact that no fish were caught may indicate a failed haul. Station 32, south of Laurie Island, yielded the next lowest benthic invertebrate density, 0.36 t/nmi^2, at a mean depth of 314 m. At the Antarctic Peninsula, stations 103 and 104

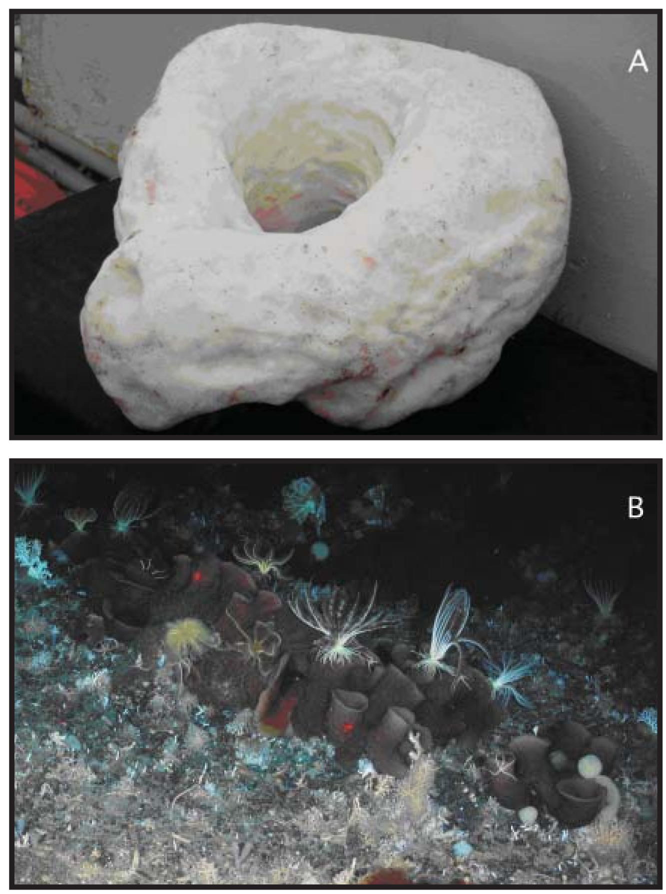

Figure 10.3. Two unidentified hexactinellid sponge species collected at station 101 east of Joinville Island (mean depth 623 m). A) a trumpet-lipped glass sponge approx. 1 m in diameter. B) a brown glass sponge that did not retain its form in the trawl. N.B. Distance between red laser dots is 50 cm.

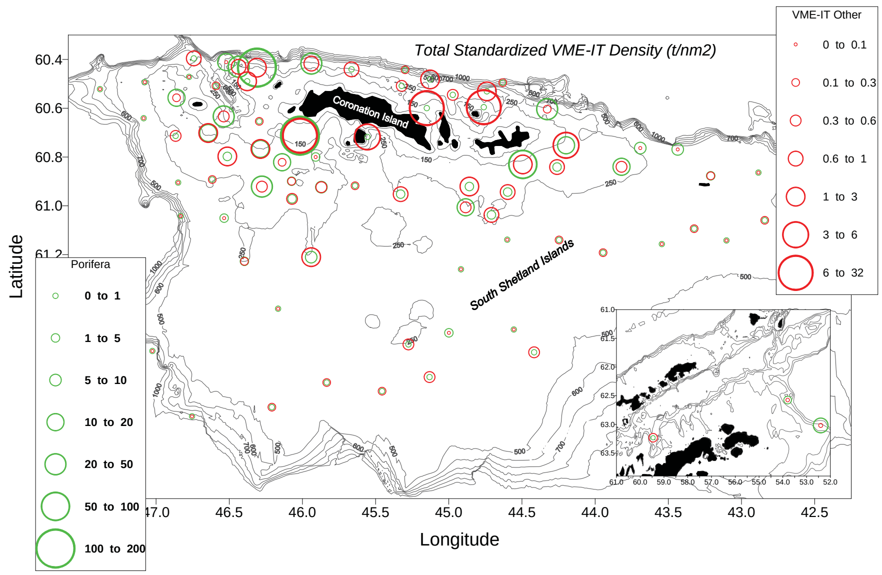

Figure 10.4. Standardized VME-IT densities (t/nmi²). Green – Porifera. Red – other VME-IT (refer to Table 10.1 for a list of taxa). Note the differing scales.

(mean depth: 731 m and 759 m respectively) had a relatively low community density, following the depth trend apparent during the 2006 survey of that region (Lockhart & Jones, 2006). However, an interesting outlier to the rule was uncovered at a mean depth of 623 m east of Joinville Island (station 101). Although demosponges make up most of the almost 84 t/nmi² of invertebrate density found at this station, hexactinellid sponges also contribute significantly and included two unidentified species never before encountered by the authors: an impressive trumpet-lipped species (Figure 10.3A) and a beautiful, at least *in situ*, brown species (Figure

Figure 10.5. Sea pen (VME-IT), *Umbellula sp.* (Cnidaria: Pennatulacea), collected from station 13 (mean depth: 350 m) north of Powell Island, South Orkney Islands.

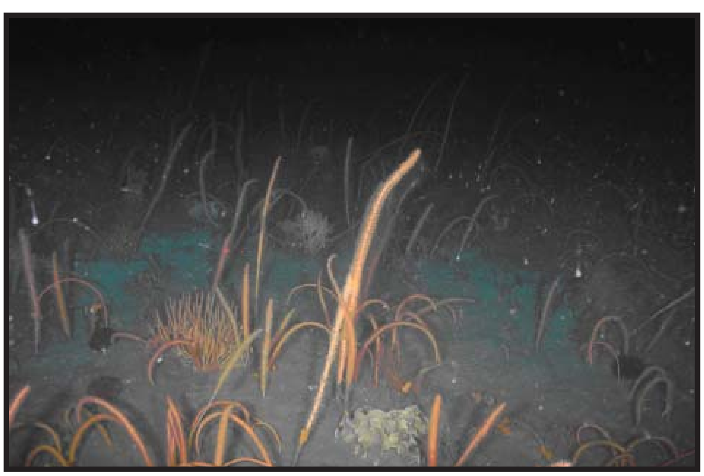

Figure 10.6. Diverse primnoid gorgonians at station 82 (mean depth: 96 m) off the southwest tip of Coronation Island, South Orkney Islands.

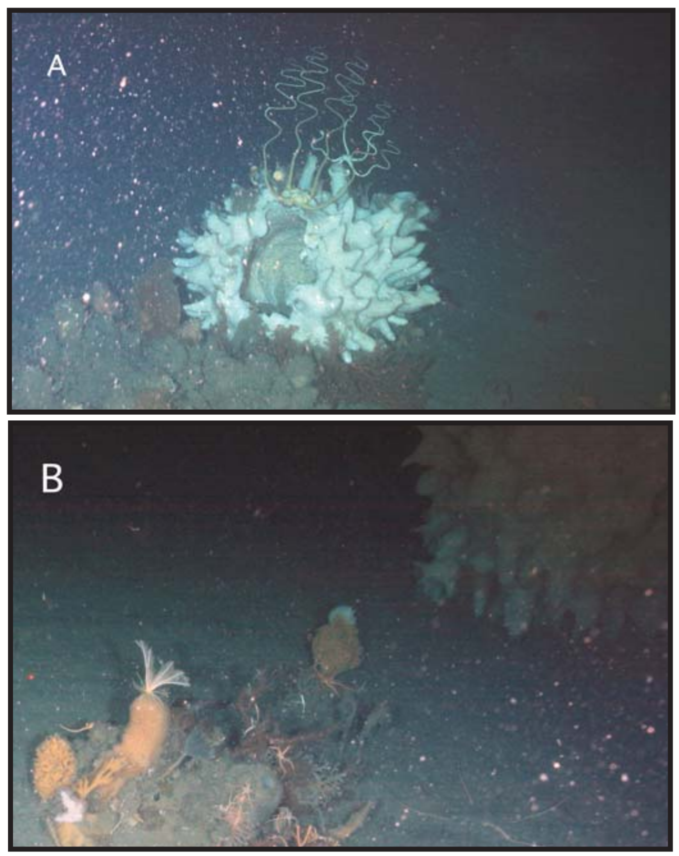

Figure 10.7. Volcano glass sponges (Porifera: Hexactinellida) near the 2005/06 AMLR Survey station 12 (max. depth: 398 m) off the Trinity Peninsula, Antarctic Peninsula. A) Specimen measures more than 50 cm in diameter. Two brittle stars of the VME-IT, Astrotoma agassizi, can also be seen. B) The portion of glass sponge in the top right corner is substantially greater than 50 cm wide, making the true diameter of this impressive specimen extremely large. In the foreground, VME-IT include several species of demosponges, hexactinellid sponge, numerous bryozoan species and some primnoid gorgonians.

10.3B). Also contributing significantly to the high biomass at this station were three specimens of a giant octopus, one of which weighed over 37 kg. Lastly, of note at this location, which shows great potential for designation as a VME, was a substantial biomass of stylasterid hard corals (or hydrocorals: Figure 10.3B) and a lovely delicate bamboo coral species not observed by us previously

As those taxa deemed indicators of VME risk areas (VME-IT) were of paramount interest, the standardized density of sponges (Porifera) and all other VME-IT (see Table 10.1) are mapped in Figure 10.4. Due to their greater weight the pattern of standardized sponge density is for the most part a reflection of the total benthic community density seen in Figure 10.2. Over 139 t/nmi^2 of sponges were encountered at Station 82. There were a number of stations that yielded no sponge community: stations 32, 34, 67, 85, 88 (mean depths: 314 m, 426 m, 299 m, 371 m, and 764 m, respectively) and, of course, the previously mentioned station 87.

The distribution of non-sponge VME-IT densities around the South Orkney Islands is somewhat different. The greatest densities are found along the narrow northern shelf. The densest community of non-sponge VME-IT, 31.90 t/nmi^2 , was encountered at Station 97 (mean depth: 118 m) north of Laurie Island, 98% of which was compound ascidians. Thirteen other stations support non-sponge VME-IT densities greater than one t/nmi^2. For all of these, it is the biomass of ascidians and anemones that dominate the non-sponge VME-IT densities, and if these are to remain VME-IT it may prove more informative to treat these 'heavy' taxa separately along with sponges. Aside from station 87, only one station, station 46 (mean depth: 352 m), had no VME-IT other than sponges and tunicates.

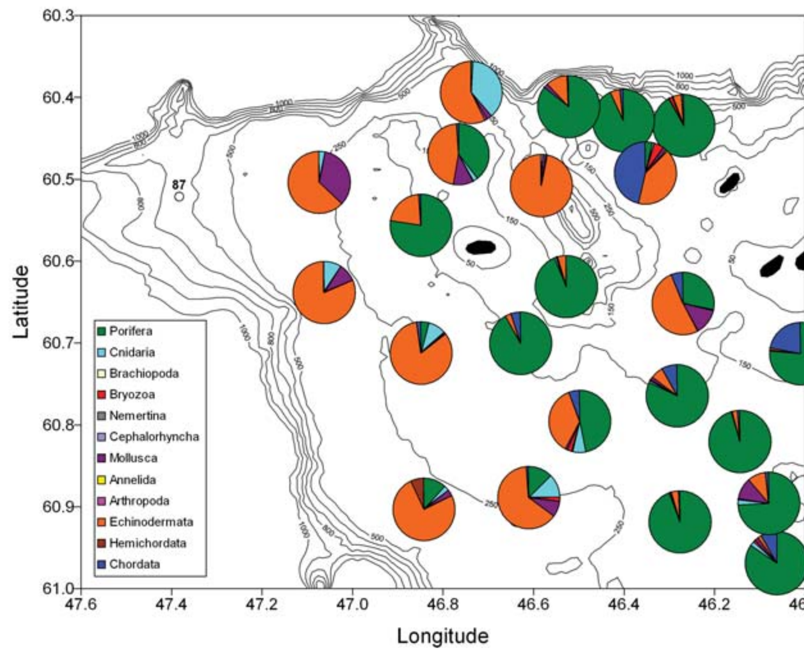

Figure 10.8. Relative contributions of invertebrate phyla to the benthic community composition at the South Orkney Islands, western shelf.

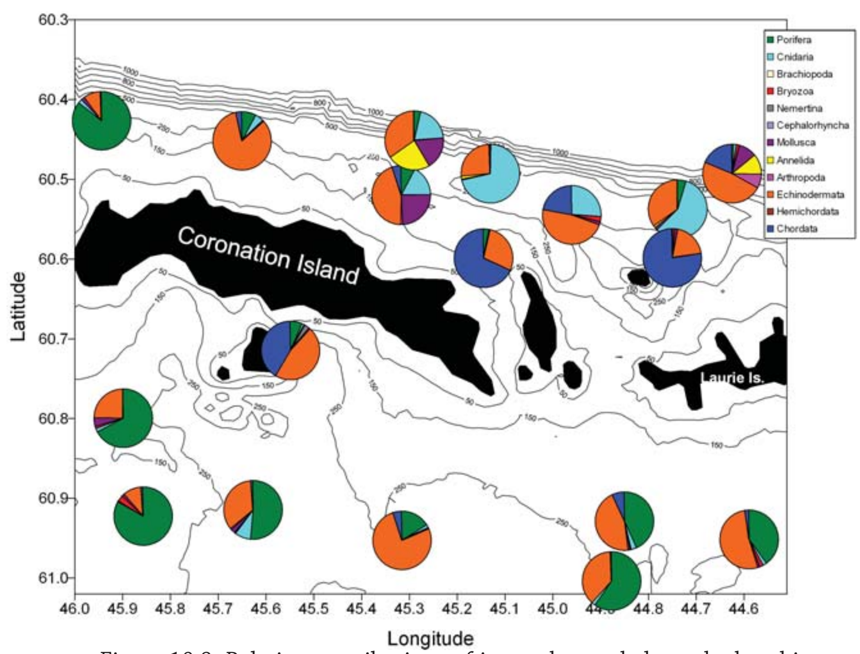

Figure 10.9. Relative contributions of invertebrate phyla to the benthic community composition at the South Orkney Islands, main island shelves.

The sea pen, *Umbellula sp*. (Figure 10.5), would be particularly vulnerable to commercial bottom fishing activities. The large disc shaped heads (up to12 cm in diameter) are attached to very long and very thin stalks (up to 3.5 m long) lending this location (Station 13) great potential for designation as a VME. Another exceptional local with considerable potential for VME designation is Station 82, already mentioned as having the greatest invertebrate density due to an extensive demosponge community and diverse prim-

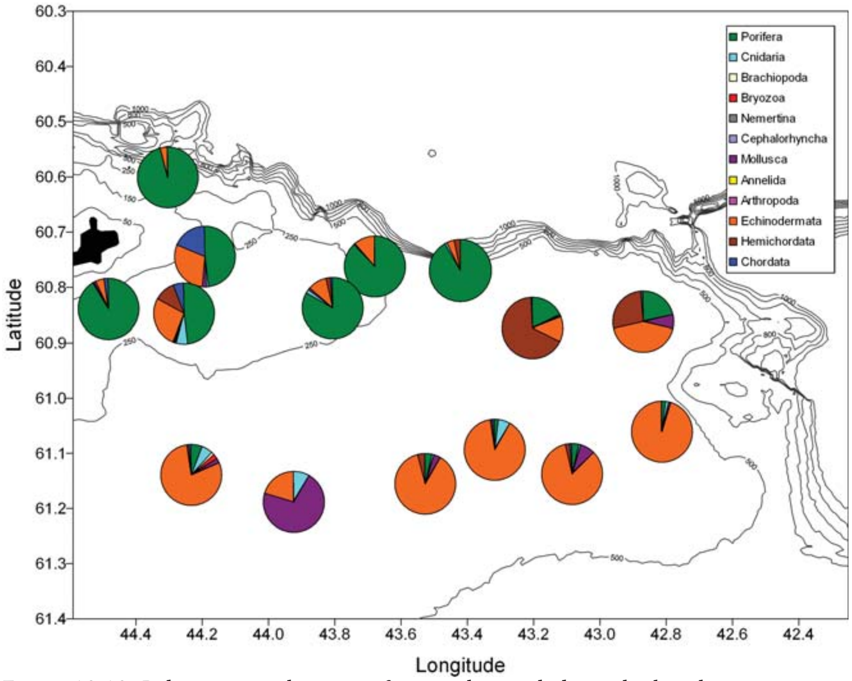

Figure 10.10. Relative contributions of invertebrate phyla to the benthic community composition at the South Orkney Islands, eastern shelf.

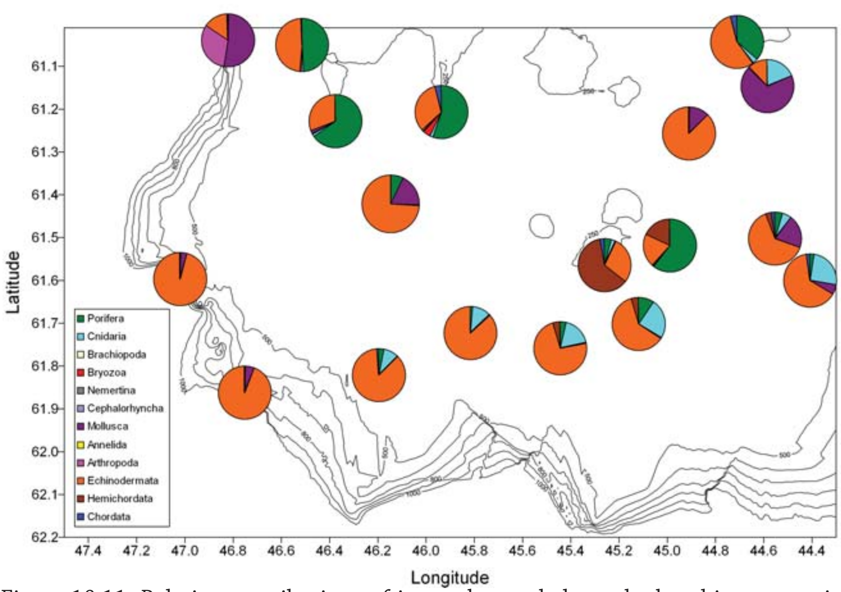

Figure 10.11. Relative contributions of invertebrate phyla to the benthic community composition at the South Orkney Islands, southern shelf.

noid gorgonian assemblage (Figure 10.6).

Additionally, although the location was not trawled, a photographic and video transect (Chapter 11) was conducted in the Bransfield Strait where, during the 2006 survey (Lockhart & Jones, 2006; Lockhart & Jones, 2008), 1.5 metric tons of extremely large hexactinellid sponges considered to be of ancient age (at least many hundreds of years) were recorded (Figure 10.7). Images like those in Figure 10.7 serve as direct evidence in support of designating and registering VME risk areas.

A broad geographic pattern in is apparent, with megafaunal invertebrate dominance on the western shelf of the South Orkney Islands (Figure 10.8). Echinodermata dominates the outermost shelf areas while Porifera dominates the benthic communities between Inaccessible Island and the largest of the South Orkney Islands, Coronation Island, a pattern reflected in the total standardized invertebrate densities (Figure 10.2).

The well-established sponge assemblages extend north and south of the western tip of Coronation Island (Figure 10.9). Further east, echinoderms begin to become more important components of the benthic community. However, between Coronation and Signy Islands, between Coronation and Powell Islands, and also between Powell and Laurie Islands, tunicates, both solitary and colonial, contribute significantly to the total community biomass. This association of high ascidian biomass at locales with presumably high water flow, also observed between the islands of the South Shetland Island chain and between the Trinity Peninsula and Joinville Island (Lockhart & Jones, 2008: Figure 4), appears to be quite robust and predictable over a large geographic range. Cnidaria make up a significant portion of the megafaunal assemblage on the northern edge of this shelf system. The Cnidaria biomass here is attributed, for the most part, to anemones and the large *Umbellula sp.* sea pens (Figure 10.5).

East of Laurie Island (Figure 10.10), Porifera once again dominates the benthic assemblage. On the outer northeastern shelf, particularly at stations 22 and 23 (mean depths: 359 m and 336 m, respectively), vast communities of Pterobranchia, a little known phylum of worm-like colonial organisms, were encountered. The stations sampled further south on the eastern shelf reveal a return to echinoderm-dominated benthos; a trend that covers the majority of the outer south shelf of the South Orkney Islands (Figure 10.11).

In the Bransfield Strait (Figure 10.12), station 104 (mean depth: 759 m) follows the bathymetric pattern seen in the 2006 survey data (Lockhart & Jones, 2006). Stations 101 and 103 (mean depth: 731 and 623 m, respectively), on the other hand, reveal surprisingly complex sponge-dominated benthic assemblages that, perhaps due to their depth, have escaped iceberg scour.

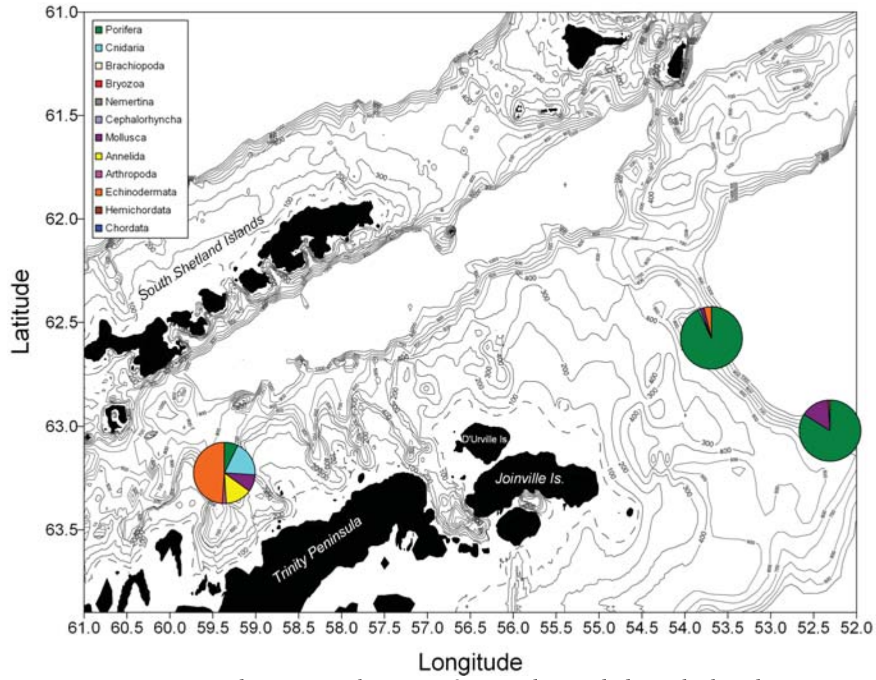

Figure 10.12. Relative contributions of invertebrate phyla to the benthic community composition off the Antarctic Peninsula and east of Joinville Island.

Bioiversity, in terms of OTUs, was greatest at station 41 (mean depth: 240 m), south of the western tip of Coronation Island, where 38 OTUs were represented despite supporting a relatively low community density (12.69 t/nmi^2). Biodiversity was lowest (with the exception of station 87) at Station 32, where only six OTUs were encountered. Biodiversity, in terms of the VME-IT, was again greatest at Station 41 and also at Station 60 (mean depth: 150 m), southwest of the western tip of Coronation Island, where 12 of the 20 accepted VME-IT (with bryozoans and ascidians each split into two categories) were represented. Both these stations support reasonably high, but not the highest, densities of non-sponge VME-IT (0.80 t/nmi^2 and 0.50 t/nmi^2, respectively). This raises the question of whether or not diversity should factor into required criteria for VME risk area designation. Again. with the exception of Station 87, VME-IT diversity was lowest at Station 32 as it was for overall biodiversity. Interestingly, the one VME-IT encountered in abundance here was the sea pen, *Umbellula sp.*, which, as explained above, would be a species highly vulnerable to damage by bottom fishing gear.

Discussion

At the South Orkney Islands a pattern is revealed when the total standardized benthic invertebrate density (t/nmi^2) at each station is mapped (Figure 10.2). The benthic invertebrate communities with the greatest densities are clustered at both the western and eastern limits of the island chain. In general, the communities are sparser on the outer shelves. This is particularly so to the south, where the wide shelf extends into the Weddell Sea. Although this may be due in part to scouring by icebergs carried in the Weddell Sea currents, there appears to be other factors at work here. Further research into oceanographic conditions such as bottom water temperature may elucidate additional causal elements.

It is thought that benthic community structure and distribution is largely determined by glacial scouring. Based on the results of this survey, the biogeographic patterns in benthic invertebrate community density and composition described above can not be explained simply in terms of iceberg scour, which was believed to play an important role in the patterns detected off the Trinity Peninsula in 2006 (Lockhart & Jones, 2006). However, the driving forces behind these patterns may be elucidated with further analysis, concurrent with analyses of additional oceanographic conditions, such as bottom water temperature, which Lockhart & Jones (2008) suggested had a significant effect on distribution patterns seen in community composition around the South Shetland Islands and the Antarctic Peninsula. The South Orkney Islands appear to present a complexity that is reminiscent of the composition and water temperature distribution seen around Elephant Island (Lockhart & Jones, 2008).

Protocol Deviations

There were no signification deviations from the standard benthic sampling protocol during the course of the 2008/09 AMLR Survey.

Acknowledgements

This research could not have been conducted without the assistance of many on board, whose cheerful and untiring assistance in sorting the large amounts of invertebrate catch is gratefully acknowledged. In particular, many thanks go to John Moore, Ryan Driscoll and Kim Dietrich.

Disposition of Data

Benthic invertebrate data collected during the trawl survey are available from Christopher Jones, Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, 3333 North Torrey Pines Court, La Jolla, CA 92037; phone/fax – (858) 546-5605/546-5608; e-mail: Chris.D.Jones@noaa.gov. Invertebrate samples collected for taxonomic and genetic analyses will be deposited and housed at Yale's Peabody Museum. Tissue samples will be housed at Scripps Oceanographic Institute. Additional samples collected by request for taxonomic and genetic research will be sent to the University of California, Fullerton, the California Academy of Sciences (San Francisco) and the Museum of Victoria (Australia).

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AMLR ANTARCTIC MARINE LIVING RESOURCES PROGRAM

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Objectives, Accomplishments and Tentative Conclusions

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The National Oceanic and Atmospheric Administration (NOAA), organized in 1970, has evolved into an agency which establishes national policies and manages and conserves our oceanic, coastal, and atmospheric resources. An organizational element within NOAA, the Office of Fisheries is responsible for fisheries policy and the direction of the National Marine Fisheries Service (NMFS).

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The U.S. Antarctic Marine Living Resources (AMLR) program provides information needed to formulate U.S. policy on the conservation and international management of resources living in the oceans surrounding Antarctica. The program advises the U.S. delegation to the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), part of the Antarctic treaty system. The U.S. AMLR program is managed by the Antarctic Ecosystem Research Group located at the Southwest Fisheries Science Center in La Jolla.

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